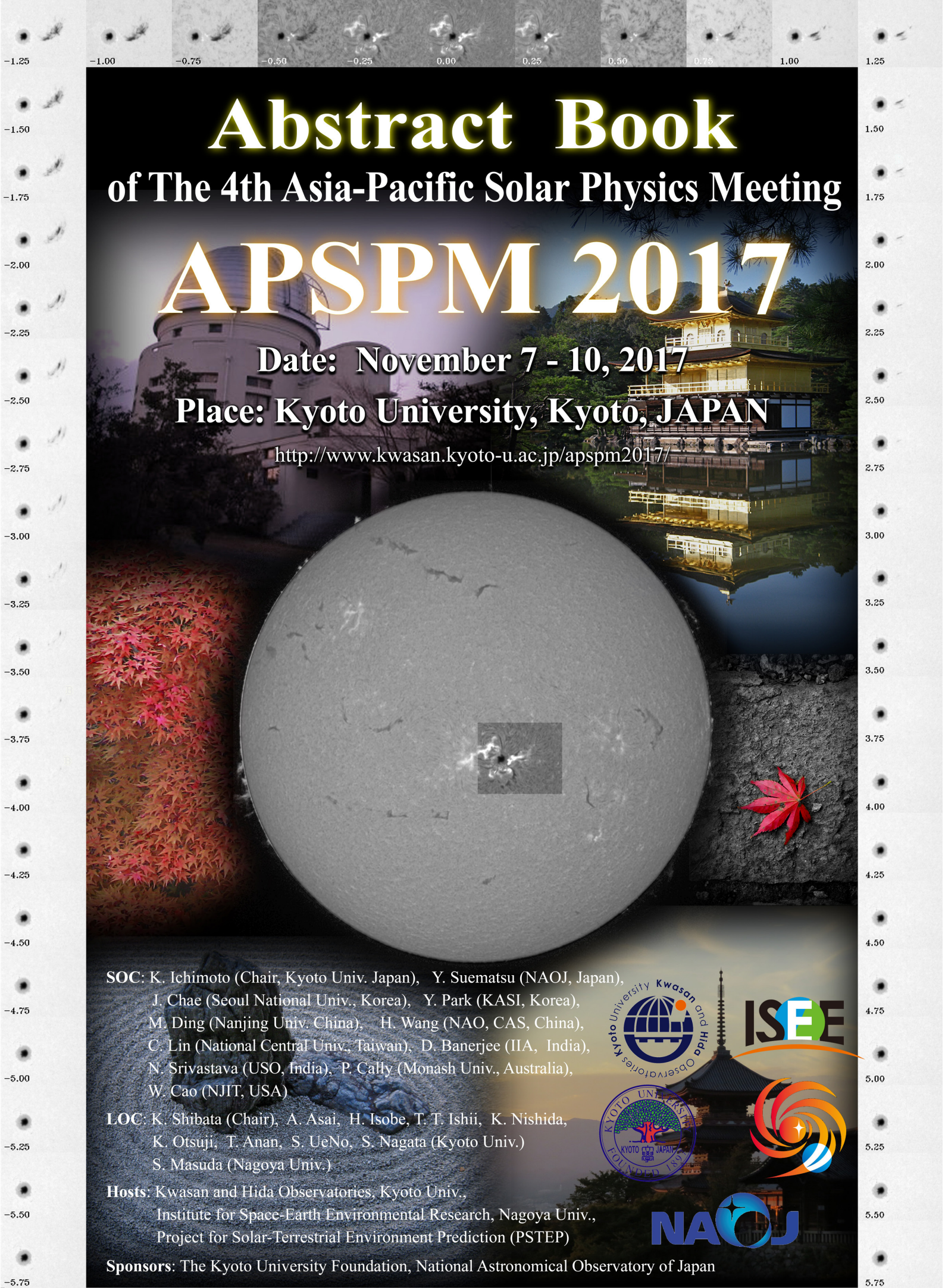

Abstract Book

of The 4th Asia-Pacific Solar Physics Meeting

APSPM 2017

Date: November 7 - 10, 2017

Place: Kyoto University, Kyoto, JAPAN

http://www.kwasan.kyoto-u.ac.jp/apspm2017/

SOC: K. Ichimoto (Chair, Kyoto Univ. Japan), Y. Suematsu (NAOJ, Japan), J. Chae (Seoul National Univ., Korea), Y. Park (KASI, Korea), M. Ding (Nanjing Univ. China), H. Wang (NAO, CAS, China), C. Lin (National Central Univ., Taiwan), D. Banerjee (IIA, India), N. Srivastava (USO, India), P. Cally (Monash Univ., Australia), W. Cao (NJIT, USA)

LOC: K. Shibata (Chair), A. Asai, H. Isobe, T. T. Ishii, K. Nishida, K. Otsuji, T. Anan, S. UeNo, S. Nagata (Kyoto Univ.) S. Masuda (Nagoya Univ.)

Hosts: Kwasan and Hida Observatories, Kyoto Univ., Institute for Space-Earth Environmental Research, Nagoya Univ., Project for Solar-Terrestrial Environment Prediction (PSTEP)

Sponsors: The Kyoto University Foundation, National Astronomical Observatory of Japan

Caption of solar images: The SDDI is a new instrument that was installed in SMART/T1 at Hida Observatory in 2016. It can obtain full-disk filtergrams at 73 wavelengths from H-alpha - 9 Å to +9 Å during 15 s. These solar images show a filament eruption on 21st May 2016 taken with the SDDI.

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	(Session 1) O1_001I			O3_041
10:00	O1_002	O4_021I	O3_034I	O3_042
	O1_003			O3_043
10:30	Coffee break	O4_047	O3_035	
		Coffee Break	O3_036	Break
11:00	O1_004I	**(Session 2)** O2_018K	O3_037	**(Session 4)** O4_044K
	O1_005I		O3_038	
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12:00	O1_007	O3_023	Lunch	O4_046
	O1_008	Lunch		Lunch
12:30	Lunch		**Young Career Award**	
13:00			YCA lecture YCA_039	
13:30				**(Session 2)** O2_019I
14:00	O1_009I	O3_024K	**Excursion**	O2_048
14:30	**(Session 2)** O2_010K	O3_025		**(Session 4)** O4_049I
		O3_026		O4_050I
15:00	O2_011	03_027		O4_051
	O2_012	O3_028		Closing, Award, and Remarks
15:30	Poster & Coffee break	Poster & Coffee break		
16:00				
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17:00	O2_014	O3_030		
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	O2_017		**Banquet**	
18:00				
	7 Nov (Tue)	8 Nov (Wed)	9 Nov (Thu)	10 Nov (Fri)

Campus map

Wifi

Wireless LAN (SSID：eduroam) is available in the venue of APSPM 2017.
Those who belongs to the institute of eduroam, please prepare your eduroam account at each institute in advance.
For the information of institute, please check
https://www.eduroam.org/
or
http://www.eduroam.jp/participants/siteinfo.html (Japan).
For non-members, we will prepare eduroam accounts for visitors.

Excursion

Excursion to Kwasan Observatory will be planned in the afternoon of Nov. 9 (Thu).
Fee: 1,000 yen.
The participants will travel there by two buses (limit 40 seats).
The buses will leave the conference venue at 14:00 on 9 Nov (Thu) after taking group photo. So please be sure to stay the venue of group photo.

On the 9 Nov (Thu), the passenger lists for each bus will be displayed at the reception desk. Please check the list to confirm on which bus you will be riding and be sure to get on that bus. At Kwasan Obs., participants will be divided into two groups and be taken on a tour around telescopes. All the passengers on the same bus will be treated as a single group.

There will be NO space to put large luggage on the buses for the excursion.
In addition, after the excursion, the buses will go directly to ‘Ganko Takasegawa Nijoen’, without returning to the conference venue.
Please do not bring large luggage to the conference venue on that day.

Banquet

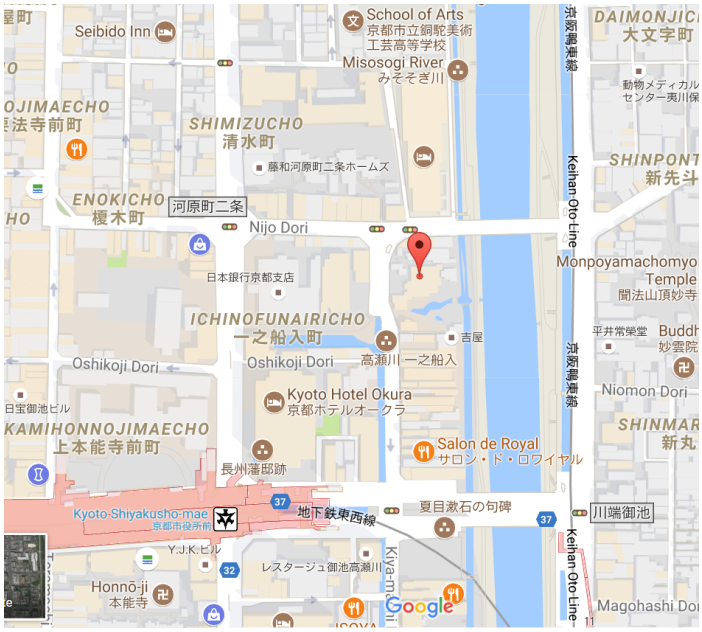
Banquet will be held in the evening of Nov. 9 (Thu) at the ‘Ganko Takasegawa Nijoen’ at 18:30-21:00.

Place: Ganko Takasegawa Nijoen

Address:
484-6, Higashi Namasu-cho,
Nijo-kudaru, Kiyamachi-dori,
Nakagyo-ku, Kyoto

Tel: 075-223-3456

Fee: 7,000 yen.



APSPM-2017 Meeting

7 November(Tuesday)

Chair	Time	Presenter	Title
	9:00		Registration
	9:30-9:45	Kazunari Shibata	Opening
Takashi Sakurai	**Session1: Progress on instrumentation and future plans**		
	9:45-10:10	Thomas Rimmele invited O1_001I	Progress and perspective of the DKIST
	10:10-10:25	Kiyoshi Ichimoto contributed O1_002	Progress in Solar Observing Instrumentation at Hida Observatory
	10:25-10:40	Stanislav Gunar contributed O1_003	Quiescent Prominences in the Era of ALMA: Kinetic Temperature Diagnostics
	10:40-10:55		Coffee break
Wenda Cao	**Session1: Progress on instrumentation and future plans**		
	10:55-11:20	Kyungsuk CHO invited O1_004I	Toward Next Generation Coronagraph: Development of Compact Diagnostic Coronagraph on ISS
	11:20-11:45	Weiqun Gan invited O1_005I	Advanced Space-based Solar Observatory: Progress and Prospect
	11:45-12:00	Hui Li contributed O1_006	The Lyman-alpha Solar Telescope (LST): Status and Update
	12:00-12:15	Carlos Quintero Noda contributed O1_007	Chromospheric polarimetry through multi-line observations of the 770 and 850 nm spectral regions
	12:15-12:30	Haosheng Lin contributed O1_008	Instrumentation for Solar Physics from Cubesat and Small Satellites
	12:30-14:00		Lunch
Yoshinori Suematsu	**Session1: Progress on instrumentation and future plans**		
	14:00-14:25	Dipankar Banerjee invited O1_009I	Science with India's space mission Aditya L1
	Session2: MHD processes in photosphere, chromosphere and corona		
	14:25-15:00	Shadia Habbal keynote O2_010K	plasma physics in corona and solar wind
	15:00-15:15	Paul Cally contributed O2_011	Hidden Alfvénic Energy in the Solar Atmosphere
	15:15-15:30	Elena Kupriyanova contributed O2_012	A role of the co-phased quasi-periodic pulsations in the energy release of the weak solar flare
	15:30-16:45		Poster & Coffee break
Jongchul Chae	**Session2: MHD processes in photosphere, chromosphere and corona**		
	16:45-17:10	Shin TORIUMI invited O2_013I	Physical Processes of Flux Emergence and Active Region Formation
	17:10-17:25	Hui Tian contributed O2_015	Two types of surge-like activities above sunspot light bridges
	17:25-17:40	Shahin Jafarzadeh contributed O2_016	Slender Ca II H Fibrils in the Low Solar Chromosphere
	17:40-17:55	Kumi Hirose contributed O2_017	Statistical study of small blue shifted events

8 November(Wednesday)

Chair	Time	Presenter	Title
	Session4: Solar interior and activity cycle of the Sun and stars		
Arnab R. Choudhuri	9:30-10:05	Yasuo Takeuchi keynote O4_020K	Solar neutrino measurements at Super-Kamiokande
	10:05-10:30	Hideyuki Hotta invited O4_021I	Recent development of solar dynamo model
	10:30-10:45	Sarah Jabbari contributed O4_047	Formation of dynamo-driven bipolar magnetic spots in stratified turbulence
	10:45-11:00		Coffee Break
	Session2: MHD processes in photosphere, chromosphere and corona		
Chia-Hsien Lin	11:00-11:35	Mark Cheung keynote O2_018K	Using Radiative MHD Simulations and SDO/AIA to Study the Thermal Structure and Evolution of Solar Flares
	Session3: Flare, ejection and space weather		
	11:35-12:00	Piyali Chatterjee invited O3_022I	Modeling Repeatedly Flaring δ Sunspots
	12:00-12:15	Mingde Ding contributed O3_023	Spectral features of an X-shaped flare as implications for energy release and dynamics in the flare atmosphere
	12:15-14:00		Lunch
	Session3: Flare, ejection and space weather		
Kiyoshi Ichimoto	14:00-14:35	Haimin Wang keynote O3_024K	High Resolution Flare Observations with the 1.6 m NST at BBSO
	14:35-14:50	Akiko Tei contributed O3_025	Blue asymmetry of the chromospheric Mg II lines in a solar flare
	14:50-15:05	Yu-Lun Liou contributed O3_026	Analysis of Hard X-ray and Microwave Observations with Fokker-Planck Model in Solar Flares
	15:05-15:20	Yuri Litvinenko contributed O3_027	Models of diffusive and nondiffusive transport of solar energetic particles
	15:20-15:35	David Tsiklauri contributed O3_028	Particle-In-Cell, fully kinetic scale modelling of solar radio bursts
	15:35-16:30		Poster & Coffee Break
	Session3: Flare, ejection and space weather		
Young-deuk Park	16:30-17:05	Nat Gopalswamy keynote O3_029K	CME kinematics and geo effectiveness
	17:05-17:20	Zigong Xu contributed O3_030	Observations of the CME shocks and the production of SEPs
	17:20-17:35	Hsiu-Shan Yu contributed O3_031	The dynamic character of the solar wind, and its implications for Solar Probe Plus and Solar Orbiter
	Session1: Progress on instrumentation and future plans		
	17:35-18:00	Toshifumi Shimizu invited O1_032I	Future plans of Japanese space solar missions

9 November (Thursday)

Chair	Time	Presenter	Title
Hiroaki Isobe	**Session3: Flare, ejection and space weather**		
	9:30-10:05	Kanya Kusano keynote O3_033K	Project for Solar-Telestorial Environment Prediction (PSTEP)
	10:05-10:30	Yong-Jae Moon invited O3_034I	Development of space weather forecast models based on statistics and deep-learning methods
	10:30-10:45	Rok-Soon Kim contributed O3_035	Space weather forecast using background information generated by superposed observations over previous Carrington cycles
	10:45-11:00	Susanta Bisoi contributed O3_036	Evidence of electron cyclotron maser emission at decimetric frequency: First high cadence GMRT observations
	11:00-11:15	Masumi Shimojo contributed O3_037	The First ALMA Observation of a Solar Plasmoid Ejection from an X-Ray Bright Point
	11:15-11:30	Jeongwoo Lee contributed O3_038	Sigmoidal Hot Channel Before Solar Eruptions
	11:30-12:50		Lunch
Kazunari Shibata	12:50-13:00		APSPM Young Career Award
	13:00-13:40	Pengfei Chen YCA lecture YCA_039	Coronal EIT waves: A story of Twenty Years
	13:40-14:00		**Group Photo**
	14:00-17:30		**Excursion (Kwasan Observatory)**
	18:30-21:00		**Banquet (Ganko Takasegawa Nijoen)**

10 November (Friday)

Chair	Time	Presenter	Title
Mingde Ding	**Session3: Flare, ejection and space weather**		
	9:30-9:55	Daisaku Nogami invited O3_040I	Superflares on solar-type stars
	9:55-10:10	Yuta Notsu contributed O3_041	Spectroscopic observations of solar-type superflare stars
	10:10-10:25	Kosuke Namekata contributed O3_042	Statistical Study of Solar White-light Flares and Comparisons with Superflares on Solar-type Stars
	10:25-10:50	Petr Heinzel contributed O3_043	Continuum emission from solar flares
	10:50-11:05		Break
Paul Cally	**Session4: Solar interior and activity cycle of the Sun and stars**		
	11:05-11:40	Jie Jiang keynote O4_044K	Flux transport dynamo and solar cycle
	11:40-11:55	Gopal Hazra contributed O4_045	A theoretical model of the variation of the meridional circulation with the solar cycle
	11:55-12:10	Chia-Hsien Lin contributed O4_046	Probing magnetic fields in the solar convection zone with solar-cycle variations of meridional flows
	12:10-13:30		Lunch
Ayumi Asai	**Session2: MHD processes in photosphere, chromosphere and corona**		
	13:30-13:55	Tetsuya MAGARA invited O2_019I	Flux-Emergence Model for the Characterization of Solar Active Regions
	13:55-14:10	Takaaki Yokoyama contributed O2_048	ALMA observations of the solar chromosphere on the polar limb
	Session4: Solar interior and activity cycle of the Sun and stars		
	14:10-14:35	Dean-Yi Chou invited O4_049I	Interaction Between Acoustic Waves and Sunspots
	14:35-15:00	Junwei Zhao invited O4_050I	Studying Solar Interior and Higher Atmosphere using Helioseismic Waves
	15:00-15:15	Arnab Choudhuri contributed O4_051	3D Kinematic Model of the Solar Flux Transport Dynamo
	15:15-15:45	Kiyoshi Ichimoto	Closing Remarks, Award, Remark from SOC-Chair of the 5th APSPM, Closing

List of Poster

Session1: Progress on instrumentation and future plans

ID	Presenter		Title
P1_ 001	Ming	Xiong	Prospective Out-of-ecliptic White-light Imaging of Interplanetary Corotating Interaction Regions at Solar Maximum
P1_ 002	Tetsu	Anan	Developments of multi-lines spectro-polarimeter of the Domeless Solar Telescope at Hida Observatory
P1_ 003	Su-Chan	Bong	2017 Total Solar Eclipse Expedition of KASI
P1_ 004	Masaoki	Hagino	Coronal green line observation at the Lijiang Station of Yunnan Observatory
P1_ 005	Agustinus	Admiranto	Preliminary Study on Solar Observing Facility in Timau National Observatory
P1_ 006	Zhi	Xu	Introduction of the New Vacuum Solar Telescope of China
P1_ 007	Natsuki	Tsuda	Observation of Solar Radio Bursts by CALLISTO Radio Spectrometer in Ibaraki University
P1_ 008	N.N.M.	Shariff	Sunspots Monitoring Using a Small Telescope at Universiti Teknologi MARA

Session2: MHD processes in photosphere, chromosphere and corona

ID	Presenter		Title
P2_ 010	Kiyoto	Shibasaki	Magnetic moment of thermal plasma and activities in the solar atmosphere
P2_ 011	Yikang	Wang	Effect of radiative loss on waves in chromosphere
P2_ 012	Daniela	Lacatus	Comparative studies of the quiet sun under different conditions: in a coronal hole, under a magnetic canopy, and “pure” quiet sun
P2_ 013	David	Tsiklauri	Alfven wave phase-mixing in flows: why over-dense solar coronal open magnetic field structures are cool?
P2_ 014	Chia-Hsien	Lin	Solar Cycle Variation of Open Magnetic Flux Regions
P2_ 015	Rahul	Yadav	Stokes Profile Inversion code for the Photospheric spectral line
P2_ 016	Shota	Ninomiya	Statistical analysis of formation of solar magnetic flux tube with kilogauss magnetic field strength
P2_ 017	Jingwen	Zhang	Dark knots in a penumbral intrusion into a sunspot umbra
P2_ 018	Kyuhyoun	Cho	Origin of three minute oscillations in a sunspot umbra
P2_ 019	Donguk	Song	Three-minute Sunspot Oscillations Driven by Magnetic Reconnection in a Light Bridge
P2_ 020	Tanmoy	Samanta	Study of supersonic downflow at the transition region above sunspots
P2_ 021	Juhyeong	Kang	Foot point Brightening at near pore boundary
P2_ 022	Debi Prasad	Choudhary	Flows along the Super-Penumbral Fibrils in Sunspots
P2_ 023	Priya	T G	Emergence of running penumbral waves in the sunspots
P2_ 024	Hannah	Kwak	Velocity oscillations in the chromosphere and transition region above plage region
P2_ 025	Minju	Seo	Analysis of Ellerman Bomb Spectra Observed by FISS
P2_ 026	Satomi	Tokuda	Observation of Fine Scale Dynamics in the Solar Chromosphere with a Dual Camera Imaging System
P2_ 027	Yoshinori	Suematsu	High Resolution Observations of Spicules in Upper-Photospheric Lines
P2_ 028	M.	Yoshida	Wave Propagation on Spicules Observed by Chromospheric Lyman-Alpha Spectro-Polarimeter (CLASP)
P2_ 029	Yamini K.	Rao	Driving process for highly impulsive plasma outflows

P2_ 030	Takako	Ishii	H-alpha surges at the emerging flux region observed before the pore formation (NOAA 12660)
P2_ 031	Qingmin	Zhang	Large-amplitude prominence oscillations: observations and numerical simulations
P2_ 032	Keisuke	Nishida	The Role of a Flux Rope Ejection in a Three-dimensional Magnetohydrodynamic Simulation of a Solar Flare
P2_ 033	Yuhao	Zhou	Three-dimensional MHD simulation of solar prominence oscillations in a magnetic flux rope
P2_ 034	Aki	Machida	Determination of the wave property in the quiescent prominence from the phase difference
P2_ 035	Sanetaka	Okada	Temperature diagnosis of Solar prominences with a simultaneous observation of H-alpha, H-beta and Ca II 8542A lines
P2_ 036	Y.	Hanaoka	Statistical Study of the Magnetic Field in Solar Filaments
P2_ 037	Yuwei	Huang	H-alpha absorption profile of erupting filament
P2_ 038	Heesu	Yang	Observation of the Streaming-Kink Instability in the Solar Prominence
P2_ 039	Denis	Cabezas	Doppler Characteristics and Dynamics Processes of the Moreton Wave on 2014 March 29

Session3: Flare, ejection and space weather

ID	**Presenter**		Title
P3_ 040	Xiaoli	Yan	Recent scientific results of 1 m New vacuum solar telescope at Fuxian Lake Observatory
P3_ 041	Ahmed	Ibrahim	The FMT at KSU as part of the CHAIN project with preliminary results
P3_ 042	Qi	Hao	A Circular White-Light Flare with Impulsive and Gradual White-Light Sources
P3_ 043	Yongliang	Song	A white-light flare triggered by flux emergence in NOAA active region 11476
P3_ 044	Satoshi	Masuda	Cold Solar Flares Observed with Nobeyama Radioheliograph
P3_ 045	Ze	Zhong	The transition from circular to nonstandard two-ribbon flares due to magnetic flux ropes bifurcation
P3_ 046	Dong	Li	Explosive Chromospheric Evaporation Driven by Nonthermal Electrons around One Footpoint of a Solar Flare Loop
P3_ 047	Yu	Chen	Case study of chromospheric evaporation at flare ribbons by IRIS
P3_ 048	Yun-Chen	Yang	APPARENT MOTION OF FLARING RIBBONS OBSERVED BY SDO/AIA
P3_ 049	Kyoung-Sun	Lee	Spectroscopic observation of a loop-top source of an M1.3 limb solar flare
P3_ 050	Yuandeng	Shen	Observational Analysis of the Fine Structure and Formation of Solar Jets
P3_ 051	Chloe	Pugh	Properties of quasi-periodic pulsations in solar flares from a single active region
P3_ 052	Lilis	Mubasaroh	Analysis of Sunspot Proper Motion related to X-Class Solar Flare
P3_ 053	Takahito	Sakaue	Emergence Process of the Satellite Spots Leading to the Successive Flares
P3_ 054	Shin'ichi	Nagata	On the relationship between the rapid penbumbra formation and impulsive flare in NOAA12403
P3_ 055	Herna	Fahriyah	Evolution of Coronal Jets on the Solar Limb based on SDO/AIA Images Datas
P3_ 056	Jincheng	Wang	The formation of an active-region filament: the material by jets
P3_ 057	Alin	Paraschiv	Recurrent Active region coronal jets: Examining the magnetic configuration of a persistent jet inducing micro-flare site
P3_ 058	Huaning	Wang	Type of magnetic null point and filament in the solar atmosphere
P3_ 059	Rui	Liu	Magnetic Flux Rope: Topology and Twist Profile

P3_ 060	Daikichi	Seki	Increase in the amplitude of Line-of-sight velocities of the small-scale motions in a solar filament before eruption
P3_ 061	Kenichi	Otsuji	Rapid eruptive phenomena observed by SMART/SDDI and its influence to the interplanetary space
P3_ 062	Navin	Joshi	Investigation of a Large Ejective Solar Eruption from a Typical Coronal-Jet-Base Field Configuration
P3_ 063	David	Tsiklauri	Electron plasma wake field acceleration in solar coronal and chromospheric plasmas
P3_ 064	Keiji	Hayashi	MHD simulation of solar active region driven by observation-inferred plasma motion and electric field
P3_ 065	Jie	Hong	RADYN simulations of non-thermal and thermal models of Ellerman bombs
P3_ 066	Tangmu	Li	2.5D Particle-in-cell Simulation of Solar type III radio bursts
P3_ 067	Wenjun	Ding	2.5 D particle-in-cell to simulate Coronal Particle Acceleration of HeG3 / 4
P3_ 068	Jihye	Kang	Relationship between the Occurrence of a Flare and the Small-Scale Variation of Photospheric Magnetic Field in Active Region 12371
P3_ 069	Jongchul	Chae	Evidence for a Magnetic Reconnection Origin of Plasma Outflows along Post-CME Rays
P3_ 070	Anand	Joshi	Pre-eruption Oscillations in Quiescent Filament
P3_ 071	Ryoya	Uemura	Statistical Study of Active-region Microflares Observed with Hinode/XRT
P3_ 072	Ya-Hui	Yang	Flare Productivity in Different Magnetic Types of Active Regions
P3_ 073	Harim	Lee	Statistical study on the radial and azimuthal wave modes of 24 Halo Coronal Mass Ejections using multi spacecraft
P3_ 074	Subhash	Kaushik	Transient Plasma Signatures and Space Weather
P3_ 075	Eunsu	Park	Solar Flare Forecast Model based on Convolutional Neural Network using SOHO MDI Data and its Optimizations
P3_ 076	Daye	Lim	Forecast of Solar Major Flare Occurrence Rates Based on Vector Magnetic Parameters Using SDO/HMI Data
P3_ 077	Naoto	Nishizuka	Flare Forecast using Machine-learning of Multi-wavelength Observations of Active Regions
P3_ 078	Kangwoo	Yi	Flare Occurrence Prediction based on Convolution Neural Network and Comparison with Previous Models
P3_ 079	Hiroyuki	Maehara	Starspot activity and superflares on solar-type stars
P3_ 080	Abbas	Raboonik	Prediction of Solar Flares Using Unique Signatures of Magnetic Field Images
P3_ 081	Dongmin	Ryu	Solar particle event statistical model comparison for Korean Pathfinder Lunar Orbiter mission
P3_ 093	Zety Sharizat bt	Hamidi	The Observation of Heart-shape Active Region 2529 Producing Strong M6.7 class Solar Flare and Gradual Coronal Mass Ejections on 18th of April 2016

Session4: Solar interior and activity cycle of the Sun and stars

ID	**Presenter**		Title
P4_ 082	Masumi	Shimojo	Variation of Solar Microwave Spectrum in Last Half Century
P4_ 083	Sudip	Mandal	Overview of the science results obtained from Kodaikanal digitized data archive: white-light and Ca-K
P4_ 084	Makoto	Hasegawa	Search for periodic modulations of the solar neutrino flux in Super-Kamiokande
P4_ 085	Satoru	UeNo	Development of data-archives of solar chromospheric full-disk images and researches on long-term variations of solar activities and the earth's upper atmosphere
P4_ 086	Chuan	Li	Waiting time distributions of solar and stellar activities: Poisson process or with memory?
P4_ 087	Kyeore	Lee	Shock Merging in the Chromosphere of Sunspots
P4_ 088	Ganghua	Lin	Data Processing for Multiple Solar Activity Cycles
P4_ 089	Shota	Arai	Influence of strong viscosity on convective energy transport

P4_ 090	Alina	Donea	Studies on the acoustic directionality of solar flare-induced quakes
P4_ 091	K.	Kuzanyan	Merging Mosaics and Super-Mosaics of High Resolution Vector Magnetic Field Maps for Studies of Spatial Spectra of Solar Magnetic Field and Helicity
P4_ 092	Ryuji	Mineta	Construction of a mean field model of the convection zone with turbulence transport coefficients parameterization based on 3D global simulations

APSPM 2017

YCA lecture

Coronal EIT waves: A story of Twenty Years

Abstract Author(s): Pengfei Chen

Institution(s): Nanjing University

Presentation: YCA_039

Abstract

Coronal EIT waves are a large-scale wavelike phenomenon, which was first observed by the Extreme-Ultraviolet Imaging Telescope (EIT) in 1997. Therefore, this year marks the 20th anniversary of the great discovery, which was initially named "EIT wave" after the telescope. Such a spectacular phenomenon sparked long-lasting interest and debates. The debates were concentrated on two topics, one is about the driving source, and the other is about its nature. While it is now widely accepted that EIT waves are driven by mass ejections rather than by the pressure pulse in solar flares, the interpretation of EIT waves is still controversial. The fast-mode MHD wave model, which is believed by many colleagues, is confronted with many observational discrepancies. Fifteen years ago, we proposed that EIT waves are an apparent propagation due to successive stretching of magnetic field lines in order to explain why EIT waves are generally 3 times slower than the fast-mode waves in the corona. In this talk, I will explicate how this model matches well with the new observations from the Solar Dynamics Observatory and how the model is updated with new observational features.

APSPM 2017

Session 1

Progress on instrumentation and future plans

APSPM 2017
Session 1: Progress on instrumentation and future plans

Status of the Daniel K. Inouye Solar Telescope

Abstract Author(s): Thomas Rimmele (Valentín Martínez Pillet) and the DKIST Team

Institution(s): National Solar Observatory

Presentation: O1_001I

Abstract

The construction of the 4m Daniel K. Inouye Solar Telescope (DKIST) on Haleakala, Maui is progressing on schedule. The construction is 80% complete. Operations are scheduled to begin early 2020. DKIST will replace the NSO facilities on Kitt Peak and Sac Peak with the worlds largest solar telescope. DKIST was designed to meet the needs of critical high resolution and high sensitivity spectral and polarimetric observations of the sun. DKIST's superb resolution and polarimetric sensitivity will enable astronomers to unravel many of the mysteries the Sun. The design allows DKIST to operate as a coronagraph at infrared wavelengths where the sky background is low and bright coronal emission lines are available. Taking advantage of its large aperture and infrared polarimeters DKIST will be capable to routinely measure the currently illusive coronal magnetic fields. The state-of-the-art adaptive optics system provides diffraction limited imaging and the ability to resolve features approximately 20 km on the Sun. Five first light instruments will be available at the start of operations. The data from these instruments will be distributed to the community via the NSO/DKIST data center. We provide an overview of the facility and discuss the project status.

APSPM 2017
Session 1: Progress on instrumentation and future plans

Progress in Solar Observing Instrumentation at Hida Observatory

Abstract Author(s): Kiyoshi Ichimoto, Hida Observatory team

Institution(s): Kyoto University

Presentation: O1_002

Abstract

Hida observatory has two advanced solar telescopes, i.e., the Domeless Solar Telescope (DST) and the Solar Magnetic Activity Research Telescope (SMART). The DST is a 60cm aperture vacuum telescope equipped with high dispersion spectrometers, and aims at precise observations in high spatial and spectral resolution. The SMART is a set of refractive telescopes with apertures of 20cm and 25cm, and aims at a regular basis observation in wide fields of view to capture flares and filament eruptions and, by which, to contribute to the space weather study. Recently we have installed a new adaptive optics system and a multi-wavelength spectro-polarimeter on DST, and a high cadence full disk Doppler imaging system and a total solar spectral monitor on SMART. We will present some details of these advanced instruments that have started for providing unique dataset for solar research.

APSPM 2017
Session 1: Progress on instrumentation and future plans

Quiescent Prominences in the Era of ALMA: Kinetic Temperature Diagnostics

Abstract Author(s): Stanislav Gunar, P. Heinzel, U. Anzer, D. Mackay, M. Barta, I. Skokic

Institution(s): Astronomical Institute of the Czech Academy of Sciences, Max-Planck Institute for Astrophysics, University of St Andrews

Presentation: O1_003

Abstract

We provide the theoretical background for the analysis of the ALMA prominence observations and the diagnostics of the prominence plasma kinetic temperature. To do this we employ the 3D whole-prominence fine structure model which provides us with the synthetic ALMA-like observations of a complex simulated prominence. We use such synthetic observations as if these were a pair of actual ALMA observations, where in one the prominence is optically thin and in the other optically thick. This allows us to develop a technique that can be used for the accurate analysis of the prominence plasma thermal properties from such a pair of simultaneous ALMA observations. In addition to the synthetic observations, the used 3D model offers detailed information about the properties of the simulated plasma distributed along any line of sight (such as kinetic temperature and the optical thickness). This allows us to assess the accuracy of the developed technique and its results. We also briefly present the European ALMA Regional Center (EU ARC), namely its Czech node located at the Astronomical Institute of the Czech Academy of Sciences. This node has Europe-wide unique expertise in solar research with ALMA. Finally, we offer an overview of the recent Science Verification solar ALMA observations acquired by the international Solar ALMA ObsMode Development Team with participation of the Czech ARC node astronomers.

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Session 1: Progress on instrumentation and future plans

Toward Next Generation Coronagraph: Development of Compact Diagnostic Coronagraph on ISS

Abstract Author(s): Kyungsuk Cho

Institution(s): Korea Astronomy and Space Science Institute

Presentation: O1_004I

Abstract

The Korea Astronomy and Space Science Institute plans to develop a coronagraph in collaboration with National Aeronautics and Space Administration (NASA) and install it on the International Space Station (ISS). The coronagraph is an externally occulted one stage coronagraph with a field of view from 2.5 to 15 solar radii. The observation wavelength is approximately 400 nm where strong Fraunhofer absorption lines from the photosphere are scattered by coronal electrons. Photometric filter observation around this band enables the estimation of 2D electron temperature and electron velocity distribution in the corona. Together with the high time cadence ($<$ 12 min) of corona images to determine the geometric and kinematic parameters of coronal mass ejections, the coronagraph will yield the spatial distribution of electron density by measuring the polarized brightness. For the purpose of technical demonstration, we intend to observe the total solar eclipse in 2017 August for the filter system and to perform a stratospheric balloon experiment in 2019 for the engineering model of the coronagraph. The coronagraph is planned to be installed on the ISS in 2021 for addressing a number of questions (e.g. coronal heating and solar wind acceleration) that are both fundamental and practically important in the physics of the solar corona and of the heliosphere.

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Advanced Space-based Solar Observatory: Progress and Prospect

Abstract Author(s): Weiqun Gan, ASO-S team

Institution(s): Purple Mountain Observatory

Presentation: O1_005I

Abstract

ASO-S (Advanced Space-based Solar Observatory) is a mission proposed for the 25th solar maximum by the Chinese solar community. Its scientific objectives aim at the relationships among solar magnetic field, solar flares, and coronal mass ejections. By September. 2017, ASO-S fulfilled all the procedures to be an established approval project. This talk describes in brief the progress of ASO-S and the prospect in near future.

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The Lyman-alpha Solar Telescope (LST): Status and Update

Abstract Author(s): Hui Li, the LST team

Institution(s): Purple Mountain Observatory

Presentation: O1_006

Abstract

The Lyman-alpha Solar Telescope (LST) is one of the three payloads of the proposed Advanced Space-based Solar Observatory (ASO-S), which is composed of a Solar Disk Imager (SDI) with an aperture of 60 mm, a Solar Corona Imager (SCI) also with an aperture of 60 mm and a White-light Solar Telescope (WST) with an aperture of 80 mm. The SDI is to image the Sun from the disk center to 1.2 solar radii in the Lyman-alpha waveband (121.6±7.5nm) with a cadence of 3 - 12s. and a pixel resolution is 0.56". The SCI uses a 2k by 2k CCD camera to image the inner solar corona from 1.1 to 2.5 solar radii with a cadence of 3 - 120s in both the Lyman-alpha waveband (121.6±10nm) and white-light (700±20nm). The WST is design to image the Sun in violet narrow-band continuum (360±2.0 nm) from the disk center to 1.2 solar radii with a general cadence of 3 - 12s (it can be as high as 0.2s in the fast event mode). In this talk, I will introduce the LST instrument, its preliminary design, current status and updates.

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Chromospheric polarimetry through multi-line observations of the 770 and 850 nm spectral regions

Abstract Author(s): Carlos Quintero Noda, Yukio Katsukawa, Masahito Kubo, Toshifumi Shimizu, the Sunrise/SCIP Team.

Institution(s): Japan Aerospace Exploration Agency, National Astronomical Observatory of Japan

Presentation: O1_007

Abstract

Sunrise Chromospheric Infrared Polarimeter is an international instrument under development for the third flight of the Sunrise balloon, scheduled for 2020. It aims to ascertain the magnetic field topology and the physical properties of dynamics events in the lower atmosphere. The instrument will observe multiple spectral lines at two spectral regions, i.e. 770 and 850 nm, where we can find Zeeman sensitive photospheric lines, the upper photospheric K I D1 and D2, and the chromospheric Ca II infrared lines. In addition, although some of the mentioned lines have been observed before, most of them are new candidates for solar observations. In this regard, we study the characteristics of those lines examining their sensitivity to perturbations on several physical parameters, their height of formation, and the maximum polarization signals they produce. The first results, presented in Quintero Noda et al. (2016, 2017a,b), show that the spectral lines are sensitive to changes in the atmospheric parameters in a range of heights that cover the photosphere and the middle chromosphere. Therefore, observing multiple lines, allows simultaneously covering various atmospheric layers, what brings the possibility of expanding our knowledge of the Sun and unravelling the properties of the chromospheric magnetic field.

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Instrumentation for Solar Physics from Cubesat and Small Satellites

Abstract Author(s): Haosheng Lin

Institution(s): University of Hawaii

Presentation: O1_008

Abstract

The rapid advancement of cubesat and small satellites technologies offers new low-cost space access opportunities for solar physics research. However, the stringent size limitations of small satellites is a formidable challenge to instrument design that have intrinsic requirement for the aperture size of the telescope. New optical designs are needed to reduce the volume of the optical system without compromising the optical performance of the instrument. This paper will present optical designs for compact large-field, multi-slit, multi-channel disk and coronal spectropolarimeters for deployment by cubesat and small satellite platforms.

APSPM 2017
Session 1: Progress on instrumentation and future plans

Science with India's space mission Aditya L1

Abstract Author(s): Dipankar Banerjee

Institution(s): Indian Institute of Astrophysics

Presentation: O1_009I

Abstract

Aditya-L1 is India's first dedicated scientific mission to study the sun. Aditya-L1 mission will be inserted in a halo orbit around the L1, which is 1.5 million km from the Earth. The satellite will be launched around 2020 by PSLV-XL from Sriharikota, India. It will carry seven payloads which will provide observations of Sun's Photosphere, Chromosphere (NUV) and corona (Visible, soft and hard X-ray and NIR). In addition, particle payloads will study the particle flux emanating from the Sun and reaching the L1 orbit, and the magnetometer payload will measure the variation in magnetic field strength at the halo orbit around L1. In this talk I will give an overview of the different payloads and its science objectives. Plans for co-ordinated observations with other ground and space based facilities will be discussed.

APSPM 2017
Session 1: Progress on instrumentation and future plans

Studies for next generation solar physic mission

Abstract Author(s): Toshifumi Shimizu

Institution(s): Japan Aerospace Exploration Agency

Presentation: O1_032I

Abstract

In 2016, an advisory team for next generation solar physics mission (NGSPM's Science Objectives Team) was formed with 14 members appointed by NASA, JAXA, and ESA as a means of improving international coordination in solar physics and developing a multilateral solar physics mission concept for the next decade. This is likely to be realized as a Japan-led mission launched after 2024, with substantial contributions from the United States and Europe. In the team study, we developed and documented scientific objectives in the field of solar physics and priorities for an NGSP mission, within the resources and framework by the three agencies. Specific sub-objectives and essential observational tasks were identified in three top-level science objectives, i.e., 1) Formation mechanisms of the hot and dynamic outer solar atmosphere, 2) Mechanisms of large-scale solar eruptions and foundations for predictions, and 3) Mechanisms driving the solar cycle and irradiance variation. There are two broad avenues, both with distinct merits, for future research: physical mechanisms on elemental (small) scales, versus global processes affecting/involving large fractions of the solar interior and/or atmosphere. With the resources available for a NGSPM on the timescale of the next decade, the team recommends the study of fundamental physical processes at high spatial and temporal resolution through all temperature regimes of the solar atmosphere. For this study, the SOT identified a minimum set of instruments with which NGSPM can address the greatest number of sub-objectives and maximize the science return of the mission. The Japanese solar physics community makes efforts to realize a part of such instruments in the middle of the next decade. The other avenue requiring global, multi-vantage observations would be one of the path for the decades after 2030's, because they require strategic preparation of technologies and large resources. The NGSPM Science Objectives Team final report submitted to the agencies is used at various occasions, such as to propose the missions and to coordinate international collaborations.

APSPM 2017
Session 1: Progress on instrumentation and future plans

Prospective Out-of-ecliptic White-light Imaging of Interplanetary Corotating Interaction Regions at Solar Maximum

Abstract Author(s): Ming Xiong, Jackie A. Davies, Bo Li, Liping Yang, Ying D. Liu, Lidong Xia, Richard A. Harrison, Hayashi Keiji, Huichao Li

Institution(s): National Space Science Center, Rutherford Appleton Laboratory Space, Shandong University, HIT Institute of Space Science and Applied Technology, University of Chinese Academy of Sciences, Nagoya University

Presentation: P1_001

Abstract

Interplanetary corotating interaction regions (CIRs) can be remotely imaged in white light (WL), as demonstrated by the Heliospheric Imagers (HIs) on board the STEREO spacecraft. Because of the in-ecliptic locations of both the STEREO spacecraft, the longitudinal dimension of interplanetary CIRs has, up to now, always been integrated in WL imagery. To synthesize the WL radiance patterns of CIRs from an out-of-ecliptic (OOE) vantage point, we perform forward magnetohydrodynamic modeling of the 3D inner heliosphere at solar maximum. The mixing effects associated with viewing 3D CIRs are significantly minimized from an OOE viewpoint. Our forward modeling results demonstrate that OOE WL imaging from a latitude greater than 60 can (1) enable the garden-hose spiral morphology of CIRs to be readily resolved, (2) enable multiple coexisting CIRs to be differentiated, and (3) enable the continuous tracing of any interplanetary CIR back toward its coronal source. In particular, an OOE view in WL can reveal where nascent CIRs are formed in the extended corona and how these CIRs develop in interplanetary space. Therefore, a panoramic view from a suite of wide-field WL imagers in a solar polar orbit would be invaluable in unambiguously resolving the large-scale longitudinal structure of CIRs in the 3D inner heliosphere.

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Developments of multi-lines spectro-polarimeter of the Domeless Solar Telescope at Hida Observatory

Abstract Author(s): Tetsu Anan, Yu Wei Huang, Yoshikazu Nakatani, Kiyoshi Ichimoto, Satoru Ueno, Goichi Kimura

Institution(s): Kyoto University

Presentation: P1_002

Abstract

Multi-lines spectro-polarimetry enables us to diagnose structures of magnetic field vectors along the line of sight, or develop new diagnoses of other anisotropies in the solar atmosphere, for examples, electric fields, radiations and collisions. We developed a new spectro-polarimeter on the Domeless Solar Telescope at Hida Observatory to obtain full Stokes spectra in multi-spectral windows simultaneously. The new polarimeter consists of a 60 cm aperture vacuum telescope, an image rotator, a slit spectrograph, polarization modulator and analyzer composed of a continuously rotating waveplate whose retardation is nearly constant in 500 - 1100 nm and a polarimetric beam splitter located closely behind the focus of the telescope, fast and large format CMOS cameras and an infrared camera. The spectrograph allows us to obtain spectra in as many wavelength windows as the number of cameras. We developed the polarization modulator and the analyzer, and calibrated instrumental polarizations of the system.

2017 Total Solar Eclipse Expedition of KASI

Abstract Author(s): Su-Chan Bong, Seonghwan Choi, Jihun Kim, Jongyeob Park, Bi-Ho Jang, Young-Deuk Park, Kyung-Suk Cho, Kyuhyoun Cho, Jongchul Chae

Institution(s): Korea Astronomy and Space Science Institute, Seoul National University

Presentation: P1_003

Abstract

Korea Astronomy and Space Science Institute (KASI) plans to develop a coronagraph to measure the coronal electron density, temperature, and speed using four different filters around 400 nm, where strong Fraunhofer lines from the photosphere are scattered by coronal electrons. During the total solar eclipse occurring on August 21 across USA, KASI will organize an expedition team to demonstrate the coronagraph measurement scheme and the instrumental technology. The observation site is in Jackson Hole, Wyoming, USA. We plan to build two coronagraphs without occulter to improve signal to noise ratio. In addition, images of white light corona, wide field background, and all sky are planned to be taken with DSLR cameras. We will present the preliminary results of the expedition.

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Coronal green line observation at the Lijiang Station of Yunnan Observatory

Abstract Author(s): Masaoki Hagino, Takashi Sakurai, Kazuya Shinoda, Yu Liu, Tengfei Song, Xuefei Zhang, Mingyu Zhao, Zhong Liu, Kiyoshi Ichimoto, Goichi Kimura, Kanta Hamada, Isao Suzuki

Institution(s): National Astronomical Observatory of Japan , Yunnan Observatories, Kyoto University, Meisei University, Bunkyo Gakuin University

Presentation: P1_004

Abstract

A coronagraph and a filter instrument attached to it (Norikura Green Line Imaging System: NOGIS), which observe the intensity and Doppler shift of the coronal green line (Fe XIV 530.3 nm), had been used at the Norikura Solar Observatory/NAOJ still 2009. After the closure of Norikura Solar Observatory, the coronagraph and the NOGIS instrument was relocated to the Lijiang Station of the Yunnan Observatory of NAOC in November 2013 and the observation of the solar corona has been resumed. The name should then be changed to YOGIS (Yunnan Observatory Green-line Imaging System). The YOGIS instrument can observe not only coronal plasma motions but also velocity fields. Such observations are important in researches on coronal heating, flares, coronal mass ejections and space weather. In this paper we will introduce the YOGIS instrument and discuss the continuity of coronal green-line data between Norikura and Lijiang observations.

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Preliminary Study on Solar Observing Facility in Timau National Observatory

Abstract Author(s): Agustinus Gunawan Admiranto, E. Sungging Mumpuni, Dhani Herdiwijaya

Institution(s): Indonesian National Institute of Aeronautics and Space, Bandung Institute of Technology

Presentation: P1_005

Abstract

Solar physics research in Indonesia is mainly conducted in LAPAN and ITB/Bosscha Observatory. Solar physics research in LAPAN is in line with Space Science Center mission to be the center of regional forecast and prediction system. In line with this mission, solar physics research in LAPAN is on the study of sunspots, flares, coronal mass ejection, and solar radio burst. In collaboration with several institution (Bandung Institute of Technology, Nusa Cendana University, Nusa Tenggara Province and Kupang municipality) LAPAN is planning a National Obervatory in which the planned location is in the Mount Timau (elev. 1300 m above sea level) near Kupang, East Nusa Tenggara, and some of the proposed equipment are of solar physics equipment which are hopefully related to the solar physics research in a broader context (not only in space weather related fields), i.e. solar transient phenomena, solar fine structure, solar interior, coronal mass ejections, solar cycle phenomena, magnetohydrodynamics, dynamics of solar chromosphere, and dynamics of solar magnetic field related with interplanetary magnetic field. Due to the broadness of the proposed field of research, there are many steps of equipment proposals, and the first step is related with the observations of sunspot proper motion and simultaneous multi-wavelength observations for solar flare prediction in both photosphere and chromosphere layers. In this respect, the equipment proposed are telescope for full disk observations in continuum, telescopes for multi-wavelength partial disk observations, and solar imaging spectroscopy. All this are supported with a high performance computer for speckle multi-wavelength imaging and real-time image processing.

Introduction of the New Vacuum Solar Telescope of China

Abstract Author(s): Zhi Xu

Institution(s): Yunnan Observatories

Presentation: P1_006

Abstract

The New Vacuum Solar Telescope (NVST) is a 1 meter vacuum solar telescope that aims to observe the fine structures on the Sun. The main tasks of NVST are high resolution imaging and spectral observations, including the measurements of solar magnetic field. It is located by the Fuxian Lake of southwest China, where the seeing is good enough to perform high resolution observations. The instruments, including the multi-channel high resolution imaging system and two vertical spectrometers are located either on a 6 meter rotatable instrument platform or on the frames of the vertical hanging bracket below the rotating platform. As one of the current large solar telescopes in the world, NVST achieves its designed performance in terms of high resolution observations. Considering that it is located between Europe and America, NVST could work in combination with other European and American large solar telescopes to form a global high resolution observation network. In this presentation I will introduce the salient features of the observation mode, data process and data requirement of NVST.

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Observation of Solar Radio Bursts by CALLISTO Radio Spectrometer in Ibaraki University

Abstract Author(s): Natsuki Tsuda, Satoshi Nozawa, Kazumasa Iwai, Ema Washida

Institution(s): Ibaraki University

Presentation: P1_007

Abstract

A solar radio burst is defined as a sudden, rapid and intense variation in the solar radio emission. Solar radio type-III bursts appear in the frequency range between several kHz and several GHz, and they are characterized by a rapid frequency drift from high to low. These radio waves are thought to be emitted by high energy electron beams accelerated by solar flares. Therefore, observation of the type-III bursts is important in order to understand the generation processes of high energy particles. The CALLISTO radio spectrometer is a solar radio receiver. We have developed a solar radio observation system using a CALLISTO receiver with a log-periodic antenna in the Mito campus of Ibaraki University. The CALLSITO is operated in the frequency range between 100 and 850MHz with 400 channels every 0.5 s. Our Ibaraki CALLISTO is joining the worldwide solar radio monitoring network (e-CALLISTO) which is led by ETH Zurich. Several solar radio type-III bursts related with C and M class flares has been observed on April and July, 2017. The time evolutions of the observed radio bursts are quite similar to those of other observatories. From these data analysis, high reliability of our Ibaraki-CALLISTO system has been shown.

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SUNSPOTS MONITORING USING A SMALL TELESCOPE AT UNIVERSITI TEKNOLOGI MARA

Abstract Author(s): N.N.M. Shariff

Institution(s): Universiti Teknologi MARA

Presentation: P1_008

Abstract

Sunspot is an activity that occurs on photosphere of the Sun. Sometimes it emits highly energetic sub-atomic particles into space. These particles can cause damages on our electrical systems. We have experienced sunspot events that break our communications links and disrupting the ionosphere (which we use to propagate radio signals in the High Frequency (HF) radio spectrum of 3 MHz-30 MHz) and also by causing power surges on electrical power lines that trip circuit breakers. Therefore, sunspot is a very good indicator to measure the activeness of the Sun. By monitoring the sunspots, perhaps we can predict them and learn more about its structure. Since this field is new in our faculty, therefore, we have embark this research with a small optical telescope-Celestron 8 Edge HD. Data taken using Canon EOS 700D on daily basis, if weather permits. During the observation, daily visitor/passer-by (who are interested to know) are around 10-15 persons at set-up area (we do not have a proper observatory yet). Although this research is just a small step compared to other research, we really hope this research can contribute to solar research in terms of public awareness on scientific matters.

Session 2

MHD processes in photosphere, chromosphere and corona

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New Insights into the Physics of the Corona and the Solar Wind from Total Solar Eclipse Observations

Abstract Author(s): Shadia Rifai Habbal, Adalbert Ding, Miloslav Druckmueller

Institution(s): University of Hawaii, Technische Universitae, Institute for Technical Physics, Brno University of Technology

Presentation: O2_010K

Abstract

Most of the clues to the physical processes that heat the corona and accelerate the solar wind are embedded in the properties and behavior of minor ions, namely elements heavier than alpha particles. These properties are manifested in remote sensing observations of the corona and in-situ particle measurements in interplanetary space. At present, there is an abundance of space-based instruments dedicated to solar and heliospheric observations. However, the field of view common to these instruments leaves an essential data gap where the gradients in plasma parameters are the steepest, including changes in the magnetic field. At present, this gap can be covered only by total solar eclipse observations. Furthermore, the visible wavelength range offers unique diagnostic potential for investigations of the physics and thermodynamics of the corona. In this presentation, we will briefly review some of the currently established views on coronal heating and solar wind acceleration. We then present multi-wavelength imaging and spectroscopic observations of the corona acquired over the past decade during total solar eclipses. Among the important empirical inferences from these data are the spatial distribution of coronal temperature, and the freeze-in distance of minor ions in the inner corona. We show how these inferences provide new insights, as well as raise new questions, regarding the processes that control the outer solar atmosphere and the solar wind flow. In particular, we will describe the central role that prominences seem to play in the dynamics and thermodynamics of coronal structures and the solar wind, from defining the electron temperature distribution in the corona, to the generation of plasma instabilities and coronal mass ejections.

Hidden Alfvénic Energy in the Solar Atmosphere

Abstract Author(s): Paul Cally

Institution(s): Monash University

Presentation: O2_011

Abstract

When large-scale fast MHD waves from the solar interior enter the solar atmosphere dominated by flux tube structures, they partially turn into kink waves, which may be observed. However, modeling suggests that most of the incident fast wave energy instead converts quickly to Alfvén waves, which are incompressive and fine-scale, and hence largely invisible. This leads us to suggest that there are huge reserves of hidden or dark Alfvénic energy in the solar atmosphere. The observed kink waves are merely the tip of the iceberg. This energy may be ample to heat the active corona.

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Session 2: MHD processes in photosphere, chromosphere and corona

A role of the co-phased quasi-periodic pulsations in the energy release of the weak solar flare

Abstract Author(s): Elena Kupriyanova, Masuda Satoshi, Kashapova Larisa, Zhdanov Dmitry

Institution(s): Pulkovo Observatory, Nagoya University, ISTP SO RAN

Presentation: O2_012

Abstract

Quasi-periodic pulsations (QPPs) are usually observed during solar flares and they carry an important information about processes of both energy release and energy transfer. We present an analysis of unusual co-phased QPPs found in the emission of the weak GOES C class solar flare occurred at the eastern limb on Dec 21, 2015. The revealed periods of QPPs are about 15 seconds. Moreover, the QPPs are co-phased within the wide spectral range (from microwaves to hard X-rays). This could be evidence of the single source of the emission generating at different heights of the solar atmosphere and resulted by various mechanisms. The results of the analysis are discussed in respect to a possible scenario of energy release during the flare and possibilities of their application for diagnosing the acceleration processes at the initial phases of more powerful events.

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Physical Processes of Flux Emergence and Active Region Formation

Abstract Author(s): Shin Toriumi

Institution(s): National Astronomical Observatory of Japan

Presentation: O2_013I

Abstract

This invited review is dedicated to the introduction of various physical processes of flux emergence and its resultant formation of active regions. The dynamo-generated magnetic flux rises through the convection zone and eventually appears at the surface as tiny pieces of magnetic elements of positive and negative polarities. Through merging and cancellation, they gradually develop into larger pores and sunspots, with exhibiting a wide variety of activity events including bursts and jets. The representative of such events is solar flares, which is the catastrophic release of magnetic energy stored in the active regions through complex emergence of magnetic flux. In this talk, we will review important physical processes of flux emergence in the interior and in the atmosphere, focusing especially on the recent progresses of both observational and theoretical approaches.

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Realistic simulations of magnetic flux emergence from the convection zone to the corona: Formation of solar active regions and eruptions

Abstract Author(s): Feng Chen, Matthias Rempel, Yuhong Fan

Institution(s): High Altitude Observatory

Presentation: O2_014

Abstract

We present realistic simulations of emergence of magnetic flux generated in a solar convective dynamo from the convection zone to the corona. The magnetic and velocity fields in a horizontal layer near the top boundary of the solar convective dynamo simulation are used as a time-dependent bottom boundary to drive the radiative magnetohydrodynamic simulations spanning from the upper convection zone to about 100 Mm in the corona. The main results are: 1) The emerging flux bundles fragment into small-scale magnetic elements that further rise to the photosphere and give rise to several bipolar sunspot pairs. The large-scale flow pattern in the convection zone is not affected in this process. 2) The mixed polarity magnetic field maintained by the small-scale dynamo in the convection zone can provide sufficient energy to heat the Quiet Sun corona to over one million K. As active regions are forming through flux emergence in the photosphere, the corona is further heated to three million K. 3) The bipolar sunspot pairs formed in the photosphere preserve the asymmetries in the emerging flux bundles and resemble the well-known asymmetries in observed sunspot. 4) More than 100 flares occurs in about 50 hours, half of which are above C class. The largest flare reaches M2.5 class and is associated the eruption of a twisted flux rope.

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Two types of surge-like activities above sunspot light bridges

Abstract Author(s): Hui Tian

Institution(s): Peking University

Presentation: O2_015

Abstract

Surge-like activities have been frequently reported from chromospheric observations of sunspot light bridges. Using NST and IRIS observations, we found two types of surge-like activities at a sunspot light bridge. The type-I surges appear above all locations at the light bridge at any time, likely driven by magnetoacoustic waves leaking upward from the photosphere. The type-II surges are clearly caused by reconnection-driven jets which occasionally occur at some locations of the light bridge. Evidences include the inverted Y-shape structures at the footpoints of these jets in Halpha wing images and the IRIS bomb like line profiles. The type-II surges are generally higher and brighter than the type-I surges.

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Slender Ca II H Fibrils in the Low Solar Chromosphere

Abstract Author(s): Shahin Jafarzadeh, Sami Solanki, Rob Rutten, Sven Wedemeyer, Ricardo Gafeira, Marco Stangalini

Institution(s): University of Oslo, Max Planck Institute for Solar System Research, Osservatorio Astronomico di Roma

Presentation: O2_016

Abstract

We present observations of dynamic, slender bright fibrils seen in high-quality narrow-band Ca II H images from the SuFI instrument onboard the SUNRISE balloon-borne solar observatory. We show that these slender Ca II H fibrils (SCFs) map magnetic fields in the low solar chromosphere derived from magnetostatic extrapolation of the photospheric field obtained with SUNRISE/IMaX and SDO/HMI. Our analysis reveals the prevalence of magnetohydrodynamic (MHD) kink and sausage waves in the SCFs, propagating at high-frequencies (up to 30 mHz), with speeds on the order of 9-15 km/s. Characteristics of these waves differ from those found for other fibrillar structures, which, however, were observed mainly in the upper solar chromosphere (from observations with SST/CHROMIS). These MHD waves are found to be similar to those observed in the photospheric magnetic elements, but also penetrating into the lower solar chromosphere. The estimated energy flux ($\sim$ 15 kW/m^2) carried by the observed waves in the SCFs is marginally enough to heat the chromosphere (and perhaps the corona). We have further explored temperature distributions of the fibrillar structures from a coordinated observations between ALAM and IRIS. The temperatures are compared with those determined in the fibrils as a result of the MHD waves.

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Statistical study of small blue shifted events

Abstract Author(s): Kumi Hirose, Kiyoshi Ichimoto, Kenichi Otsuji, Takako T. Ishii, Ayumi Asai

Institution(s): Kyoto University

Presentation: O2_017

Abstract

Solar Dynamics Doppler Imager (SDDI) which is equipped with the Solar Magnetic Activity Research Telescope (SMART) at Hida Observatory observed many small blue shifted events. We present a statistical study of these events, such as the occurrence frequency or the place where the events often observed in the solar surface. Routine observation using SDDI started from May 2016. Using SDDI, we can get solar full disk images not only H-alpha center but also the wing images from H-alpha -9.00A to H-alpha +9.00A, totally 73 wavelengths. According to the investigation of data totally 10 hours in August 2016, the events occur about 10 times an hour. The sizes of them are about 10 to 20 arcsec, and that is equivalent to 10,000 km on the solar surface. The shift amounts from H-alpha center are -1.25A to -2.00A, in other words, the line of sight velocity is about 60 to 90 km/s. We discuss the result of the statistical study about these blue shifted events using automatic detection algorithm. In addition, we discuss the result of the comparison between SDDI data and SDO data.

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Using the Solar Dynamics Observatory and Radiative MHD Simulations to Study the Thermal Structure and Evolution of Solar Flares

Abstract Author(s): Mark Cheung

Institution(s): Lockheed Martin Solar and Astrophysics Laboratory

Presentation: O2_018K

Abstract

In part one of this presentation, we present a validated method to perform differential emission measure (DEM) inversions on extreme ultraviolet imaging observations of the solar corona taken by the Atmospheric Imaging Assembly onboard NASAs Solar Dynamics Observatory. We begin with a description of the method and proceed to discuss test cases used for validation. We then present applications of the method to a number of science cases, including the (1) thermal structure of active regions and emerging flux regions, (2) magnetic reconnection outflows and (3) chromospheric evaporation in solar flares. In part two, we present results from a 3D radiative MHD model of a solar flare and compare synthetic remote sensing diagnostics with flare observations (e.g. GOES X-ray light curve, temperature dependence of footprint evaporation flows and x-ray spectra).

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Flux-Emergence Model for the Characterization of Solar Active Regions

Abstract Author(s): Tetsuya Magara

Institution(s): Kyung Hee University

Presentation: O2_019I

Abstract

We present a model for characterizing solar active regions on the basis of their evolutionary paths. To make a quantitative comparison of active regions having different morphological features, the model is used to derive physical properties of a subsurface magnetic field that characterize an active region formed through flux emergence. The derivation is performed by inversion from an evolutionary relation between two observables, emerged magnetic flux and injected magnetic helicity, the former of which gives the scale information on active regions while the latter represents their magnetic configurations.

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ALMA observations of the solar chromosphere on the polar limb

Abstract Author(s): Takaaki Yokoyama, Masumi Shimojo, Takenori J. Okamoto, Haruhisa Iijima

Institution(s): The University of Tokyo, National Astronomical Observatory of Japan , Nagoya University

Presentation: O2_048

Abstract

We report preliminary results of the Atacama Large Millimeter/submillimeter Array (ALMA) observations of the solar chromosphere on the southern polar limb. The coordinated observations with IRIS and Hinode are also carried out. ALMA has provided us unprecedented high spatial resolutions (approximately 1.5 arcsec) in the millimeter band at 100 GHz frequency with very high cadence (2 sec). The preliminary results are as follows: (1) A clear solar limb in the millimeter band is located at approximately 5 arcsec above the photosphere. (2) Many dynamic saw-tooth patterns are identified on the chromospheric edge. They are co-located with the similar structure in the AIA 171 band and can be interpreted as low-temperature high-density materials. (3) A blob-ejection event is found. By comparing with the IRIS Mg slit jaw images, the trajectory of the blob seems to be along the spicular patterns. The ejection is accompanied by a brightening jet event at the footpoint area.

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Magnetic moment of thermal plasma and activities in the solar atmosphere

Abstract Author(s): Kiyoto Shibasaki

Institution(s): Solar Physics Research Inc.

Presentation: P2_010

Abstract

Thermal plasma in the solar atmosphere is magnetized (diamagnetic) even under highly collisional condition. According to the Classical Theory of Electromagnetism, magnetic moment is determined at each moment, hence the complete gyration of charged particles around magnetic field is not needed. They do exist even in highly collisional thermal plasma. The Orbit Theory is not needed to derive magnetic moment and drift motion. Magnetized fluid is subjected to Kelvin force in non-uniform magnetic field. Generally, magnetic field strength decreases upwards in the solar atmosphere, hence the Kelvin force is directed upwards along the field. By adding the Kelvin force to the MHD equation of motion, we can expect temperature dependent plasma flows along the field which are found by many observations. The temperature dependence of the flow speed is explained by temperature dependence of magnetic moment. From the observed parameters, we can infer physical parameters in the solar atmosphere such as scale length of the magnetic field strength and the friction force acting on the flowing plasma. Without the friction force, we can expect upward acceleration of plasma flow, which is the solar wind. In case of closed magnetic field lines, loop-top concentration of hot plasma is expected.

Effect of radiative loss on waves in chromosphere

Abstract Author(s): Yikang Wang, Takaaki Yokoyama

Institution(s): The University of Tokyo

Presentation: P2_011

Abstract

Radiation is one of the major tools for observing the sun. In the chromosphere, it is even more important since it is a main source of energy loss, which has a significant influence on chromosphere dynamics. While previous studies are likely to ignore radiative loss due to its difficulty, we perform 1D radiative MHD simulation and shown that the height of transition region and temperature distribution in the chromosphere is affected by radiative loss obviously. Our research indicates that chromosphere heating and spicule launching could be explained simultaneously by wave driving model, which also provides enough energy flux in coronal which may contribute to coronal heating.

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Comparative studies of the quiet sun under different conditions: in a coronal hole, under a magnetic canopy, and pure quiet sun

Abstract Author(s): Daniela Adriana Lacatus, Alina Donea

Institution(s): Monash University

Presentation: P2_012

Abstract

A strong grasp of the quiet sun processes and their influence on the emitted spectra is important in understanding the more dynamic active regions. We use IRIS data to make a comparative study of the quiet sun under various conditions: a) under the canopy fields of an active region b) in a coronal hole and c) in a pure quiet sun. We analyzed the chromospheric and transition region lines profiles. The aim is to identify the network/internetwork differences on the quiet Sun while taking into account the evolution of the underlying magnetic field and its influence. The Si IV and C II lines emission is barely visible above the background in the cell interior while becoming relatively bright at the cell boundary. This clearly suggests that there is more heating in the network lanes. Observational evidence was presented that the Mg II h&k lines exhibit a systematic broader line profile in the network region of a coronal hole, as a better comprehension of the non-eruptive solar atmosphere is essential for current and future numerical simulations.

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Alfvén wave phase-mixing in flows: why over-dense solar coronal open magnetic field structures are cool?

Abstract Author(s): David Tsiklauri

Institution(s): Queen Mary University of London

Presentation: P2_013

Abstract

The motivation for this study [1] is to include the effect of plasma flow in Alfvén wave (AW) damping via phase mixing and to explore the observational implications. Our magnetohydrodynamic simulations and analytical calculations show that, when a background flow is present, mathematical expressions for the AW damping via phase mixing are modified by the following substitution: C_A' (x) $\rightarrow$ C_A' (x) + V_0' (x), where C_A and V_0 are AW phase and the flow speeds, and the prime denotes a derivative in the direction across the background magnetic field. Although the result is generic and is applicable to different laboratory or astrophysical plasma systems, we apply our findings to addressing the question why over-dense solar coronal open magnetic field structures (OMFS) are cooler than the background plasma. Observations show that the over-dense OMFS (e.g. solar coronal polar plumes) are cooler than surrounding plasma and that, in these structures, Doppler line-broadening is consistent with bulk plasma motions, such as AW. If over-dense solar coronal OMFS are heated by AW damping via phase-mixing, we show that, co-directional with AW, plasma flow in them reduces the phase-mixing induced-heating, thus providing an explanation of why they appear cooler than the background.

[1] D. Tsiklauri, Astron. Astrophys. 586, A95 (2016)

Solar Cycle Variation of Open Magnetic Flux Regions

Abstract Author(s): Chia-Hsien Lin, Guan-Han Huang , Lou-Chuang Lee

Institution(s): National Central University, Academia Sinica

Presentation: P2_014

Abstract

Coronal holes are the regions on the solar surface with magnetic field lines extending far away from the Sun, allowing plasma to flow from the Sun into interplanetary space, causing disturbance to the space weather. How coronal holes change over time can provide important information not only for space weather and space climate, but also for the understanding of solar dynamo and flux transportation. In this poster, we present our results on the spatial-temporal variation of coronal holes over 3.5 solar cycles.

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Stokes Profile Inversion code for the Photospheric spectral line

Abstract Author(s): Rahul Yadav, Shibu K. Mathew

Institution(s): Udaipur Solar Observatory

Presentation: P2_015

Abstract

Inversion codes are the most useful tools to infer the magnetic and thermodynamic properties of the solar atmosphere from the interpretation of Stokes profiles. The basic idea of an inversion code is to minimize the differences between the observed and the synthetic Stokes profiles. A new Milne-Eddington (M-E) based inversion code (named as SPIN- Stokes Profile INversion) has been developed at Udaipur Solar Observatory. The purpose of SPIN is to provide the researchers a user-friendly tool for understanding and interpreting the spectro-polarimetric observations. This code will be dedicated to analyze the pipeline data of Multi-Application Solar Telescope (MAST) to extract the magnetic vector and velocity fields from the spectro-polarimetric observations. It solves the polarized radiative transfer equation under M-E approximation and the inversion approach is based on the application of the modified Levenberg-Marquardt. The code has been tested and validated with the other widely used inversion codes like SIR and VFISV. We will present these results and describe the utilization of the SPIN code to invert the spectro-polarimetric data for a single photospheric spectral line. We will also discuss the application of the SPIN to invert the spectro-polarimetric data obtained from MAST and its comparison with the HMI/SDO inverted data.

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Statistical analysis of formation of solar magnetic flux tube with kilogauss magnetic field strength

Abstract Author(s): Shota Ninomiya, Kiyoshi Ichimoto

Institution(s): Kyoto University

Presentation: P2_016

Abstract

In the quiet region, there are ubiquitously flux tubes which have strong magnetic field strength(1-2kG). These strong flux tubes are made by convective collapse. There are many observations in time series but there are few statistical observations. In addition, time series observations are made by selecting a part of the flux tubes which convective collapse occurred. In this observation, we analyze statistically the state of flux tube based on observations with the Solar Optical Telescope (SOT) aboard Hinode.And we verify the formation scenario of flux tube which have kilogauss magnetic field strength. As a result of analysis, there are many flux tubes with physical quantities that agree with the conventional formation model.

Dark knots in a penumbral intrusion into a sunspot umbra

Abstract Author(s): Jingwen Zhang, Hui Tian , Haimin Wang

Institution(s): Peking University , New Jersey Institute of Technology

Presentation: P2_017

Abstract

High-resolution observations of the sunspot penumbra have revealed the existence of dark lanes in the center of penumbral filaments near umbral regions. Previous studies speculated that these dark lanes are stagnant points above magneto-convection cells and that they are dark because of radiative loss. We present very high-resolution TiO and Halpha images of a sunspot in NOAA Active Region 12371 taken by the 1.6m New Solar Telescope at Big Bear Solar Observatory on 2015 June 20. The observed region contains penumbral filaments intruding into the umbra and light bridges. The penumbral filaments constantly intrude into the umbra and some of them develop into narrow light bridges. The observation shows that the dark lane within a narrow light bridge is not a continuous line but separated by many dark knots. These dark knots appear to move inward along the light bridge, accompanied by brighter penumbral grains on both sides. Surge-like oscillations (light wall) can be identified above the same light bridge in the Halpha core passband. In addition, the 1400 Angstrom and 2796 Angstrom slit-jaw images taken by the Interface Region Imaging Spectrograph (IRIS) satellite reveal a few brightenings moving inward on this light bridge, which appears to be related to the inward motion of dark knots in the photosphere.

Origin of three minute oscillations in a sunspot umbra

Abstract Author(s): Kyuhyoun Cho, Jongchul Chae

Institution(s): Seoul National University

Presentation: P2_018

Abstract

Three minute oscillations in sunspots are the observable aspect of slow mode waves that can give us important clues to the sunspots structure and MHD processes therein. We investigated the origin of the three minute oscillations by observing the leading sunspot of AR 12663 on 2017 June 15 with the Fast Imaging Solar Spectrograph. The Fe I 5434.5 angstrom line and the Ni I 5435.5 angstrom line were employed to measure velocity oscillations of the temperature minimum region and the upper photosphere, respectively. We confirmed that the three minute oscillations on the sunspot umbra are upward propagating waves. More importantly, we estimated three minute oscillation power and the wave energy flux at the each layer, and examined their spatial, temporal distributions. Based on our results we discuss the possibility that magnetoconvection inside sunspots may be the origin of three minute oscillations.

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Three-minute Sunspot Oscillations Driven by Magnetic Reconnection in a Light Bridge

Abstract Author(s): Donguk Song, Jongchul Chae, Hannah Kwak, Ryouhei Kano, Vasyl Yurchyshyn, Yong-Jae Moon, Eun-Kyung Lim, Jeongwoo Lee

Institution(s): National Astronomical Observatory of Japan, Seoul National University, Big Bear Solar Observatory, Kyung Hee University, Korea Astronomy and Space Science Institute

Presentation: P2_019

Abstract

We report a new type of three-minute chromospheric oscillations above a sunspot in association with a small-scale impulsive event in a light bridge. During our observations, we find a transient brightening in a LB. The brightening consists of elementary bursts that are a manifestation of fast repetitive magnetic reconnections in a light bridge. Interestingly, the oscillations in the neighboring region such as a sunspot umbra are impulsively excited when the intensity of the brightening in the light bridge reached at the peak. The initial period of the oscillations is about 2.3 minutes and then gradually increased to 3.0 minutes. In addition, we find that the amplitude of the oscillations is twice larger than before the brightening. Based on our results, we proposed a possibility that magnetic reconnection occurring in a light bridge can unexpectedly lead to excitation of oscillations in the nearby a sunspot umbra.

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Study of supersonic downflow at the transition region above sunspots

Abstract Author(s): Tanmoy Samanta, Hui Tian, Sean McKillop

Institution(s): Peking University, Harvard-Smithsonian Center for Astrophysics

Presentation: P2_020

Abstract

Downflows at supersonic speed have been observed in the transition region above sunspots for more than two decades. These downflows are often seen in different transition region spectral lines above sunspots, although, it is still poorly understood why these strong downflows at supersonic speed exists within sunspots. We try to emphasize the important properties these downflows by performing a statistical analysis over a large sample which was missing earlier. The Interface Region Imaging Spectrograph (IRIS) has provided a wealth of high- spatial and spectral resolution observational data of sunspots in the past few years. We have identified sixty datasets obtained with IRIS raster scans. Using an automated code we identified the locations of strong downflows within these sunspots. We found that around eighty percent of the sunspots show supersonic downflows in the Si IV 1403 Å line. Furthermore, a detailed spectral analysis was performed by selecting a small spectral window containing the O IV 1399 Å, O IV 1401 Å and Si IV 1403 Å transition region lines. Six Gaussian functions were simultaneously fitted to these three spectral lines and their satellite lines (due to strong down flows). We calculated the intensity, Doppler velocity and line width for these lines. We also computed the density using the O IV doublet line ratio for both the static and downflow components. We also discuss the source of these supersonic downflows.

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Foot point Brightening at near pore boundary

Abstract Author(s): Juhyeong Kang, Jongchul Chae

Institution(s): Seoul National University

Presentation: P2_021

Abstract

We investigate fine scale transient brightening event at the pore boundary. We observed the pore on June 4, 2014, from the Fast Imaging Solar Spectrograph (FISS) of the 1.6 m Goode Solar Telescope (GST), the Atmospheric Imaging Assembly (AIA) aboard the Solar Dynamics Observatory (SDO), and Helioseismic and Magnetic Imager (HMI) aboard SDO. The event occurs at foot point of the loop with a conjugate brightening at the other foot point outside the FISS field-of-view. These foot point brightening events appear in all AIA extreme ultraviolet bands, also in the two FISS lines, H and Ca II 8542 Å, and last for a minute. The Brightening near the pore boundary exhibit a redshift of 4.3 km s-1 in the H, and about 2.3 km s-1 in Ca II line. Differential emission measure derived from the AIA passbands and cloud model fitting of the two FISS lines show the temperature increase between 10,000 and 20 MK at the main event. After the brightening, the upward mass motion is found in EUV bands of AIA. This brightening is possibly related the foot point brightening caused by the magnetic reconnection.

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Flows along the Super-Penumbral Fibrils in Sunspots

Abstract Author(s): Debi Prasad Choudhary, Christian Beck

Institution(s): San Fernando Observatory

Presentation: P2_022

Abstract

Sunspots are main ingredient of solar cycle and site of major eruptive events. Understanding the structure of these objects is an important aspect studying our nearest star. We have observed several sunspots using the Spectropolarimeter in near-Infrared and Optical wavelength ranges at the Dunn Solar Telescope during 29 July to 4 August 2013. The data consists of full Stokes profiles in the Ca II 854.2 nm and Fe I 1.56 micron lines. The inversion of these Stokes spectra provides the magnetic, thermal and velocity structure at photospheric and chromospheric heights of sunspots. In this lecture, we present the results on the 3D thermal structure in the superpenumbral canopy of a round sunspot, derived by a novel approach for the inversion of Ca II IR spectra. Tracing individual fibrils in the super-penumbral canopy, we find that about half of them form only short loops of a a few Mm length that return to the photosphere in the close surroundings of the sunspot instead of connecting to more remote magnetic network at the outer end of the moat flow. We also find indications for standing shocks at the inner foot points of the flow channels that are compatible with a supersonic siphon flow scenario scientific matters.

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Emergence of running penumbral waves in the sunspots

Abstract Author(s): Priya TG

Institution(s): NAOC

Presentation: P2_023

Abstract

We present the results from high resolution imaging observations of running penumbral waves (RPWs) in active region NOAA 12127 with three sunspots. The spectra of TiO, H, and 304 Å for various atmospheric heights from the photosphere to lower corona are used to investigate the emergence of RPWs in the chromosphere. Analysis show that at the formation height of H 0.6 Å in the inner umbra, the power of 4.2-8.0 min oscillations accounts for ∼5% and ∼3% of 2.64.2 min and 1.92.6 min oscillations, respectively. We found consistency in the average power of these oscillations from H -0.6 Å upto H line center, indicating that the signal of 5-min oscillations is very weak to be easily detected in the inner umbra even if they exists. We used a phase-speed filter to extract the wave signals from the temporal sequences of H images and found that the waves with periods of 3 min and ∼4.2 min simultaneously emerge in the umbral center, and the intensity of the latter is ∼2% of the former (comparable to the above 3% or 5% proportion). Interestingly, we found that the 3 min waves become evanescent and ∼4.2 min gets enhanced while approaching the umbral boundaries, suggesting that RPWs might emerge in the center of chromospheric umbra. Similar results are obtained from the analysis of single sunspot of NOAA AR 12132, showing the consistency.

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Velocity oscillations in the chromosphere and transition region above plage region

Abstract Author(s): Hannah Kwak

Institution(s): Seoul National University

Presentation: P2_024

Abstract

We closely investigate velocity oscillations in the active region plage by using the high-spatial, high-spectral and high-temporal resolution spectral data acquired by the Interface Region Imaging Spectrograph. From the Mn I 2801.907 Å (lower chromosphere), Mg II k (chromosphere), C II (lower transition region) and Si IV (middle transition region) lines, we measure the line of sight Doppler velocity at different atmospheric layers, and present results of wavelet analysis of plage region with a range of periods from 2 to 8 minutes. In addition, we present correlations of the oscillations from the lower chromosphere to the middle transition region. Finally, we try to understand the regional dependence of the oscillation properties on physical properties such as temperature and magnetic field inclination.

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Analysis of Ellerman Bomb Spectra Observed by FISS

Abstract Author(s): Minju Seo, Jongchul Chae, Jeongwoo Lee

Institution(s): Seoul National University

Presentation: P2_025

Abstract

Ellerman bombs (EBs) are small transient events occurring near active regions that appear bright in the far wings of the Balmer lines and are believed to be due to magnetic reconnection. To estimate the heating function for EBs, we analyze the EB spectra observed by the Fast Imaging Solar Spectrograph (FISS) installed on the 1.6m Goode Solar Telescope (GST) in Big Bear Solar Observatory (BBSO), which provide H-alpha and Ca II 8542 Å line profiles with high-spectral resolution. We have mainly compared the FISS spectra of EBs with synthetic profiles computed using RH non-LTE radiative transfer code with the 1D atmospheric models. To model the heating, we introduce a temperature enhancement in Gaussian form that vary in magnitude and height, as considered adequate for EBs. In this way, we could reproduce each of the observed H-alpha and Ca II line profiles separately with different atmospheric models, but not with a single atmospheric model. It is often the case that the best-fit model for the observed H-alpha lines has much higher temperature enhancement than that for Ca II lines. We discuss possible causes for this temperature mismatch such as non-thermal heating which is not included in our model.

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Observation of Fine Scale Dynamics in the Solar Chromosphere with a Dual Camera Imaging System

Abstract Author(s): Satomi Tokuda, Aki Machida, Sanetaka Okada, Satoru Ueno, Kiyoshi Ichimoto

Institution(s): Kyoto University

Presentation: P2_026

Abstract

Using a newly developed narrowband universal tunable filter (UTF-32) equipped with a polarizing beam splitter at the exit and the following two cameras, we can take solar images in Ha(6563Å) +/-0.5Å simultaneously. It allows us to obtain accurate Dopplergrams with much suppressed seeing noise since two images in Ha+0.5Å and Ha-0.5Å suffer from exactly same distortion or blurring due to the seeing. Thus, by applying an image reconstruction technic on the difference images of Ha+/-0.5Å , it is possible to deduce a high resolution Dopplergram. We observed an active region (NOAA 12665) near the west limb on July 15, 2017 with the UTF dual camera system installed on the Domeless Solar Telescope (DST) of the Hida Observatory of Kyoto University. By applying the speckle masking image reconstruction to the observed dataset, we obtained a time series (80min duration and 10sec cadence) of Ha images and Dopplergrams with nearly diffraction limited spatial resolution for the aperture size of 60cm (0.25arcsec). We expect that this kind of observation with high resolution will allow us to investigate the time evolution of plasma flows along chromospheric fibrils, twisting motions of small jets, oscillations in filaments or prominences, and eventually to understand the origin of the fine scale dynamics in the solar chromosphere. We will present the details of our observing system and discuss the analysis results of the observation.

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High Resolution Observations of Spicules in Upper-Photospheric Lines

Abstract Author(s): Yoshinori Suematsu

Institution(s): National Astronomical Observatory of Japan

Presentation: P2_027

Abstract

The formation mechanism of the chromospheric spicules remains unresolved, although there is no doubt that they are rooted at photospheric magnetic elements most of which are seemingly unipolar. It is likely that a key mechanism for their formation is a strong slow shock formation in the chromosphere, irrespective of its original energy source, such as a p-mode acoustic wave leakage into the chromosphere, MHD wave propagation including torsional Alfven waves launched in the photosphere, magnetic reconnection happening in the lower chromosphere, etc. The formation mechanism should explain not only their tall height but also their narrow width; large aspect ratio of length to width, their multi-thread structure typically double-thread. It is likely that the some spicules are rooted in the upper photosphere since their roots show up as tiny jets in Dopplergrams in Na I D and Mg I b lines close to the limb and even on the limb, as observed in Hinode/SOT Narrow-band Filtergraphic Imager. This fact implies that the spicules start below the chromosphere and pressure waves need to be generated in the sub-photosphere: One of possible mechanisms for the wave generation might be a magnetic pumping suggested by Parker (1974). I present observational results of spicule-like jets in the upper-photospheric lines.

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Wave Propagation on Spicules Observed by Chromospheric Lyman-Alpha Spectro-Polarimeter (CLASP)

Abstract Author(s): Masaki Yoshida, Y. Suematsu, R. Ishikawa, R. Kano, N. Narukage, T. Bando, A. Winebarger, K. Kobayashi, J. Trujillo Bueno, F. Auchere

Institution(s): The Graduate University for Advanced Studies , National Astronomical Observatory of Japan, NASA Marshall Space Flight Center, Instituto de Astrofisica de Canarias, Institut d'astrophysique spatiale

Presentation: P2_028

Abstract

The MHD wave propagations on spicules are detected by Hinode and IRIS. They are considered to be a sign of mechanical energy transport for coronal heating and solar wind acceleration. To study the wave propagation on the spicule, we analyzed the Ly-alpha line spectro-polarimetric data of limb spicule from the CLASP sounding rocket experiment. The Ly-alpha line is well suited for the study of wave propagation of spicule because it shows up taller and longer-lived spicules than other chromospheric lines due to its very large opacity. Therefore, we derived the velocity field along the height of the spicule. For the study of line-of-sight doppler motion, to avoid the influence of geo-coronal absorption at the line center, we use a method called bisector analysis at the Ly-alpha line wing. As a result, we succeeded in detection of the wave propagation along the spicule. The oscillation have a short period (30 seconds) and a long period (240 seconds: observed only in half period). The velocity amplitudes are $\sim$7 km s^{-1} in short period and $\sim$20 km s^{-1} in long period. The propagation velocity is $\sim$500 km s^{-1}. If this oscillation assumed to be MHD kink wave, a magnetic field of spicule could be estimated about 2080 G when typical densities of spicules are assumed. Upward pointing flux could be estimated to be 3×10^6-6×10^7 erg cm^{-2} s^{-1} from the long period velocity amplitude and the magnetic field. The pointing flux is large enough to heat the corona in the quiet Sun.

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Driving process for highly impulsive plasma outflows

Abstract Author(s): Yamini K. Rao, A. K. Srivastava, J. G. Doyle, Bhola N. Dwivedi

Institution(s): Indian Institute of Technology , Armagh Observatory

Presentation: P2_029

Abstract

A study on an impulsive plasma outflow was conducted in the quiet-Sun using multi-wavelength datasets from Atmospheric Imaging Assembly (AIA) onboard Solar Dynamics Observatory (SDO) on 2011 March 30. This small-scale impulsive plasma outflow was found to be of the size ∼8 arcsec with a lifetime of ∼8 minutes. The simultaneous emissions from multiple SDO/AIA channels covering wide temperature range, indicated its impulsive behavior. An unusual high terminal speed of 1250 km s^{-1} was observed with which the outflow rose to the upper solar atmosphere. We also studied the temperature distribution of its plasma by an automated DEM technique using AIA wavebands sensitive to the transition region and coronal temperatures. The evolution of photospheric magnetic field was investigated using SDO/HMI temporal image data which showed the signature of negative flux emergence in the vicinity of a positive flux region. The negative flux was found to be oscillating with the period of 442s. The flux cancellation is evident from the topological behavior of magnetic polarities at the footpoint of the brightening. The oscillations with almost same period 416 s(∼7 min) was observed in 1600 Å wavelength of SDO/AIA and flux from the negative polarity at the base of the outflow region before, during, and even after the outflow. This indicated the generation of magnetoacoustic waves/shocks in the small- scale current sheet which supplied the energy required to drive the impulsive plasma outflow.

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H-alpha surges at the emerging flux region observed before the pore formation (NOAA 12660)

Abstract Author(s): Takako T. Ishii, K. Otsuji, T. Anan, K. Ichimoto

Institution(s): Kyoto University

Presentation: P2_030

Abstract

We observed point like jets and surges at the emerging flux region before/during pore formation (NOAA 12660) on 2017-May-22(JST) with SMART/SDDI at Hida Observatory, Kyoto University. SMART/SDDI (Solar Dynamics Doppler Imager) takes full-disk solar images with a field of view of 2520 arcsec^2 at multiple wavelengths around the H-alpha line (from 6561.9 Å to 6563.7 Å, with resolution of 0.25 Å). Comparing H-alpha surge activities and magnetic field evolution using SDO/HMI data, we found following results. (1) At the beginning of observation (21:45UT), this region was covered by weak negative polarity. (2) Point like jets(surges) occurred continuously from 22:00 UT to 01:00UT. (3) Positive polarity flux appeared around 22:30UT. (4) AFS (Arch filament system) in H-alpha was seen around 03:00 UT, and pore with negative polarity was formed. (5) Around 05:00 UT, pore with positive polarity was formed. (6a) After 01:00UT, long surges occurred. (6b) After the formation of AFS, large surges occurred. This result is the first observational result with magnetic field data confirmed Kurokawa (1988 Vistas in Astronomy), the first manifestation of the emerging flux region in the solar surface is a surge activity.

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Large-amplitude prominence oscillations: observations and numerical simulations

Abstract Author(s): Qingmin Zhang

Institution(s): Purple Mountain Observatory

Presentation: P2_031

Abstract

We report our studies on observations and numerical simulations of large-amplitude prominence/filament oscillations. Using the multi-wavelength observations from Hinode, SDO, and GONG, we studied the longitudinal oscillations of an AR prominence and an intermediate filament, simultaneous longitudinal and horizontal oscillations of a quiescent prominence, and vertical oscillation of a polar coronal cavity. Numerical simulations are performed to investigated the triggering mechanism, restoring force, and damping mechanism of oscillations. The longitudinal oscillations are mainly triggered by microflares in the filament channels. However, a new mechanism of triggering mechanism is found, i.e., jet-like flows from a remote flare. The restoring force of longitudinal oscillations is mainly the projected gravity of filament along the dip. However, the magnetic pressure gradient may play an important role in the restoring force for the magnetic flux rope hosting a prominence. The damping mechanism of longitudinal oscillations is mainly radiative loss. However, downward mass drainage from one of the prominence legs may accelerate the damping of amplitude. For vertical oscillations, they can be triggered by large-scale EUV waves from a remote site of solar eruption.

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The Role of a Flux Rope Ejection in a Three-dimensional Magnetohydrodynamic Simulation of a Solar Flare

Abstract Author(s): Keisuke Nishida, Naoto Nishizuka, Kazunari Shibata

Institution(s): Kyoto University, National Institute of Information and Communications Technology

Presentation: P2_032

Abstract

We investigated the dynamic evolution of a three-dimensional (3D) flux rope eruption and magnetic reconnection process in a solar flare, by simply extending two-dimensional (2D) resistive magnetohydrodynamic simulation model of solar flares with low beta plasma to 3D model. We succeeded in reproducing a current sheet and bi-directional reconnection outflows just below the flux rope during the eruption in our 3D simulations. We found that there is a positive feedback between the ejection speed of a flux rope and the reconnection rate both in the 2D and 3D simulations, and we conclude that the plasmoid-induced reconnection model can be applied to 3D. We also found that small scale plasmoids are formed inside a current sheet and make it turbulent. These small scale plasmoid ejections have a role in locally increasing the reconnection rate intermittently as observed in solar flares, coupled with a global eruption of a flux rope.

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Three-dimensional MHD simulation of solar prominence oscillations in a magnetic flux rope

Abstract Author(s): Yuhao Zhou, Chun Xia, Rony Keppens, Pengfei Chen

Institution(s): Nanjing University, University of Leuven

Presentation: P2_033

Abstract

Solar prominences are always subject to all kinds of perturbations during their lifetime, which lead to the frequently observed prominence oscillations. The study of prominence oscillations provides an alternative way for investigating their internal structure as well as their interplay with the solar corona. A number of theoretical models as well as one- or two-dimensional simulation works have been performed to explain the observed periods of these oscillations. In this work, we present a three-dimensional magnetohydrodynamic simulation of prominence oscillations in an elongated magnetic flux rope, with the help of the numerical code MPI-AMRVAC. It is found that, while the oscillation periods predicted by analytical solutions are roughly consistent with our numerical results, the latter does show some new features that are missing in the simplified analysis. These results would be helpful to improve prominence seismology.

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Session 2: MHD processes in photosphere, chromosphere and corona

Determination of the wave property in the quiescent prominence from the phase difference

Abstract Author(s): Aki Machida, Kiyoshi Ichimoto, Sanetaka Okada, Satomi Tokuda, Ayumi Asai, Satoru Ueno, Kazunari Shibata

Institution(s): Kyoto University

Presentation: P2_034

Abstract

The mechanism of coronal heating has not yet been fully solved. One of the hypotheses is dissipation of waves. To understand the wave dynamics, prominences are good target, since they are denser, and therefore, variations of physical parameters are more detectable than the surrounding corona. Thus, it is expected that investigating wave dynamics in prominences give some suggestions to the coronal heating problem. Not only from observations of Doppler velocity but also from those of temperature simultaneously, we can understand the wave dynamics in more detail. If the temperature has the periodicity, we can conclude whether the wave is compressive or not. From the phase difference between the temperature and the Doppler velocity variations, we can determine that the wave is a propagating wave or a standing wave. Furthermore, from the time variation of the temperature, we can capture the process in which the wave damps and is converted into the heat energy. On 16 October 2016, we observed the prominence with the Domeless Solar Telescope and the horizontal spectrograph at the Hida Observatory, Kyoto University. From the simultaneous observation of three spectra, Ha(6563A), Hbeta(4861A), and Ca(8542A), we detected the quasi-periodic time variations of the temperature and the Doppler velocity. From the phase difference of 180 degree, it is concluded that we captured the propagating magneto-acoustic wave.

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Temperature diagnosis of Solar prominences with a simultaneous observation of H-alpha, H-beta and CaII 8542Å lines

Abstract Author(s): Sanetaka Okada, Aki Machida, Satomi Tokuda, Kiyoshi Ichimoto, Satoru, Ueno, Ayumi Asai, Kazunari Shibata

Institution(s): Kyoto University

Presentation: P2_035

Abstract

We observed a solar prominence on the east limb with the Domeless Solar Telescope at Hida observatory on October 16 2016. We scanned the prominence by the slit of the spectrograph and obtained the spectra of Ha. Hbeta, Ca 8542 at each point of the prominence. By fitting the profiles of obtained spectra using a simple 1D slab model, we determined the doppler width of the spectra at each point of the prominence and obtained the distribution of temperature(T) and turbulent velocity(ξ). In the fitting we considered the fine structure of Ha and Hbeta lines and found that the derived temperature differs by about 1000K from the results when the fine structure is ignored. We also examined the optimized way for constraining the fitting parameters and finally fixed the ratios of opacity and source function of H-alpha and H-beta in order to better determine the optical thickness and the Doppler width of the hydrogen lines with a higher confidence. From the fitting of three lines, at the top of the prominence we found high temperature region (T$\sim$15000K) with high turbulent velocity (ξ $\sim$10km/s). This suggests that turbulence is related to the heating of the prominence.

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Statistical Study of the Magnetic Field in Solar Filaments

Abstract Author(s): Yoichiro Hanaoka, T. Sakurai, IRMag Group

Institution(s): National Astronomical Observatory of Japan

Presentation: P2_036

Abstract

We carried out a statistical study of the magnetic field orientation in solar filaments based on our daily full-Sun, full-Stokes spectropolarimetric observations with the He I 10830 line. The analysis of more than 400 filaments revealed that the average direction of the magnetic field in filaments generally deviates from their axis by 10-30 degrees, and the direction of the deviation strongly depends on the hemisphere where the filaments appear. This hemispheric pattern is consistent with the well-known chirality pattern of the fine structure seen in filaments, and for some of the filaments we can confirm that the magnetic field direction is parallel to that of the fine structure in the filaments. Filaments sometimes erupt as a part of CMEs, and therefore, magnetic field information of filaments taken with the full-Sun observation is important from the viewpoint of the space weather.

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H-alpha absorption profile of erupting filament

Abstract Author(s): Huang Yuwei, Kiyoshi Ichimoto

Institution(s): Kyoto University

Presentation: P2_037

Abstract

H-alpha is the most important chromospheric line in solar observation, especially in prominence and filament observation. However, as pointed out by Hyder and Lites (1970), H-alpha Doppler brightening and Lyman-alpha dimming effects due to apparent Doppler shifts will strongly modify the H-alpha emission profile of prominence, and these Doppler velocity dependency was demonstrated quantitatively using non-LTE techniques by Heinzel and Rompolt (1987). In contrast to Heinzel and Rompolt (1987), whose hydrogen energy levels belonging to the same principal quantum number n are degenerate, we developed a non-LTE radiative transfer code which includes the consideration of forbidden transition between levels with different angular momentum J, to investigate the behavior of the absorption profile of erupting filament. Furthermore, we compare our quantitative analysis with the filament eruption data obtained by the Solar Dynamic Doppler Imager (SDDI), a new instrument developed in Hida-observatory to monitor full solar disk in H-alpha with a wavelength range of ± 9 Å, to investigate the dynamic motion of erupting filaments.

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Observation of the Streaming-Kink Instability in the Solar Prominence

Abstract Author(s): Heesu Yang

Institution(s): Korea Astronomy and Space Science Institute

Presentation: P2_038

Abstract

Many solar prominences end their lives through eruptions or abrupt disappearances that are associated with the thermal or dynamical instabilities. Such instabilities are very important at the Sun because they may have a big responsiblility for energy transport and conversion. We present a clear observation of the Streaming-Kink Instability (SKI) taking place in a solar prominence on the limb observation using the Hα Lyot filter installed at the New Vacuum Solar Telescope, Fuxian Solar Observatory in Yunnan, China. Beside the prominence, plasma floated up from the chromosphere and streamed parallel to the limb. The plasma stream is accelerated to the velocity of about 20 - 60 km s^{-1} and then undulated. We found that the 2 and 5-size vortices formed in the stream, and they floated along the stream and then broken up. After breaking of the 5-size vortex, plasma appeared to eject from the stream in the AIA images. We attribute the phenomenon to the SKI triggered by the velocity shear between the stream guided by the magnetic field and the surrounding media. The plasma ejection may indicate a considerable transport of the prominence material into the upper layer by magnetic reconnection at the vortices.

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Doppler Characteristics and Dynamics Processes of the Moreton Wave on 2014 March 29

Abstract Author(s): Denis P. Cabezas, Ayumi Asai, Satoru UeNo, Kiyoshi Ichimoto, Kazunari Shibata

Institution(s): Kyoto University

Presentation: P2_039

Abstract

Shock waves are fundamental physical processes in solar and stellar plasmas. Their properties and effects have widely been discussed in the framework of magneto-hydrodynamics (MHD) theory. In the Suns chromosphere a large-scale wavelike propagating disturbance, known as Moreton wave, occasionally happens in association with strong flares and coronal mass ejections (CMEs). In this work we present a study of the Moreton wave that accompanied an X-class flare on 2014 March 29. This event was successfully detected in multiwavelength imaging in Ha line by the Flare Monitoring Telescope (FMT) installed in Peru. We made use of FMT wing (Ha-0.8A and Ha+0.8A) observations to investigate the Doppler features of the Moreton wave, as well as its dynamic and the shock characteristics. The Doppler analysis clearly shows a downward motion of the chromospheric plasma, this might indicate plasma compression due to the wave propagation in the corona. In addition, the coronal plasma responses are also examined, since fast-mode wave propagating in the corona was associated with the event under study. We use Hinode XRT data to derive the temperature and the plasma condition as the wave propagates in the corona. We complement our investigation with the SDO/AIA data, from which the differential emission measure (DEM) has been extracted.

Session 3

Flare, ejection and space weather

Modelling of superactive delta sunspots in the Sun

Abstract Author(s): Piyali Chatterjee

Institution(s): Indian Institute of Astrophysics

Presentation: O3_022I

Abstract

Active regions (AR) appearing on the surface of the Sun are classified into alpha, beta, gamma, and delta by the rules of the Mount Wilson Observatory, California on the basis of their topological complexity. Amongst these, the delta-sunspots are known to be super-active and produce the most X-ray flares. Here, we present results from a simulation of the Sun by mimicking the upper layers and the corona, but starting at a more primitive stage than any earlier treatment. We find that this initial state consisting of only a thin sub-photospheric magnetic sheet breaks into multiple flux-tubes which evolve into a colliding-merging system of spots of opposite polarity upon surface emergence, similar to those often seen on the Sun. The simulation goes on to produce many exotic delta-sunspot associated phenomena: repeated flaring in the range of typical solar flare energy release and ejective helical flux ropes with embedded cool-dense plasma filaments resembling solar coronal mass ejections. Further, we demonstrate that these simulated solar flares can be predicted in time and height in solar atmosphere using the method of weighted magnetic gradient which uses the distance between barycenters of two opposite polarities in the active region as a precurser for solar flares.

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Spectral features of an X-shaped flare as implications for energy release and dynamics in the flare atmosphere

Abstract Author(s): Mingde Ding, Ying Li, Jie Hong

Institution(s): Nanjing University, Purple Mountain Observatory

Presentation: O3_023

Abstract

We present the spectral observations of an X-shaped flare on 2014 November 9 that was observed by IRIS. The flare shows some peculiar spectral features including broadened Si V line wings at the X-point and a wholly red-shifted Si V line at the flare ribbon, which are possible signatures of direct energy release (magnetic reconnection) in a lower site and the dynamic response of the chromosphere to an electron beam heating. We make some preliminary radiative hydrodynamic simulations to check the origin of the spectral features.

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High Resolution Flare Observations with the 1.6 m NST at BBSO

Abstract Author(s): Haimin Wang, Hossein Safari, Nasibe Alipour, Michael S. Wheatland

Institution(s): New Jersey Institute of Technology, University of Zanjan, The University of Sydney

Presentation: O3_024K

Abstract

This talk presents some exciting new results of 1.6m Goode Solar Telescope (GST, formally named as NST) at Big Bear Solar Observatory (BBSO). I will report: (1) Flare ribbons and post-flare loops are observed in the scale of around 100 to 200 km. (2) the sudden flare-induced rotation of a sunspot. It is clearly observed that the rotation is non-uniform over the sunspot: as the flare ribbon sweeps across, its different portions accelerate at different times corresponding to peaks of flare hard X-ray emission. The rotation may be driven by the surface Lorentz-force change due to the back reaction of coronal magnetic restructuring and is accompanied by a downward Poynting flux. (3) We found the clear evidence that electron streaming down during a flare can induce extra transient transverse magnetic field that cause apparent rotation only at the propagating ribbon front. Sometimes they are associated with so called negative flares in HeI 10830 and D3 lines. (4) We found evidence that episodes of precursor brightenings are initiated at a small-scale magnetic channel (a form of opposite polarity fluxes) with multiple polarity inversions and enhanced magnetic fluxes and currents, lying near the footpoints of sheared magnetic loops. The low-atmospheric origin of these precursor emissions is corroborated by microwave spectra. (5) Twisted magnetic flux ropes are observed and analyzed in comparison with NLFFF extrapolation.

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Blue asymmetry of the chromospheric Mg II lines in a solar flare

Abstract Author(s): Akiko Tei, Takahito Sakaue, Takenori J. Okamoto, Tomoko Kawate, Satoru UeNo, Ayumi Asai, Kiyoshi Ichimoto, Kazunari Shibata

Institution(s): Kyoto University, National Astronomical Observatory of Japan , Japan Aerospace Exploration Agency

Presentation: O3_025

Abstract

In solar flares, dynamic phenomena occur in the chromosphere, while the details of the dynamics and the mechanism of energy injection are still unknown. Chromospheric observations of flares lead us to a new understanding of heating mechanisms of the chromosphere, energy transports, and energy release processes in the corona. We performed coordinated observations of AR 12205, which produced a C-class flare on 2014 November 11, with IRIS and DST at Hida Observatory. Using spectral data by IRIS and DST, we investigated the temporal and spatial evolution of the flare in the chromosphere. We detected a flare ribbon apparently moving 9 along the IRIS slit with a propagation speed of about 31 km/s during the impulsive phase of the flare. The flare kernels showed intensity enhancement in the blue wing (blue asymmetry) prior to a drastic change of the intensity in the red wing (red asymmetry) only in the Mg II h line. At the locations that the flare ribbon passed over, the blueshifts with a speed of up to 17 km/s lasted for about 40 s and were followed by the strong redshifts with a speed of 58 km/s for 50-100 s. We suggest that the observed phenomenon is explained by an upflow of the chromospheric-temperature (cool) plasma lifted up by the evaporated (hot) plasma owing to the penetration of non-thermal electrons into the deep chromosphere.

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Analysis of Hard X-ray and Microwave Observations with Fokker-Planck Model in Solar Flares

Abstract Author(s): Yu-Lun Liou, Ya-Hui Yang

Institution(s): National Central University

Presentation: O3_026

Abstract

The electrons accelerated to several MeV during flare impulsive phase are believed to be responsible for the non-thermal emissions in hard X-ray (HXR) and microwave observations. In order to understand the behaviors of these non-thermal electrons, we analyze a M2.3 flare on 2014 September 23 by combining the RHESSI and Nobeyama measurements. The microwave peak is observed to be 20s later than HXR peak, which is different from the typical delay time of several seconds presented in most previous events. The HXR sources are appeared as double chromospheric footpoints in RHESSI CLEAN maps with the soft-hard-harder (SHH) spectral profile, while the microwave emission is shown as loop-top source in Nobeyama 17 GHz images with the SHH pattern. In addition, microwave spectrums are harder compared with the HXR spectrum. By solving the spatially homogeneous Fokker-Planck equation with different energy, we further calculate the spectral indices of precipitating and trapping non-thermal electrons for HXR and microwave emission respectively to explain the trapped effect on the high-energy electron spectrum.

Models of diffusive and nondiffusive transport of solar energetic particles

Abstract Author(s): Yuri Litvinenko

Institution(s): University of Waikato

Presentation: O3_027

Abstract

When energetic particles propagate in interplanetary space following powerful solar flares, the particles interact with a turbulent interplanetary magnetic field. As a result, the transport of the solar energetic particles is diffusive. A diffusion equation for the particle density is known to approximate the Fokker-Planck equation when the particle pitch angle distribution is weakly anisotropic. The evolution of strongly anisotropic particle distributions on time scales that are shorter than or comparable with a characteristic scattering time leads to nondiffusive behavior. The nondiffusive transport of the solar energetic particles has been a subject of much recent research interest. I will review possible refinements of the basic diffusion model and present a detailed side-by-side comparison of an evolving particle density profile, predicted by the telegraph and hyperdiffusion models in the context of a physically meaningful initial-value problem. I will also compare the predictions with the solution based on the Fokker-Planck equation and discuss the applicability of the approximations to the transport of strongly anisotropic particle distributions in interplanetary space.

Particle-In-Cell, fully kinetic scale modeling of solar radio bursts

Abstract Author(s): David Tsiklauri

Institution(s): Queen Mary University of London

Presentation: O3_028

Abstract

Basic physics of the radio emission mechanisms of solar type III bursts will be briefly reviewed. A case will be made for alternatives to plasma emission, such as non-gyrotropic electron beam [1-3]. Further self-consistent particle-in-cell simulations of fundamental and harmonic radio plasma emission mechanisms will be presented [4]. Also, particle-in-cell simulations of the relaxation of electron beams in inhomogeneous solar wind plasmas [5] will presented, alleviating the problem of the beams travelling large interplanetary distances without experiencing quasilinear relaxation.

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CME kinematics and geoeffectiveness

Abstract Author(s): Nat Gopalswamy

Institution(s): NASA Goddard Space Flight Center

Presentation: O3_029K

Abstract

Coronal mass ejections (CMEs) are one of the major sources of space weather because they cause solar energetic particle (SEP) events and major geomagnetic storms. While SEP acceleration depends on the shock-diving capability of CMEs, geomagnetic storms depend on the magnetic structure of CMEs and/or the shock sheath. In particular, the CME magnetic field needs to have a southward component that reconnects with Earths magnetic field. Both the space weather phenomena depend on CME kinematics: fast and wide CMEs drive shocks and carry intense magnetic fields. When CMEs attain high speeds is also important: high-speeds near the Sun (within a couple of solar radii) results in shock formation in high magnetic field regions, leading to efficient acceleration of CMEs. On the other hand CMEs remaining fast close to Earth result in intense geomagnetic storms, provided the magnetic field they carry has a southward component. The magnetic and particle environment of CMEs can also significantly affect their space weather consequences. For example, CMEs can be deflected towards and away from the Sun-Earth line that can enhance or reduce the geoeffectiveness of CMEs. This talk will highlight the role played by CME kinematics in understanding their space weather consequences.

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Observations of the CME shocks and the production of SEPs

Abstract Author(s): Zigong Xu, Chuan Li

Institution(s): Nanjing University

Presentation: O3_030

Abstract

The acceleration mechanism of SEPs is still a hot debated problem especially during the onset of large SEPs. Here, we present a case study on 2011-08-09 SEP event to clarify its acceleration source and an 3D statistical study including 19 SEPs in order to know where and how the particles are released. Based on the remote-sensing and in-situ observations as well as the DSA theory, we found that the theoretical par-ticle spectrum was comparable to a observational one and a weak correla-tion was obtained between the electrons producing HXR and the in-situ observed electrons. These results indicated that the coronal shock wave was the potential accelerator of SEPs. In statistical study, we obtained the electrons and protons solar release and compare to the 3D CME struc-tures. It is found the electrons are released 8 minutes earlier (0.5 Rs lower) than the protons.

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The dynamic character of the solar wind, and its implications for Solar Probe Plus and Solar Orbiter

Abstract Author(s): Hsiu-Shan Yu, B. V. Jackson, A. Buffington, P. P. Hick

Institution(s): University of California

Presentation: O3_031

Abstract

Ulysses Solar wind observations show the polar regions to be uniform and non-structured during solar minimum. However, as shown by analyzing LASCO C2 and STEREO SECCHI COR2 coronagraph images, and using UCSD-developed correlation-tracking techniques, the observed solar wind outflow is not a static well-ordered motion, but instead shows highly-variable speed structures. The high-speed polar structures are associated with slightly brighter (and also patchy) coronal structures. When these patches are averaged with the slower surrounding corona, solar wind acceleration with distance is observed consistently across the polar coronal hole regions. This acceleration with distance is also consistent with the outward flow speed observed in polar regions determined from mass flux considerations and coronagraph polarization brightness. The preliminarily results of the corona velocity determination using HI-1A images also reveal the variable nature of the solar wind in the lower latitude regions. From this we conclude that Solar Probe Plus and Solar Orbiter will not only measure these structures in-situ as a variable wind, but they may also determine the key abundances and magnetic fields associated with these structures and how these parameters relate to the solar wind acceleration seen in coronagraph and heliospheric observations.

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Project for Solar-Terrestrial Environment Prediction (PSTEP)

Abstract Author(s): Kanya Kusano

Institution(s): Nagoya University

Presentation: O3_033K

Abstract

Project for Solar-Terrestrial Environment Prediction (PSTEP) is a Japanese nation-wide research collaboration, which was launched with the support of a Grant-in-Aid for Scientific Research on Innovative Areas from MEXT/Japan. PSTEP aims to develop a synergistic interaction between predictive and scientific studies of the solar-terrestrial environment and to establish the basis for next-generation space weather forecasting using the state-of-the-art observations and the advanced physics-based modeling. In this paper, we will explain the basic strategy of PSTEP and the new results of flare prediction study of PSTEP. Recently, Ishiguro and Kusano (2017, ApJ) clarifies that the double-arc electric current loop, which can be formed by the tether-cutting reconnection, can produce a new type of instability called double-arc instability (DAI). The stability analysis of the DAI suggests that the new parameter kappa may represent the critical condition of DAI. Therefore, we have analyzed the correlation of a new parameter kappa. Also, we analyzed the statistical property of magnetic twist of various active regions using SDO/HMI data and the nonlinear force-free field extrapolation technique to devise a new way to evaluate the criticality of the DAI. We will discuss the prospects of physics-based new flare prediction based on those results.

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Development of space weather forecast models based on statistics and deep-learning methods

Abstract Author(s): Yong-Jae Moon

Institution(s): Kyung Hee University

Presentation: O3_034I

Abstract

For the last decade, we have developed several space weather (solar flare, coronal mass ejections, solar proton event, and geomagnetic storm) forecast models based on statistics. In this talk we will review our main results and discuss scientific implications. First, we have examined solar flare (R) and CME occurrence probabilities depending on sunspot McIntosh classification, its area change, and solar cycle phase. We find that sunspot area and its increase (a proxy of flux emergence) greatly enhance solar flare and CME occurrence rates for several sunspot classes. Second, we have developed a solar proton event (S) forecast model depending on flare parameters (flare strength, duration, and longitude) as well as CME parameters (speed and angular width). We find that solar proton event probability strongly depends on these parameters. Third, we have developed an empirical storm (G) forecast model to predict the probability and strength of a storm using halo CME-Dst storm data. Fourth, we have developed a full ice-cream cone model for CME 3-D parameters using single coronagraph data and found that the derived 3-D parameters are similar to those from stereoscopic methods using multi-spacecraft. Recently we are developing a set of flare occurrence model based on deep learning methods such as convolution neural network using solar magnetograms and EUV images. These models show a very remarkable improvement of skill scores relative to the conventional ones.

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Space weather forecast using background information generated by superposed observations over previous Carrington cycles

Abstract Author(s): Rok-Soon Kim, J.-Y. Park, J.-H. Baek, I.-H. Cho, B.-G. Kim

Institution(s): Korea Astronomy and Space Science Institute, Kyung Hee University, Chungnam National University

Presentation: O3_035

Abstract

It is well known that there are good relations of coronal hole (CH) parameters such as the size, location, and magnetic field strength to the solar wind conditions and the geomagnetic storms. Especially in the minimum phase of solar cycle, CHs in mid- or low-latitude are one of major drivers for geomagnetic storms, since they form corotating interaction regions (CIRs). Space Weather Research Center (SWRC) in Korea Astronomy and Space Science Institute (KASI) has done daily forecast of solar wind speed and Dst index from 2010. Through years of experience, we realize that the geomagnetic storms caused by CHs have different characteristics from those by CMEs. Therefore, we analyze the characteristics and causality of the geomagnetic storms by the CHs and solar activities statistically. As the results, we show the different trends of the solar wind parameters and geomagnetic indices depending on the degree of solar activities and suggest space weather forecast using background information generated by superposed observations over previous Carrington cycles to improve forecasting capability.

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Evidence of electron cyclotron maser emission at decimetric frequency: First high cadence GMRT observations

Abstract Author(s): Susanta Kumar Bisoi, H. S. Sawant, P. Janardhan, Y. Yan, L. Chen , S. Srivastava, G. Gao

Institution(s): National Astronomical Observatories, National Institute for Space Research, Physical Research Laboratory, Yunnan Observatories

Presentation: O3_036

Abstract

We report, for the first time, an investigation of solar flare activity, using high cadence (0.5 s) observations at the frequency of 610 MHz with the Giant Meterwave Radio Telescope (GMRT), India. We mapped all the radio burst events at GMRT/610 MHz associated with the two solar flares (a C1.4 and a M1.0 flare), that erupted on 20 June 2015, and a coronal mass ejection (CME) aftermath the M1.0 flare. Strong 610 MHz radio bursts were identified, near the flaring active region, during the M1.0 flare maximum and after the onset of the CME. In contrast, during the C1.4 flare maximum, a strong 610 MHz radio burst was rather identified near the south-east solar limb, located far away from the flaring active region, where no corresponding coronal features were seen. The 610 MHz limb radio burst showed a good temporal correspondence with a metric type-III burst as identified by the Solar Broadband Radio Spectrometer at Yunnan Astronomical Observatory (SBRS/YNAO), China. We carried out a multi-wavelength analysis to locate source regions of both decimetric and metric bursts, and also found that the decimetric bursts were produced by the electron cyclotron maser emission process in opposite to the generally observed coherent plasma emission process at 610 MHz.

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The First ALMA Observation of a Solar Plasmoid Ejection from an X-Ray Bright Point

Abstract Author(s): Masumi Shimojo, Hugh S. Hudson, Stephen M. White, Timothy S. Bastian, Kazumasa Iwai

Institution(s): National Astronomical Observatory of Japan , Grasgow University, AFRL, NRAO, Nagoya University

Presentation: O3_037

Abstract

Eruptive phenomena are important features of energy releases events, such solar flares, and have the potential to improve our understanding of the dynamics of the solar atmosphere. The 304 A EUV line of helium, formed at around 10^5 K, is found to be a reliable tracer of such phenomena, but the determination of physical parameters from such observations is not straightforward. We have observed a plasmoid ejection from an X-ray bright point simultaneously with ALMA, SDO/AIA, and Hinode/XRT. This paper reports the physical parameters of the plasmoid obtained by combining the radio, EUV, and X-ray data. As a result, we conclude that the plasmoid can consist either of (approximately) isothermal $\sim 10^5$ K plasma that is optically thin at 100 GHz, or a $\sim 10^4$ K core with a hot envelope. The analysis demonstrates the value of the additional temperature and density constraints that ALMA provides, and future science observations with ALMA will be able to match the spatial resolution of spaceborne and other high-resolution telescopes.

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Sigmoidal Hot Channel Before Solar Eruptions

Abstract Author(s): Jeongwoo Lee, Bernhard Kliem, Stephen M. White, Chang Liu, Satoshi Masuda

Institution(s): Seoul National University, University of Potsdam, Air Force Research Laboratory, New Jersey Institute of Technology, Nagoya University

Presentation: O3_038

Abstract

We present an excellent piece of evidence that a flux rope can exist before a flare in the form of hot channel as found from the observations of the 2015 June 21 flare with the Solar Dynamics Observatory (SDO) and the Nobeyama Radioheliograph (NoRH). The SDO EUV images and the extrapolated nonlinear force-free field show that the impulsive flare results from the eruption of highly sheared low-lying flux and remains confined, but nevertheless spawns a vertical current sheet, where magnetic reconnection creates flare ribbons and loops and a sigmoidal hot channel. Until the second gradual flare, magnetic reconnection continues at a low rate and the sigmoid's elbows expand, while its center remains stationary under the erupted but still confined flux. The reconnection during and after the confined flare acts as tether-cutting reconnection, leading the flux rope to the point of instability and subsequent full eruption, seen as an accelerated rise of the entire hot channel and the formation of a fast halo coronal mass ejection (CME). The hot channel can only be interpreted as a magnetic flux rope, and this event is one of the clearest cases so far showing the existence of a flux rope prior to an eruption.

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Superflares on Solar Type Stars

Abstract Author(s): Daisaku Nogami

Institution(s): Kyoto University

Presentation: O3_040I

Abstract

Superflares are defined as flares which are over 10 times more energetic ($> 10^{33}$ erg) than largest flares ever observed on the Sun, and many superflares have been found on many solar-type stars, i.e. G-type main sequence stars in the Kepler-spacecraft data. Statistical analyses indicate that the frequency distribution to the flare energy of the superflare is almost consistent with that of the Sun. Many of superflare stars show quasi-periodic variations with timescales of about 1 to 30 days. Spectroscopic measurements of the projected rotation velocity suggest that these variations are due to rotation of superflare stars with large starspots. The size distribution of starspots shows the power-law distribution which is on the same line of the size distribution of relatively large sunspots. The frequency-energy distributions for flares originating from spots with different sizes are the same for solar-type stars with superflares and the Sun. These results suggest that the magnetic activity on solar-type stars with superflares and that on the Sun is caused by the same physical processes. Long term monitoring of the chromospheric activity and research on possible coronal mass ejections accompanying with superflares will give us an insight on the effects of superflares on the planetary environment, and possible extreme space weather events on the Earth.

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Spectroscopic observations of solar-type superflare stars

Abstract Author(s): Yuta Notsu, Hiroyuki Maehara, Suzanne Hawley, Satoshi Honda, Shota Notsu, Kosuke Namekata, Kai Ikuta, Daisaku Nogami, Kazunari Shibata

Institution(s): Kyoto University, National Astronomical Observatory of Japan , University of Washington, University of Hyogo

Presentation: O3_041

Abstract

Superflares are flares that release total energy 10-10^4 times greater than that of the biggest solar flares ($\sim 10^{32}$ erg). Recent Kepler-space-telescope observations found more than 1000 superflares on a few hundred solar-type stars. Such superflare stars show quasi-periodic brightness variations. Rotation period and starspot coverage can be estimated from these brightness variations. However, spectroscopic observations are needed to investigate whether the variation is really due to the rotation, and whether superflares can occur on ordinary single stars similar to our Sun. Then we have carried out spectroscopic observations for 65 solar-type superflare stars with Subaru/HDS and Apache Point Observatory 3.5m telescope. As a result, more than half of the target stars show no evidence of binarity, and the atmospheric parameters are in the range of solar-type stars. The detailed analyses show that (1) the projected rotational velocities (v sin i) are consistent with the rotational velocities estimated from the brightness variations, (2) there is a correlation between the brightness variation amplitude and the intensity of Ca II lines. In particular, the latter correlation suggests that as for starspot coverage, results from Kepler and those from spectroscopic observations are consistent. These support that the brightness variation discussed above is explained by the rotation of a star with large starspots.

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Statistical Study of Solar White-light Flares and Comparisons with Superflares on Solar-type Stars

Abstract Author(s): Kosuke Namekata, Takahito Sakaue, Kyoko Watanabe, Ayumi Asai, Hiroyuki Maehara, Yuta Notsu, Satoshi Honda, Shota Notsu, Takako T. Ishii, Kai Ikuta, Daisaku Nogami, Kazunari Shibata

Institution(s): Kyoto University, National Defense Academy of Japan, National Astronomical Observatory of Japan , University of Hyogo

Presentation: O3_042

Abstract

Recently, many superflares on solar-type stars have been discovered as white-light flares. The statistical study found a correlation between their energies (E) and durations (t): $t \propto E^{0.39}$, similar to those of solar hard/soft X-ray flares: $t \propto E^{0.2-0.33}$. This indicates a universal mechanism of energy release on solar and stellar flares, i.e., magnetic reconnection. We here carried out a statistical research on 50 solar white-light flares with SDO/HMI and examined the correlation between the energies and durations. As a result, the t-E relation on solar white-light flares ($t \propto E^{0.42}$) is similar to that on stellar superflares ($t \propto E^{0.39}$). However, the durations of stellar superflares are one order of magnitude shorter than those expected from solar white-light flares. We present the following two interpretations for the discrepancy. (1) In solar flares, the cooling timescale of white light may be longer than the reconnection one, and the decay time of solar white-light flare can be determined by the cooling time. (2) The distribution can be understood by applying a scaling law ($t \propto E^{1/3}B^{-5/3}$) derived from the magnetic reconnection theory. In this case, the observed superflares is expected to have 2-4 times stronger magnetic field strength than solar flares.

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Continuum emission from solar flares

Abstract Author(s): Petr Heinzel

Institution(s): Czech Academy of Sciences

Presentation: O3_043

Abstract

I will review recent advances in observations and modeling of the continuum emission from solar flares. In the optical range the continuum enhancement is traditionally called the white-light flare (WLF), and depending on the particular flare, the WLF intensity may consist of both the photospheric as well as chromospheric components. The latter one manifests itself also in the blue part of the spectrum, behind the Balmer limit at 364.6 nm. Despite of many attempts, the Balmer continuum was hard to detect from the ground and only a few decisive detections exist. However, recent flare observations by IRIS in its NUV channel have revealed a significant continuum enhancement which was interpreted as the hydrogen Balmer recombination continuum. In the optical range, Paschen recombination continuum should thus be also detectable. On the other hand, recent SDO/HMI detection of the WLFs above the limb seems to be due to Paschen-continuum emission. I will also present recent radiation-hydrodynamical (RHD) models of the electron-beam heated flares, computed with the FLARIX code developed at the Ondrejov Observatory. Numerical simulations show that at the flare peak the radiation losses from the chromosphere are dominated by the Balmer continuum and thus a reliable detection of this continuum (and Paschen one) represents a strong constraint on the flare modeling and diagnostics.

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Recent scientific results of 1 m New vacuum solar telescope at Fuxian Lake Observatory

Abstract Author(s): Xiaoli Yan

Institution(s): Yunnan Observatories

Presentation: P3_040

Abstract

One-metre New Vacuum Solar Telescope (NVST) located at the Fuxian Lake solar observatory of Yunnan Observatories is one of three observational systems that can observe fine structure of the Sun in the world. It is a largest solar telescope in China. Its space resolution is better than 0.2 arc-seconds and time resolution can reach one second. This telescope can observe different layers of the Sun, e.g., photosphere, chromosphere. In recent year, a series of original and innovative results are obtained on the small-scale activities and fine structure of solar atmosphere based on NVST data. In this talk, I will present several new results on small-scale magnetic reconnection, filament formation and eruptions observed by NVST.

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The FMT at KSU as part of the CHAIN project with preliminary results

Abstract Author(s): Ahmed Ibrahim, S. UeNo, Mohamad Elnawawy, Mohmad Rezk, Ayman Kordi, Husen Trabulsy, Aboazza Elmohammadi

Institution(s): King Saud University, Kyoto University

Presentation: P3_041

Abstract

A new flare monitoring telescope (FMT) is installed at King Saud University (KSU), Kingdom of Saudi Arabia since November 2015. This telescope is the most recent contributor to the CHAIN project. It is a worldwide project aims to make continuous H-alpha imaging network. There are three members contribute in this project: one at Hida. The Solar Magnetic Activity Research Telescope (SMART) in Japan, the second FMT at Peru and our FMT is the third a possible fourth one is planned in Algeria. The FMT can be used to investigate many of the explosive solar activity in particular flare events. The FMT has five solar imaging telescopes that observe simultaneously the full solar disk at different wavelengths plus or minus the central H-alpha absorption line. Hence the FMT can be useful to get three-dimensional results of the velocity of the moving events during its evolution on the solar disk. It is hope to be able to monitor solar flare events and the other erupting solar phenomena and investigate their correlation with CME and their impact on the space weather. Using our FMT we were able to get solar observations for more than one year from November 2015 to Nov. 2016. The most interesting raw data results are presented.

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A Circular White-Light Flare with Impulsive and Gradual White-Light Sources

Abstract Author(s): Qi Hao, Kai Yang, Xin Cheng, Yang Guo, Cheng Fang, Mingde Ding, Pengfei Chen, Zhen Li

Institution(s): Nanjing University

Presentation: P3_042

Abstract

Solar flares are one of the most energetic eruptive events in the solar system that have a great impact on space weather. White-light flares are the flares that have emissions visible in the optical continuum. They are thought to be rare and among the most energetic flaring events, which pose the most stringent requirements in energy transport and heating in the lower atmosphere. Here we for the first time report a rare circular white-light flare that occurred on 2015 March 10 and was well observed by the Optical and Near-infrared Solar Eruption Tracer (ONSET) and Solar Dynamics Observatory(SDO). The white-light emission of the flare consists of two components, one being impulsive and closely following the impulsive increase of the hard X-ray (HXR) flux, and the other being gradual without obvious HXR sources. Especially, the gradual source is a new finding, which requires a mechanism other than the bombardment by an electron beam as in the classical model. A possible mechanism is the quasi-separatrix layer reconnection or the large-scale Alfven waves transporting the energy from the reconnection site to the lower atmosphere.

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A white-light flare triggered by flux emergence in NOAA active region 11476

Abstract Author(s): Yongliang Song, Hui Tian

Institution(s): Peking University

Presentation: P3_043

Abstract

We report a white-light flare SOL2012-05-10T04:11 (M5.7) in NOAA active region 11476. Using data from SDO, ONSET, NoRH, RHESSI and GOES, we investigated the relationship between the white-light enhancement and emission of hard X-ray and microwave. Our result supports the back-warming model. Just prior to the flare, we found clear evidence of flux emergence at the location of the white light enhancement. We also reconstructed the magnetic field configuration before the flare through a nonlinear force-free field (NLFFF) extrapolation method, and found a fan-spine topology. Reconnection in such a topology may be responsible for the occurrence of this white light flare.

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Cold Solar Flares Observed with Nobeyama Radioheliograph

Abstract Author(s): Satoshi Masuda

Institution(s): Nagoya University

Presentation: P3_044

Abstract

When a solar flare takes place, magnetic energy is impulsively released, and it is converted to other kinds of energy such as thermal energy (plasma heating), kinetic energy (mass ejection), and energy of high-energy particles (particle acceleration). The ratio of these three energies seems different in each solar flare. What controls the energy conversion ratio? In order to solve this problem, one of the effective ways is an analysis of some extreme flares such as thermal-rich flares and purely nonthermal flares. Then, we focused on so-called cold flare which shows significant nonthermal emissions with relatively very small amount of thermal emissions. A case study was done for a cold solar flare occurring on 10 March 2011 observed with Nobeyama Radioheliograph (Masuda et al. 2013). The characteristics of this flare were short duration and very compact size. From these facts, we concluded that the magnetic field of the loop top region might be very intense. To confirm this, we analyzed a few additional cold flares. Their characteristics seem to be the same as the previous event. We discuss how cold flares are produced based on this result.

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The transition from circular to nonstandard two-ribbon flares due to magnetic flux ropes bifurcation

Abstract Author(s): Ze Zhong, Yang Guo, Mingde Ding

Institution(s): Nanjing University

Presentation: P3_045

Abstract

Magnetic flux ropes play a key role in understanding solar flares in the solar atmosphere. In this work, we investigate the magnetic field structure of active region NOAA 12268 over thirty six hours from 2015 January 29 to 30, during which time three M-class and three C-class flares were triggered without coronal mass ejections (CMEs). With the evolution of the active region, the ultraviolet emissions displayed the flare ribbons were transformed from the circular to the multiple ribbons. We find a two-stage progress from a series of three-dimensional nonlinear force-free field with boundary conditions using the vector magnetic field data observed by the Helioseismic and Magnetic Imager. In the first stage, sheared arcades transformed into flux ropes through magnetic reconnection. And then, the flux ropes began to bifurcate with the appearance of multi-ribbon flares. The twist of the flux ropes gradually accumulated and eventually led to instability. We also identify that a large-scale quasi-separatrix layer (QSL) associated with three-dimensional null points by the quadrupolar magnetic field always existed stably during thirty six hours and another three topological structures coexisted when the flux ropes took shape: bald patch, hyperbolic flux tube and QSL around the flux rope. All these topological structures explain the behavior of the flares.

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Explosive Chromospheric Evaporation Driven by Nonthermal Electrons around One Footpoint of a Solar Flare Loop

Abstract Author(s): Dong Li

Institution(s): Purple Mountain Observatory

Presentation: P3_046

Abstract

We explore the temporal relationship between microwave/hard X-ray (HXR) emission and Doppler velocity during the impulsive phase of a solar flare on 2014 October 27 (SOL2014-10-27) that displays a pulse on the light curves in the microwave (34 GHz) and HXR (25-50 keV) bands before the flare maximum. Imaging observation shows that this pulse mainly comes from one footpoint of a solar flare loop. The slit of the Interface Region Imaging Spectrograph (IRIS) stays at this footpoint during this solar flare. The Doppler velocities of Fe XXI 1354.09 Å and Si IV 1402.77 Å are extracted from the Gaussian fitting method. We find that the hot line of Fe XXI 1354.09 Å ($\log T \sim 7.05$) in the corona exhibits blueshift, while the cool line of Si IV 1402.77 Å ($\log T \sim 4.8$) in the transition region exhibits redshift, indicating explosive chromospheric evaporation. Evaporative upflows along the flare loop are also observed in the AIA 131 Å image. To our knowledge, this is the first report of chromospheric evaporation evidence from both spectral and imaging observations in the same flare. Both microwave and HXR pulses are well correlated with the Doppler velocities, suggesting that the chromospheric evaporation is driven by nonthermal electrons around this footpoint of a solar flare loop.

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Case study of chromospheric evaporation at flare ribbons by IRIS

Abstract Author(s): Yu Chen

Institution(s): National Central University

Presentation: P3_047

Abstract

Chromospheric evaporation is thought to be the consequence of energy deposition on the chromosphere leading to the plasma expansion into the flaring loop. In general, the evaporation can be classified into the explosive type which is driven by non-thermal electron beam and the gentle type due to thermal conduction. We would like to characterize the evaporation flow at flare ribbons based on the imaging and spectral data of IRIS. The velocity of plasma flows is retrieved from a single or double Gaussian fitting to the profiles of Fe XXI and Si IV emission lines. By combining with the SDO/AIA and RHESSI observations, we will also discuss the temporal correlation with X-ray lightcurves, the spatial correspondence with X-ray sources, and the consistency of Neupert effect in our studied events.

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Apparent Motion of Flaring Ribbons Observed by SDO/AIA

Abstract Author(s): Yun-Chen Yang, Ya-Hui Yang

Institution(s): National Central University

Presentation: P3_048

Abstract

To understand the role of magnetic reconnection on flare evolution, we investigate the apparent motions of two-ribbon structures seen in SDO/AIA 1600 Å images systematically. The M- and X-class flares with clear two ribbons straddling the magnetic polarity inversion lines (PILs) with relatively simple configuration are selected in this study. We estimate the motion speed along the corresponding PIL (namely, Vpara) and the separation speed away from the PIL (namely, Vper). We attempt to characterize the evolution of reconnection or energy release process during major flares by examining different types of ribbon motions statistically. The comparison with other flare-related signatures will also be discussed.

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Spectroscopic observation of a loop-top source of an M1.3 limb solar flare

Abstract Author(s): Kyoung-Sun Lee, Hirohisa Hara, Shinsuke Imada, Kyoko Watanabe

Institution(s): National Astronomical Observatory of Japan, Nagoya University, National Defense Academy

Presentation: P3_049

Abstract

We have investigated an M1.3 flare on 2014 January 13 around 21:48 UT observed at the west limb using the Hinode, SDO, and STEREO. Especially, the Hinode/EIS scanned the flaring loop covering the loop-top region over the limb, which is a good target to investigate the dynamics of the flaring loop with their height. Using the multi-wavelength observations from the Hinode/EIS and SDO/AIA, we found a very hot emission above the loop-top observed in Fe XXIV (94Å channel). Measuring the intensity, Doppler velocity and line width for the flaring loop, we found that hot emission observed at the cusp like shape of loop-top region which shows strong redshift about 500 km/s and strong enhancement of the non-thermal velocity (line width enhancement) larger than 100 km/s. Combining with the STEREO observation, we also discuss the 3D structure and velocity distribution of the loop-top region.

Observational Analysis of the Fine Structure and Formation of Solar Jets

Abstract Author(s): Yuandeng Shen

Institution(s): Yunnan Observatories

Presentation: P3_050

Abstract

Solar jets are heated plasma moving along open magnetic field lines, they have linear structures and usually associated with magnetic flux emergences and cancellations, micro-flares, and coronal mass ejections. Recent high temporal and spatial resolution data taken by SDO and NVST revealed a lot of new characteristics about the fine structure and formation mechanism of solar jets. This talk will briefly introduce some of our studies on the solar jets using the SDO and NVST observations, in which we studied the driving mechanism, fine structure, and their relations with mini-filament eruptions and coronal mass ejections.

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Properties of quasi-periodic pulsations in solar flares from a single active region

Abstract Author(s): Chloe E. Pugh, Valery M. Nakariakov, Anne-Marie Broomhall

Institution(s): University of Warwick

Presentation: P3_051

Abstract

Quasi-periodic pulsations (QPPs) have been found to be a common phenomenon in solar flares, and recent exoplanet surveys are also increasing the number of observations of stellar superflares showing QPPs. The growing number of high-quality flare observations means that statistical studies of QPPs in flares can be undertaken with the aim of better understanding this mysterious phenomenon. In this study we search for QPPs in a set of 181 solar flares from a single long-lived active region (NOAA 12192), making use of a highly robust method that accounts for data uncertainties and the possible presence of red noise. When applied to X-ray and microwave data from GOES, SDO/EVE, Fermi, Vernov and Nobeyama Radioheliograph this method reveals statistically significant QPP signals in 20% of the flares. We find no correlation of the QPP periods with active region properties determined using magnetogram data from SDO/HMI, suggesting that different QPP mechanisms act in different cases and/or that the small-scale structure of the flaring region is important.

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Analysis of Sunspot Proper Motion related to X-Class Solar Flare

Abstract Author(s): Lilis Mubasaroh

Institution(s): Bandung Institute of Technology

Presentation: P3_052

Abstract

Sunspots proper motion are the motion that already happen within correction from Solar differential rotation. This proper motion may can influence the phenomena in outer solar athmosphere, such as Solar flare. Flares occur suddenly when there are magnetic field reconnection that rooted from inner Solar atmosphere and rise until corona. Multi-wavelength observation has shown that some of Solar activity in corona increase significanly when the sunspot groups have complex form and rapid motions. This study will explain the analysis of sunspot proper motion in sunspot group during X-class Solar flare, measure its linear velocity, and construct the magnetic polarity of this sunspot gorup during observational time. X-class flare choosed because this flare have chance to be observed as white-light solar flare. Data used for this study was from SDO/HMI instruments which in continuum and magnetogram archive. This analysis have goal for flare prediction from knowing the sunspot activity such sunspots proper motion.

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Emergence Process of the Satellite Spots Leading to the Successive Flares

Abstract Author(s): Takahito Sakaue, Akiko Tei, Ayumi Asai, Satoru Ueno, Kiyoshi Ichimoto, Kazunari Shibata

Institution(s): Kyoto University

Presentation: P3_053

Abstract

We report the successive flares on 2014 November 10. They were involved with the satellite spots emergence around a delta-type sunspot in the decaying active region NOAA 12205. The satellite spots have been examined as the activator of an evolved active region, but there remain questions on their formation and connectivity with the associated pivotal sunspot. Further studies are needed to comprehend the process from the birth of the satellite spots to the explosive phenomena associated with them. Thanks to the continuous full-disk observation by the Solar Dynamics Observatory, we were able to investigate these explosive phenomena in terms of their energy build-up, event trigger, and energy release phases. In particular, this study (Sakaue et al. 2017, accepted by PASJ) focuses on the energy build-up and trigger phases, by analyzing the photospheric horizontal flow field around the active region with an optical flow method. The analysis reveals that: (1) The observed explosive phenomena involved three satellite spots, the magnetic fluxes of which successively reconnected with their pre-existing ambient fields. (2) All of these satellite spots emerged in the moat region of a pivotal delta-type sunspot, especially near its convergent boundary with the neighboring supergranules or moat regions of adjacent sunspots.

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On the relationship between the rapid penumbra formation and impulsive flare in NOAA12403

Abstract Author(s): Shin'ichi Nagata

Institution(s): Kyoto University

Presentation: P3_054

Abstract

We observed an M5.6 flare occurred on 24-Aug-2016 at NOAA12403 with the tandem etalon magnetograph of the Solar Magnetic Active Research Telescope (SMART) of Hida observatory. The impulsive EUV brightness enhancement was observed with the all channels of the Atmospheric Imaging Assembly (AIA) on the Solar Dynamics Observatory (SDO). The enhancement was found around the following spot of this active region where no clear penumbra seen before the flare. We analyzed HMI data and found that appearance of penumbra after the impulsive flare. On the other hand, we find the horizontal photospheric magnetic field enhancement in the SMART magnetic field data with time scale of several minutes just after the flare. Based on the observed rapid evolution of penumbra and magnetic fields, we discuss the topological change of the magnetic field associated with the impulsive flare.

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Evolution of Coronal Jets on the Solar Limb based on SDO/AIA Images Datas

Abstract Author(s): Herna Fahriyah, Dhani Herdiwijaya

Institution(s): Institute of Technology Bandung

Presentation: P3_055

Abstract

Solar Jets are the typical collimated and transient ejecta in the solar atmosphere that is significant in mass and energy transport at various spatial and temporal scales. Jets are ubiquitous events that have the various type of morphology and complex evolution due to magnetic fields structure. This study shows physical characteristics (the heights and the apparent velocities) and temporal evolution using SDO/AIA 304Å (log T=4.7 K), 171Å (log T=5.8 K), and 211Å (log T=6.3 K) images data. They have a typical height of 68.000-160.000 km and an apparent velocity of 16,7-455,6 km/s. Each of jet was ejected from the active region and quiet region showed different characteristics. Generally, the strongest contrast of the jets on 304Å and the weakest on 211Å. Magnetic reconnection occurred in several times of jet lifetime as a reflection of magnetic fields structure complexity. Thus, this study presents an additional illustration showing how huge canopy magnetic impede plasma flow on the open magnetic fields line.

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The formation of an active-region filament: the material by jets

Abstract Author(s): Jincheng Wang, Xiaoli Yan

Institution(s): Yunnan Observatories

Presentation: P3_056

Abstract

We presented the formation process of a filament in active region NOAA 12574 during the period from August 11 to 12, 2016. Combining the observations of GONG Ha and SDO/AIA 304 A, the complete process of filament formation was exhibited. It was found that a lot of cool materials were directly lifted into the corona by a serious of jets nearby the right foot-point of filament and became the filament materials. Simultaneously, the magnetic flux emergence was found on the photosphere below the right foot-point of the filament. These suggested that cool materials in the low atmosphere can be directly injected into the filament in the corona and jets would be caused by the magnetic reconnection through the interaction of pre-existed magnetic fields and new emergence magnetic fields. Studying on a jet at 18:02 on Aug 11 in detail with NST/BBSO Tio observations, it was found that the dark threads grew or emerged in the vicinity of the right foot-point after the jet and the transvers velocity of heated plasma along the filament axis was about 157.6 km/s. On the other hand, by using Domeless Solar Telescope observation at Hida observatory, we found that the injected plasmas by a jet at 00:42 on Aug 12 were rotation. Therefore, we concluded that jets not only forces the materials for the filament, but also injects the helicity into the filament simultaneously.

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Recurrent Active region coronal jets: Examining the magnetic configuration of a persistent jet inducing micro-flare site

Abstract Author(s): Alin Paraschiv, Alina Donea

Institution(s): Monash university

Presentation: P3_057

Abstract

Active region 11302 displayed an unusually large number of solar jets during its lifetime. In search for a clue on the origin of these jets, we have analysed the emission mechanism responsible for at least ten of the observed coronal jet events, all occurring at the south-eastern penumbral boundary of the active region. The identified events were observed in extreme-ultraviolet and interesting local features were correlated with corresponding low-lying magnetic features. Our aim is to further understand this interaction process and assess jet properties from a data driven perspective. The accurate detection of local magnetic field layout is essential. We use dedicated custom tools to accurately identify, extrapolate, and visualise vertical field structures of the lower solar atmosphere. The study lead to the discovery of a peculiar hot arched structure that expands into the lower corona. We noticed the preference of low lying magnetic field lines to cluster into this unique structure. We introduce the terminology "Coronal Geyser" to define the properties of this quasi-stable structure. The Geyser undergoes multiple reconnection events which account for all of the observed jets. Recently, it was proposed that the heating of all base-arched structures and the jet emission are strongly linked to small-scale filament eruptions. The relation between the jet origin and other dynamic plasma features, such as flaring, low lying coronal loops, and twisted filaments, is amply discussed. Flux cancellations, dipole emergences, penumbral filaments and/or canopy fields embedded in a dynamical moat penumbral region are all identified as playing a significant role in fuelling the geyser structure.

Type of magnetic null point and filament in the solar atmosphere

Abstract Author(s): Huaning Wang, uan Guo, Xiaoshuai Zhu

Institution(s): National Astronomical Observatories

Presentation: P3_058

Abstract

Null points are most important topological features in solar magnetic field. A type of null points with complex eigenvalue has twisted field lines along its spine.This kind of topological features might be related to filaments in the solar atmosphere. More than 14 solar active regions with filaments has been investigated and 12 of them have null points with complex eigenvalue.

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Magnetic Flux Rope: Topology and Twist Profile

Abstract Author(s): Rui Liu

Institution(s): University of Science and Technology of China

Presentation: P3_059

Abstract

Magnetic flux rope (MFR) is among the most fundamental magnetic configurations in plasma, and also a fundamental and key structure in solar eruptions, which are the dominant contributor to adverse space weather at Earth. In this talk we will report our progress in the studies on MFRs erupting from the Sun. By quantifying magnetic connectivities and magnetic twist, we are able to identify MFRs as a 3D volume of enhanced magnetic twist, bounded by a thin quasi-separatrix layer. Further, MFRs characteristics, including the distribution of magnetic twist within the rope, can be deciphered by combining the morphology and evolution of flare ribbons, post-eruptive dimmings, and in-situ diagnostics.

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Increase in the amplitude of Line-of-sight velocities of the small-scale motions in a solar filament before eruption

Abstract Author(s): Daikichi Seki, Kenichi Otsuji , Hiroaki Isobe , Takako T. Ishii, Takahito Sakaue , Kumi Hirose

Institution(s): Kyoto University

Presentation: P3_060

Abstract

We present a study on the evolution of the small-scale velocity field in a solar filament as it approaches the eruption. The observation was carried out by the Solar Dynamics Doppler Imager (SDDI) that was newly installed on the Solar Magnetic Activity Research Telescope at Hida Observatory. The SDDI obtains a narrowband full-disk image of the Sun at 73 channels from H-alpha - 9.0 angstrom to H-alpha + 9.0 angstrom, allowing us to study the line-of-sight (LOS) velocity of the filament before and during the eruption. The observed filament is a quiescent filament that erupted on 2016 November 5. We derived the LOS velocity at each pixel in the filament using the Becker's cloud model, and made the histograms of the LOS velocity at each time. The standard deviation of the LOS velocity distribution can be regarded as a measure for the amplitude of the small-scale motion in the filament. We found that it increased with a rate of 2.8 m s^{-2} about an hour before eruption. From this result we suggest that the increase in the amplitude of the small-scale motions in a filament can be regarded as a precursor of the eruption.

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Rapid eruptive phenomena observed by SMART/SDDI and its influence to the interplanetary space

Abstract Author(s): Kenichi Otsuji

Institution(s): Kyoto University

Presentation: P3_061

Abstract

We observed a filament eruptive event which occurred on 2nd April 2017 by using Solar Dynamics Doppler Imager (SDDI) on SMART in Hida observatory. The eruption was associated with a M4.4 flare which took place at the solar west limb and developed into the eruptive prominence. The observation was done with a fast tunable filter which can take 73 wavelengths points with the step of 0.25 Angstrom and the coverage of +/-9 Angstrom centered at H alpha line (6562.808 Angstrom). We apply the Beckers cloud model to the observed dataset and derived the line of sight (LOS) velocity of the erupting prominence blobs. We also measured the transversal (apparent) velocity of the blobs on the image plane. We found that the erupting blobs have more than 100 km/s LOS velocity and 500 km/s transversal velocity. Surprisingly we found an erupting blob which seems to have near 1000 km/s transversal velocity. The erupted prominence produces a CME. We will discuss the process of the eruption and its propagation in the interplanetary space.

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Investigation of a Large Ejective Solar Eruption from a Typical Coronal-Jet-Base Field Configuration

Abstract Author(s): Navin Chandra Joshi, Alphonse C. Sterling, Ronald L. Moore, Tetsuya Magara, Young-Jae Moon

Institution(s): Kyung Hee University, Marshall Space Flight Center

Presentation: P3_062

Abstract

We investigate a large-scale ejective solar eruption of 2014 December 18 from active region NOAA 12241 using multi-wavelength observations and magnetic field data from SDO/AIA, SDO/HMI, GOES and RHESSI. This event produced a distinctive three-ribbon flare, having two parallel ribbons corresponding to the ribbons of a standard two-ribbon flare, and a larger-scale third quasi-circular ribbon offset from the other two ribbons. There are two stages to this eruptive event. First, a flux rope forms above a strong-field polarity-inversion line and erupts and grows as the parallel ribbons turn on, grow, and spread apart from that polarity-inversion line; this evolution is consistent with the tether-cutting reconnection mechanism for eruptions. Second, the erupting arcade that has the erupting flux rope in its core undergoes magnetic reconnection near the null point of the fan dome that envelops the erupting arcade, resulting in formation of the quasi-circular ribbon; this is consistent with the breakout-reconnection mechanism for eruptions. We find that the parallel ribbons begin about 12 min before the circular ribbon onset, indicating that tether-cutting reconnection or a non-ideal MHD instability initiated this event, rather than breakout reconnection. The overall setup for this large-scale eruption is analogous to that of coronal jets.

Electron plasma wake field acceleration in solar coronal and chromospheric plasmas

Abstract Author(s): David Tsiklauri

Institution(s): Queen Mary University of London

Presentation: P3_063

Abstract

Three dimensional, particle-in-cell, fully electromagnetic simulations of electron plasma wake field acceleration applicable to the solar atmosphere are presented [1]. It is established that injecting driving and trailing electron bunches into solar coronal and chromospheric plasmas results in electric fields $(-(20-5)\times 10^6$ V/m), leading to acceleration of the trailing bunch up to 52 MeV, starting from initial 36 MeV. The results provide one of the potentially important mechanisms for the extremely energetic solar flare electrons, invoking plasma wake field acceleration.

[1] D. Tsiklauri, Physics of Plasmas 24, 072902 (2017) doi: 10.1063/1.4990560

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MHD simulation of solar active region driven by observation-inferred plasma motion and electric field

Abstract Author(s): Keiji Hayashi

Institution(s): National Space Science Center

Presentation: P3_064

Abstract

Solar active regions are consequences of evolving magnetic field and plasma injected through the solar photosphere. By applying time-series observation data of solar photosphere to MHD simulation model, we in principle can trace the temporal evolution of such magnetically complex system. We will show the results from our MHD simulation model that is recently re-developed for better realistically simulating solar active region. The simulated active region system is driven by either of plasma motion and electric field on the bottom boundary (or solar surface) that are calculated from time-series vector magnetic field observation data taken by the SDO/HMI. The boundary treatment for six sub-Alfvenic boundary surfaces is based on concept of characteristics, which helps minimize mathematical and physical inconsistency. To mitigate computational difficulties arising from extremely low-beta situations, we allowed somewhat high-density situation as compromise. Many features, such as twisted field along magnetic inversion lines and magnetic free energy comparable to a strong flare, are numerically obtained through this MHD model with time-dependent boundary values.

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RADYN simulations of non-thermal and thermal models of Ellerman bombs

Abstract Author(s): Jie Hong, Mats Carlsson, M.D. Ding

Institution(s): Nanjing University, University of Oslo

Presentation: P3_065

Abstract

Ellerman bombs (EBs) are brightenings in the H line wings that are believed to be caused by magnetic reconnection in the lower atmosphere. To study the response and evolution of the chromospheric line profiles, we perform radiative hydrodynamic simulations of EBs using both non-thermal and thermal models. Overall, these models can generate line profiles that are similar to observations. However, in non-thermal models we find dimming in the H line wings and continuum when the heating begins, while for the thermal models dimming occurs only in the H line core, and with a longer lifetime. This difference in line profiles can be used to determine whether an EB is dominated by non-thermal heating or thermal heating. In our simulations, if a higher heating rate is applied, the H line will be unrealistically strong, while there are still no clear UV burst signatures.

2.5D Particle-in-cell Simulation of Solar type III radio bursts

Abstract Author(s): Tangmu Li, Wenjun Ding, Chen P.F, Fang C

Institution(s): Nanjing University

Presentation: P3_066

Abstract

Solar type III radio bursts show quickly frequency drift. In this paper, the 2.5D PIC method is used to simulate the fundamental frequency, harmonic radiation and mode conversion mechanism of the solar type III bursts caused by the relativistic electron beam in the case of actually observing the density gradient and the initial magnetic field as the background.

2.5 D particle-in-cell to simulate Coronal Particle Acceleration of HeG3 / 4

Abstract Author(s): Wenjun Ding, Tangmu Li, Chen P.F , Fang C.

Institution(s): Nanjing University

Presentation: P3_067

Abstract

In this paper, we use particle in cell to explore the acceleration of He3 / He4 by a common turbulence in the coronal plasma ,and was injected into the interstellar acceleration process. When the relative abundance of He3 / He4 in the plasma is enhanced, the mechanism can form a exponential power spectrum, which provides a possible explanation for the correlation between the abundance of He3 / He4 in the corona and the correlation between heavier particles.

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Relationship between the Occurrence of a Flare and the Small-Scale Variation of Photospheric Magnetic Field in Active Region 12371

Abstract Author(s): Jihye Kang, Tetsuya Magara, Yong-Jae Moon , Satoshi Inoue

Institution(s): Kyung Hee University, Naogya University

Presentation: P3_068

Abstract

We investigate the flare productivity of a magnetic structure by focusing on the spatial and temporal changes of photospheric magnetic field. The physical process to develop a flare-producing magnetic structure in the corona in response to these photospheric changes is one of the hot topics. We analyzed small-scale photospheric changes of observation data to see how they are related to the occurrence of a flare. It is found that difference of transverse components between potential field and observed photospheric vector field is noticeable in a small-scale emerging region near the main polarity inversion line in AR12371 when it produced an M-class flare. We also investigate a flare-producing coronal magnetic configuration of this active region by using a nonlinear force-free field model.

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Evidence for a Magnetic Reconnection Origin of Plasma Outflows along Post-CME Rays

Abstract Author(s): Jongchul Chae, Kyuhyoun Cho, Ryun-Young Kown, Eunkyung-Lim

Institution(s): Seoul National University, APL, Korea Astronomy and Space Science Institute

Presentation: P3_069

Abstract

Bright rays are often observed after coronal mass ejections (CMEs) erupt. These rays are dynamical structures along which plasmas move outward. We investigated the outflows along the post-CME rays observed by the COR2 on board STEREO Behind on 2013 September 21 and 22. We tracked two CMEs, two ray tips, and seven blobs using the NAVE optical flow technique. As a result, we found that the departure times of blobs and ray tips from the optimally chosen starting height coincided with the occurrence times of the corresponding recurrent small flares within 10 minutes. These small flares took place many hours after the major flares. This result supports a magnetic reconnection origin of the outward flows along the post-CME ray and the importance of magnetic islands for understanding the process of magnetic reconnection.

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Pre-eruption Oscillations in Quiescent Filament

Abstract Author(s): Anand D. Joshi, Yoichiro Hanaoka, Yoshinori Suematsu, Satoshi Morita, Vasyl Yurchyshyn, Kyung-Suk Cho

Institution(s): National Astronomical Observatory of Japan, Korea Astronomy and Space Science Institute , Big Bear Solar Observatory, University of Science and Technology

Presentation: P3_070

Abstract

We investigate the eruption of a quiescent filament. Large-scale activation was observed in only half of the filament in the form of pre-eruption oscillations. Consequently only this half erupted nearly 30 hr after the oscillations commenced. Time-slice diagrams of 171 Å images from the Atmospheric Imaging Assembly on board the Solar Dynamics Observatory revealed that the oscillations occurred in several thin and long features connecting the filament spine to the chromosphere below. This study traces the origin of such features and proposes their possible interpretation. Small-scale magnetic flux cancellation accompanied by a brightening was observed at the footpoint of the features shortly before their appearance, in images recorded by the Helioseismic and Magnetic Imager. A slow rise of the filament was detected when filament features were undergoing oscillations, indicating a gradual loss of equilibrium. Our analysis using potential field model indicates that a change in magnetic field connectivity between two neighbouring active regions and the quiescent filament resulted in a weakening of the overlying arcade of the filament, leading to its eruption. It is also suggested that the oscillating features are filament barbs, and the oscillations are a manifestation during the pre-eruption phase of the filaments.

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Statistical Study of Active-region Microflares Observed with Hinode/XRT

Abstract Author(s): Ryoya Uemura, Satoshi Masuda, Ryouhei Kano

Institution(s): Nagoya University, National Astronomical Observatory of Japan

Presentation: P3_071

Abstract

The microflare heating model is one of possible coronal heating mechanisms. The frequency distribution of microflares as a function of their energy is important for evaluation of this model. It is reported as a result of Yohkoh/SXT observations that the distribution was represented by a single power-law in the energy range of 10^{27} - 10^{29} with an index of about -1.6 (Shimizu 1995). It concluded that the total energy supplied by microflares and flares is not enough to maintain the active-region corona even if this distribution is extended to the lower energy range. To investigate the frequency distribution below 10^{27} erg, we analyzed high-cadence (3-6 sec) and high-resolution (1arcsec/pixel) soft X-ray images of the active region NOAA10923 taken with Hinode/XRT with several filters on November 13-14, 2006. We detected about 1000 enhancements in the light curves of 4x4-pixel-binned XRT images in each filter period (20-30 min) as microflares. The frequency distribution was represented by a power-law in the range of 10^{25} - 10^{27} erg, steeper than that with a power-law index of -2. This result indicates that, if the distribution has the same power-law index in the lower energy range, microflares can supply sufficient energy required for active-region coronal heating.

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Flare Productivity in Different Magnetic Types of Active Regions

Abstract Author(s): Ya-Hui Yang, Min-Shiu Hsieh, Hsiu-Shan Yu, Peng Fei Chen

Institution(s): National Central University, University of Alaska Fairbanks, University of California San Diego, Nanjing University

Presentation: P3_072

Abstract

Based on two datasets of daily sunspot and flare information as well as the GOES soft X-ray measurements and HMI vector magnetograms, we investigate the dependence of flare activity on the active region (AR) properties and clarify the influence of AR magnetic parameters on the flare productivity. We find that the flare behaviors are quite different in the short- and long-lived complex ARs. Moreover, the ARs with more complex magnetic configurations are likely to host more impulsive and intense flares. Our results demonstrate that the total source field strength on the photosphere has a good correlation with the flare activity in complex ARs. Intense flares tend to occur at the regions of strong source field in combination with an intermediate field-weighted shear angle, which implies that the magnetic free energy provided by a complex AR could be high enough to trigger a flare even with a moderate magnetic shear on the photosphere. We thus suggest that the magnetic free energy represented by the source field rather than the photospheric magnetic complexity is a better quantity to characterize the flare productivity of an AR, especially for the occurrence of intense flares.

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Statistical study on the radial and azimuthal wave modes of 24 Halo Coronal Mass Ejections using multi spacecraft

Abstract Author(s): Harim Lee, Yong-Jae Moon, V. M. Nakariakov

Institution(s): Kyung Hee University, University of Warwick

Presentation: P3_073

Abstract

We have made an investigation on the radial and azimuthal wave modes of full halo coronal mass ejections (HCMEs). For this, we consider 24 HCMEs which are simultaneously observed by SOHO and STEREO A & B from August 2010 to August 2012 when they were roughly in quadrature. Using the SOHO/LASCO C3 and STEREO COR2 A & B running difference images, we estimate the instantaneous apparent speeds of the HCMEs at 24 different position angles. Major results from this study are as follows. First, there are quasi-periodic variations of the instantaneous radial velocity with the periods ranging from 24 to 48 mins. Second, the amplitudes of instant speed variations are about a third of the projected speeds. Third, the amplitudes are found to have a weak anti-correlation with period. Our preliminary identification from SOHO observations shows that there are several distinct radial and azimuthal wave modes: m=0 (radial) for five events, m=1 for eleven events, m=2 for three events, and unclear for the other events. In addition, we are making a statistical investigation on the oscillation of 733 CMEs to understand their physical origins.

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Transient Plasma Signatures and Space Weather

Abstract Author(s): Subhash C. Kaushik

Institution(s): Government PG College (Jiwaji University)

Presentation: P3_074

Abstract

One of the prime challenges for space weather researchers today is to quantitatively predict the dynamics of the geo-magnetosphere from measured solar wind and interplanetary magnetic field (IMF) conditions. In the present study a correlative study between geomagnetic storms and the various interplanetary (IP) field / plasma parameters have been performed to search the perpetrators of geomagnetic activity and to develop such model suitable for predicting the occurrence of geomagnetic storms, which are significant for space weather predictions. We investigated a possible relationship between geomagnetic storms and solar wind and IMF parameters in different situations and also derived the linear relationship for all parameters in different situations based on the peak values of Disturbance storm time index (Dst). The investigation is performed utilizing the fact that the total interplanetary magnetic field (IMF Btotal) can be used to trigger an intense geomagnetic storms well represented by the Dst index. Our results inferred that the southward Bz component of the interplanetary magnetic field is an important factor for describing geomagnetic storms however its magnitude is not found maximum neither during the initial phase of the storm, i.e. at the instant of the interplanetary shock nor during the main phase, the instant of minimum disturbance storm time (Dst) index. It is also investigated that there is a time delay between the maximum value of southward Bz and the Dst minimum, and this time delay can be used in the prediction of the intensity of a magnetic storm two-three hours before the main phase of a geomagnetic storm.

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Solar Flare Forecast Model based on Convolutional Neural Network using SOHO MDI Data and its Optimizations

Abstract Author(s): Eunsu Park, Yong-Jae Moon

Institution(s): Kyung Hee University

Presentation: P3_075

Abstract

A Convolutional Neural Network(CNN) is one of the well-known deep-learning methods in image processing and computer vision area. In this study, we apply CNN to two kinds of flare forecasting models: flare classification and occurrence. For this, we consider several pre-trained models (e.g., AlexNet, GoogLeNet, and ResNet) and customize them by changing several options such as the number of layers, activation function, and optimizer. Our inputs are the same number of SOHO)/MDI images for each flare class (None, C, M and X) at 00:00 UT from Jan 1996 to Dec 2010 (total 1600 images). Outputs are the results of daily flare forecasting for flare class and occurrence. We build, train, and test the models on TensorFlow, which is well-known machine learning software library developed by Google. Our major results from this study are as follows. First, most of the models have accuracies more than 0.7. Second, ResNet developed by Microsoft has the best accuracies : 0.86 for flare classification and 0.84 for flare occurrence. Third, the accuracies of these models vary greatly with changing parameters. We discuss several possibilities to improve the models.

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Forecast of Solar Major Flare Occurrence Rates Based on Vector Magnetic Parameters Using SDO/HMI Data

Abstract Author(s): Daye Lim, Yong-Jae Moon , Jongyeob Park, Kangjin Lee, Jin-Yi Lee

Institution(s): Kyung Hee University, Korea Astronomy and Space Science Institute

Presentation: P3_076

Abstract

We investigate solar major (M and X-class) flare occurrence rates within a day using hourly SHARP vector magnetic field data from May 2010 to April 2017. We consider six SHARP parameters with high F-scores as useful predictors of flaring activity from Bobra and Couvidat (2015). We have considered two cases. In case 1, the data divided into two sets separated chronologically. 75% of the data are used for setting up a flare model and the other for test. In case 2, we divide the data into two sets every year in order to reduce the solar cycle (SC) phase effect. All magnetic parameters are divided into 100 groups to estimate the corresponding flare occurrence rates. Flare identifications are determined by using LMSAL flare locations. As a result, major flare occurrence rates are well correlated with six parameters. We also find that the logarithmic values of flaring rates are well approximated by two linear equations with different slopes. The sum of the net current emanating from each polarity gives the minimum RMS error between observed flare rates and predicted ones. The RMS error for case 2, which is taken to reduce SC phase effect, are smaller than those for case 1.

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Flare Forecast using Machine-learning of Multi-wavelength Observations of Active Regions

Abstract Author(s): Naoto Nishizuka, Yuki Kubo, Komei Sugiura, Mitsue Den, Sin-ichi Watari, Mamoru Ishii

Institution(s): National Institute of Information and Communications Technology

Presentation: P3_077

Abstract

We developed a flare prediction model using machine learning, which is optimized to predict the maximum class of flares occurring in the following 24 hr. Machine learning is used to devise algorithms that can learn from and make decisions on a huge amount of data. We used solar observation data during the period 2010-2015, such as vector magnetograms, UV 1600A and soft X-ray emissions taken by SDO and GOES. We detected active regions from the full-disk magnetogram, from which 60 features were extracted, including magnetic neutral lines, the current helicity, the UV brightening, and the flare history. We separated the database into two for training and testing, and then we compared three machine-learning algorithms: the support vector machine, k-nearest neighbors (k-NN), and extremely randomized trees. The prediction score, the true skill statistic, was higher than 0.9 with k-NN, which is higher than that for human forecasts. Furthermore, we investigated the ranking of the feature importance. We found that previous flare activity is most effective, followed by the length of magnetic neutral lines, the unsigned magnetic flux, and the area of UV brightening. This indicates that effective features are strongly correlated with the flux emergence dynamics in an active region.

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Flare Occurrence Prediction based on Convolution Neural Network and Comparison with Previous Models

Abstract Author(s): Kangwoo Yi, Yong-Jae Moon, Eunsu Park, Seulki Shin

Institution(s): Kyung Hee university

Presentation: P3_078

Abstract

In this study we apply Convolution Neural Network(CNN) to solar flare occurrence prediction with various parameter options using the 00:00 UT MDI images from 1996 to 2010 (total 4962 images). We assume that only X, M and C class flares correspond to flare occurrence and the others to non-flare. We have attempted to look for the best options for the models with two CNN pretrained models (AlexNet and GoogLeNet), by modifying training images and changing hyper parameters. Our major results from this study are as follows. First, the flare occurrence predictions are relatively good with about 80 % accuracies. Second, both flare prediction models based on AlexNet and GoogLeNet have similar results but AlexNet is faster than GoogLeNet. Third, modifying the training images to reduce the projection effect is not effective. Fourth, skill scores of our flare occurrence model are mostly better than those of the previous models.

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Starspot activity and superflares on solar-type stars

Abstract Author(s): Hiroyuki Maehara, Yuta Notsu, Shota Notsu, Kosuke Namekata, Satoshi Honda, Takako T. Ishii, Daisaku Nogami, Kazunari Shibata

Institution(s): National Astronomical Observatory of Japan , Kyoto University, University of Hyogo

Presentation: P3_079

Abstract

High-precision time-series photometry with the Kepler space telescope found more than 1000 "superflares" on solar-type stars. The bolometric energy released by superflares ranges from 10^{33} erg to 10^{36} erg which is 10-10^4 times larger than that released by a typical X10-class solar flare. Most of the stars with superflares show large-amplitude photometric variations associated with the stellar rotation which suggest that the stars with superflares have large starspots. We analyzed the correlation between starspots and superflares on solar-type stars using the data from the Kepler mission. Our analysis shows that the fraction of the stars showing superflares decreases as the rotation period increases and as the area of starspots decreases. We found that the size distribution of large starspots with the area of $> 10^4$ MSH (micro solar hemispheres; 1 MSH=3×10^{16} cm^2) on slowly-rotating solar-type stars shows the power-law distribution and both the size distribution of starspots on solar-type stars and that of larger sunspots are roughly on the same power-law line. We also found that the frequency-energy distributions for flares originating from spots with different sizes are the same for solar-type stars with superflares and the Sun. These results suggest that the magnetic activity on solar-type stars with superflares and that on the Sun is caused by the same physical processes.

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Prediction of Solar Flares Using Unique Signatures of Magnetic Field Images

Abstract Author(s): Abbas Raboonik, Hossein Safari, Nasibe Alipour, Michael S. Wheatland

Institution(s): University of Mazandaran, University of Zanjan, The University of Sydney

Presentation: P3_080

Abstract

Prediction of solar flares is an important task in solar physics. The occurrence of solar flares is highly dependent on the structure and topology of solar magnetic fields. A new method for predicting large (M- and X-class) flares is presented, which uses machine learning methods applied to the Zernike moments (ZM) of magnetograms observed by the Helioseismic and Magnetic Imager on board the Solar Dynamics Observatory for a period of six years from 2010 June 2 to 2016 August 1. Magnetic field images consisting of the radial component of the magnetic field are converted to finite sets of ZMs and fed to the support vector machine classifier. ZMs have the capability to elicit unique features from any 2D image, which may allow more accurate classification. The results indicate whether an arbitrary active region has the potential to produce at least one large flare. We show that the majority of large flares can be predicted within 48 hr before their occurrence, with only 10 false negatives out of 385 flaring active region magnetograms and 21 false positives out of 179 non-flaring active region magnetograms. Our method may provide a useful tool for the prediction of solar flares, which can be employed alongside other forecasting methods.

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Solar particle event statistical model comparison for Korean Pathfinder Lunar Orbiter mission

Abstract Author(s): Dongmin Ryu, Insoo Jun, Sung-Joon Ye

Institution(s): Seoul National University, Jet Propulsion Laboratory/NASA

Presentation: P3_081

Abstract

South Korea is now conducting project for the Korea Pathfinder Lunar Orbiter (KPLO). For the successful mission with no failure caused by radiation, radiation environment analysis should be done properly. Radiation environment is divided into three categories which are solar proton environment, trapped particle environment, and galactic cosmic radiation environment. Among them, solar proton environment is the main concern for the near-Earth interplanetary mission because of its high energy and flux. For the detailed analysis of solar proton environment, I compared several solar particle event statistical models and calculated total mission fluence for each model. JPL, ESP-PSYCHIC, Rosenqvist, and King model were compared and analyzed. Geant4, a radiation transport Monte Carlo simulation code, was used to estimate the effect of solar proton fluence to the spacecraft. From the fluence spectrum data, total ionizing dose (TID) and displacement damage dose (DDD) were separately calculated. Also, primary particle dose and secondary particle dose were calculated for the further analysis. As a brief result, 0.1 MeV integral fluence was 3.46E11 particles per square centimeter and total ionizing dose was about 80 Gray with 1 mmAl shielding for the case of JPL model. Through this work, we would be able to optimize the radiation shielding design of spacecraft for the near-Earth interplanetary mission.

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The Observation of Heart-shape Active Region 2529 Producing Strong M6.7 class Solar Flare and Gradual Coronal Mass Ejections on 18th of April 2016

Abstract Author(s): Zety Sharizat bt Hamidi

Institution(s): Universiti Teknologi MARA

Presentation: P3_093

Abstract

During large event pre-flare usually continues a few minutes and followed by impulsive phase about 3 to 10 minutes. In this study, the data of active region of the Sun was taken from official website of the Langkawi National Observatory. The image of the active region was observed by using 11-inch Celestron telescope with solar filter. This data confirms that there was a strong M class of solar flare during the day due to eruption of AR 2529 was occurred on 18th of April 2016. The evolution of small AR 2529 to a big heart-shape forms an eruption that producing strong M6.7 class of flare and three gradual CMEs. This strong flare caused significant impact around the high technologies of Pacific Ocean by fading the signal at frequencies below 15MHz. Active region 2529 also producing three associated CMEs which each of them were distinguished by number in sequence. AR2529 has developed a 'beta-gamma' magnetic field that harbours plenty of energy for this kind of explosion. CME number 46 is the fastest among all CMEs during the day with the average velocity of 544 km s^{-1}. All of the CMEs were classified as gradual CMEs.

Session 4

Solar interior and activity cycle of the Sun and stars

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Solar neutrino measurements at Super-Kamiokand

Abstract Author(s): Yasuo Takeuchi

Institution(s): Kobe University

Presentation: O4_020K

Abstract

Super-Kamiokande (SK) is a large water Cherenkov detector to study elementary particle physics and astroparticle physics. It is located in Kamioka Observatory, ICRR, The University of Tokyo. The detector consists from a cylindrical stainless steel tank (39.3 m diameter x 41.4 m height), 50 kton of purified water, and about 11,100 of 20-inch photomultiplier tubes (PMTs). It is located 1,000 m underground at Ikeno-yama Mountain, Kamioka town, Gifu, Japan.

SK started its observation in April 1996. Currently, 4th phase of the experiment is running. The main physics targets of SK are search for nucleon decay, astrophysical neutrino measurements, and accelerator neutrino measurements. The sun is most intense neutrino source on the surface of the earth. Solar neutrinos are one of major observation targets at SK. They are produced in the solar core region with the nuclear fusion processes from four hydrogen nuclei into a helium-4 nucleus. The measurements of solar neutrinos were started in 1970s.

In this presentation, a brief history of solar neutrino measurements, problem, and oscillation is explained. Then, solar neutrino measurements at SK are reviewed. Finally, some solar astrophysics related topics in current SK and in a future project, Hyper-Kamiokande, are mentioned.

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Session 4: Solar interior and activity cycle of the Sun and stars

Recent development of solar dynamo model

Abstract Author(s): Hideyuki Hotta

Institution(s): Chiba University

Presentation: O4_021I

Abstract

Recent development of the solar convection and the dynamo model are reviewed. The solar convection zone (the outer 30% of the solar interior) is fulfilled with turbulence of ionized plasma. This turbulence interacts with ubiquitous magnetic field. Then large-scale features such as 11-year cycle, are maintained. In order to understand generation process of the magnetic field using numerical calculation, huge numerical resources are required for resolving small-scale turbulence and magnetic field. Recently new method, the Reduced Speed of Sound Technique, and massive super computers, like K-computer enable us to carry out such high-resolution calculations, which resolve turbulent inertia scale. Using these high-resolution calculations, we found that the significant role of small-scale magnetic field on the large-scale magnetic field. In the high-resolution calculations, small-scale dynamo becomes efficient and the small-scale turbulence is significantly suppressed. As a result, the large-scale magnetic field is reproduced even in high-resolution situation. In the talk, the future path to the photosphere in the global convection simulation is shown.

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Flux transport dynamo and solar cycle

Abstract Author(s): Jie Jiang

Institution(s): Beihang University

Presentation: O4_044K

Abstract

Flux Transport Dynamo (FTD) models usually refer to the models in which meridional circulation plays a crucial role and the poloidal field generation takes place by the Babcock-Leighton (BL) mechanism. The models were regarded as the most promising one to understand the solar cycle. During the past few years, the major developments relevant to FTDs are as follows. (1). The important roles of the magnetic pumping, one of flux transport mechanisms, are recognized. (2). The possible poleward meridional circulation at the base of the convective zone given by helioseimology and MHD simulations brings a possible challenge to FTD. (3) BL mechanism was confirmed to be at the heart of the solar cycle. The significance of the BL mechanism for the solar cycle is twofold. One is that the long-term observational data over solar surface can be used to constrain the interior dynamics. The other is that the observable part of the BL mechanism makes the physics-based solar cycle prediction feasible. The possible strength of the subsequent cycle can be predicted when a cycle starts for a few years. (4). Some 3D kinematic BL type dynamo models have been developed.

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A theoretical model of the variation of the meridional circulation with the solar cycle

Abstract Author(s): Gopal Hazra, Arnab Rai Choudhuri

Institution(s): Indian Institute of Science

Presentation: O4_045

Abstract

Observations of the meridional circulation of the Sun, which plays a key role in the operation of the solar dynamo, indicate that its speed varies with the solar cycle, becoming faster during the solar minima and slower during the solar maxima. To explain this variation of the meridional circulation with the solar cycle, we construct a theoretical model by coupling the equation of the meridional circulation with the equations of the flux transport dynamo model. We consider the back reaction due to the Lorentz force of the dynamo-generated magnetic fields and study the perturbations produced in the meridional circulation due to it. This enables us to model the variations of the meridional circulation without developing a full theory of the meridional circulation itself. We obtain results which reproduce the observational data of solar cycle variations of the meridional circulation reasonably well. We get the best results on assuming the magnetic Prandtl number to be close to unity. We have to assume an appropriate bottom boundary condition to ensure that the Lorentz force cannot drive a flow in the subadiabatic layers below the bottom of the tachocline. Our results are ensitive to this bottom boundary condition.

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Probing magnetic fields in the solar convection zone with solar-cycle variations of meridional flows

Abstract Author(s): Chia-Hsien Lin, Dean-Yi Chou

Institution(s): National Central University, National Tsing-Hua University

Presentation: O4_046

Abstract

The solar meridional flow is a global flow that flows in the longitudinal direction. It has been proposed to be an important driver for the solar-cycle variation and re-distribution of the solar magnetic flux. On the surface, it is typically observed to flow from the equator toward the polar regions at a speed of approximately 1 km/s. Below the surface, however, the flow cannot be directly measured. Despite the efforts from many studies to probe the subsurface meridional flow, there is still no consensus on the magnitude and profile of the flow field. Lian & Chou 2015 applied a helioseismic time-distance method probe the solar cycle variation of the subsurface meridional flow. The principle is to measure the travel-time difference between a wave propagating in the opposite direction in a meridional plane. The time difference reflects the direction and magnitude of the flow along the path of the wave. The travel distance between the two surface foot points of the wave is related to the depth the wave can travel. By measuring the travel-time differences of the waves with different travel distances at different latitudes over a solar cycle, Lian & Chou 2015 created travel-time difference maps as a function of latitude and time, and found significant difference at the base of convection zone between the solar maximum and minimum periods. In this present work, we use the travel-time difference data from Lian & Chou 2015, and apply a helioseismic inversion procedure to infer the internal meridional flow pattern. The objective is to probe the difference of the flow between the solar maximum and minimum.

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Formation of dynamo-driven bipolar magnetic spots in stratified turbulence

Abstract Author(s): Sarah Jabbari

Institution(s): Monash University

Presentation: O4_047

Abstract

Recent direct numerical simulations (DNS) of large-scale turbulent dynamos in strongly stratified layers have resulted in surprisingly sharp bipolar structures at the surface in both plane-parallel and spherical geometries. Here we present new DNS of helically and non-helically forced turbulence with and without rotation in both Cartesian and spherical coordinates and compare with corresponding mean-field simulations (MFS) to show that these structures are a generic outcome of a broader class of dynamos in density stratified layers. In all these simulations, the structures have a long life which we suggest to be due to the occurrence of reconnection-like phenomena at the boarder between the opposite polarities. In the box simulations, we focus on the formation of a current sheet between bipolar regions and determine the reconnection rate. We demonstrate that for large Lundquist numbers, the reconnection rate is nearly independent of S. In the spherical geometry simulations, the kinetic helicity and therefore also the large-scale magnetic field are strongest at low latitudes. For moderately strong stratification, several bipolar spots form that eventually fill the full longitudinal extent. At early times, the polarity of spots reflects the orientation of the underlying azimuthal field, as expected from Parkers -shaped flux loops. At late times their tilt changes such that there is a radial field of opposite orientation at different latitudes separated by about 10. We confirm that in this model, strong stratification is essential ingredients behind magnetic spot formation, which appears to be associated with downflows at larger depths.

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Studying Solar Interior and Higher Atmosphere using Helioseismic Waves

Abstract Author(s): Dean-Yi Chou

Institution(s): National Tsing Hua University

Presentation: O4_049I

Abstract

The acoustic wave is a tool to probe the subsurface structure of sunspots. The interaction of solar acoustic waves with sunspots can be considered as a scattering problem. The scattering matrix is the most commonly used quantity to describe the interaction of a scattering problem. Here we first discuss the measurements of scattered waves with helioseismic data, and then discuss how to determine the scattering matrix elements from the measured scattered waves. We also discuss the computation of the Green tensor, which relates the scattering matrix elements and the interaction term in the wave equation.

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Studying Solar Interior and Higher Atmosphere using Helioseismic Waves

Abstract Author(s): Junwei Zhao, Ruizhu Chen

Institution(s): Stanford University

Presentation: O4_050I

Abstract

In this talk, we review recent progresses in helioseismology on three topics: solar meridional circulation, mapping and calibrating far-side active regions, and connections between helioseismic waves and waves in the higher atmosphere. Since the discovery of a systematic center-to-limb effect in helioseismic measurements, many authors have measured meridional circulation and found the equatorward flow in the middle of the convection zone. However, their results are not fully consistent. We will review these results and also present a new effort that measures the Sun's meridional flow in a more comprehensive way, which reveals a three-layer flow structure in the convection zone. For mapping far-side active regions, previous codes used the waves that experience 4- and 5-bounces traveling from the near side passing the far side and back to the near side again. Now we further develop the code to include 3-, 6-, and 8-skip waves. This greatly enhances the reliability of the acoustic images of the far-side active regions, which are then calibrated using STEREO-observed far-side coronal images. To study the connections between helioseismic waves and waves observed in the chromosphere, transition region, and corona, we collect observations of different atmospheric levels, and trace how waves channel up from the photosphere to the corona. It is also found that waves of different frequencies follow different paths traveling upward.

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3D Kinematic Model of the Solar Flux Transport Dynamo

Abstract Author(s): Arnab Rai Choudhuri, Gopal Hazra, Mark Miesch

Institution(s): Indian Institute of Science, High Altitude Observatory

Presentation: O4_051

Abstract

Much of our understanding about the solar cycle has come from 2D kinematic model of the flux transport dynamo in which the mean field dynamo equations are solved in the r-theta plane. However, the crucial Babcock-Leighton process involving the buoyant rise of a part of a toroidal flux tube to produce a tilted bipolar sunspot pair and its subsequent dispersal to build up the poloidal field is an inherently 3D process, treated rather crudely in 2D dynamo models. The build-up of the poloidal field from tilted bipolar sunspots has been treated more realistically by the surface flux transport models which are solved in theta and phi, but are restricted only to the solar surface. The next step is the construction of 3D kinematic flux transport dynamo models, in which the flows measured by helioseismology are incorporated as in 2D models, but the magnetic field is treated in 3D. Such models combine the best features of the 2D kinematic flux transport dynamo model and the 2D surface flux transport model. Work in this direction began only recently (Yeates & Munoz-Jaramillo 2013, MNRAS, 436, 3366; Miesch & Dikpati 2014, ApJL, 785, L8). I shall especially discuss our recent work (Hazra, Choudhuri & Miesch 2017, ApJ 835, 39) which shows that some results from the 2D surface flux transport model regarding the build-up of the polar field have to be revised considerably when subsurface processes are treated realistically.

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Variation of Solar Microwave Spectrum in Last Half Century

Abstract Author(s): Masumi Shimojo, Kazumasa Iwai, Ayumi Asai, Satoshi Nozawa, Tetsuhiro Minamidani, Masao Saito

Institution(s): National Astronomical Observatory of Japan , Nagoya University, Kyoto University, Ibaraki University

Presentation: P4_082

Abstract

The total solar fluxes at 1, 2, 3.75, and 9.4 GHz were observed continuously from 1957 to 1994 at Toyokawa, and from 1994 until now at Nobeyama, Japan with the current Nobeyama Radio Polarimeters. We examined the multi-frequency and long-term datasets, and found that not only the microwave solar flux but also its monthly standard deviation well indicates the long-term variation of solar activity. Furthermore, we found that the microwave spectra at the solar minima of Cycle 20∼24 agree with each other. These results show that the average atmospheric structure above the upper chromosphere in the quiet sun has not varied for half a century, and suggest that the energy input for atmospheric heating from the sub-photosphere to the corona has not changed in the quiet sun despite significantly different strengths of magnetic activities in the last five solar cycles.

APSPM 2017
Session 1: Progress on instrumentation and future plans

Overview of the new science results obtained from Kodaikanal digitized data archive: white-light and Ca-K

Abstract Author(s): Sudip Mandal, Subhamoy Chatterjee, Dipankar Banerjee

Institution(s): Indian Space Research Organization

Presentation: P4_083

Abstract

The Kodaikanal Observatory in India, has been acquiring the full disc images of the Sun in photographic plates/films, in three different filters since early 1900. Recently, these plates have been digitized in high-resolution fits formats. In this talk, I will present a summary of the results obtained using this digitized data archive, specifically the white-light data and the Ca-K data. I will also talk about how this data can be used by the wider solar community in order to extract the best science out of it.

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Search for periodic modulations of the solar neutrino flux in Super-Kamiokande

Abstract Author(s): Makoto Hasegawa, for the Super-Kamiokande collaboration

Institution(s): Kobe University

Presentation: P4_084

Abstract

Since solar neutrinos are generated in the solar core, they serve as an accurate probe of the internal structure and activity of the sun. Super-Kamiokande (SK) has the largest target mass(22.5kton) and one of the longest observation periods (20 years) of MeV solar neutrinos. We have reported possible periodic modulation of solar neutrino flux using the data taken between May 31st 1996 and Jul. 15th 2001(Phase SK-I) in the frequency range from 0.00020/day to 0.09870/day. In that study, the maximum peak, consistent with no modulation, was found at 0.1197/day (Phys. Rev. D 68 (2003) 092002) On the other hand, it was pointed out that a maximum peak, consistent with modulation, is found at around 9.43/year from several researchers by using the same data in SK-I with different analysis technique(e.g. Astroparticle Physics 82 (2016) 86-92). Therefore, we are trying to reanalyze SK-I data with an improved method (Generalized Lomb-Scargle method). The same method is also applied to SK-IV data (between Oct. 6th 2008 and Jan. 31st 2014). In this presentation, the current status and preliminary results of the improved periodic modulation searches in Super - Kamiokande will be reported.

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Development of data-archives of solar chromospheric full-disk images and researches on long-term variations of solar activities and the earths upper atmosphere

Abstract Author(s): Satoru UeNo, R. Kitai, A. Asai, T. Sakaue, T. Kawate, S. Notsu, Y. Notsu, H. Watanabe, A. Shinbori, T. Shibayama

Institution(s): Kyoto University, Nagoya University

Presentation: P4_085

Abstract

Kyoto University has accumulated solar chromospheric full-disk images at Kwasan Observatory, Ikomayama Solar Observatory, Hida Observatory and National Ica University in Peru, since around 1929. In this poster, at first we introduce the development of a database of digitized images of CaII K full-disk analogue data that were recorded on photo-plates or photo-films by using a spectroheliograph made by Askania company from 1929 to 1969. Next, we report the present results of our studies on long-term variations of solar activities and earths upper atmosphere using this database and another database of H-alpha full-disk digital images taken by the Flare Monitoring Telescope (FMT) since 1992 at Hida Observatory and Ica University. For example, we show the relationship between geomagnetic solar daily quiet variation (Sq), solar radio flux F10.7 and plage index that stands for the total area of plage regions on CaII K full-disk images from 1945 to 1965, and differences between the minimum phase of Solar Cycle 22/23 and the minimum phase of 23/24 whose activity was especially low.

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Waiting time distributions of solar and stellar activities: Poisson process or with memory?

Abstract Author(s): Chuan Li, Sijia Zhong, Zigong Xu

Institution(s): Nanjing University, Southeast University

Presentation: P4_086

Abstract

The statistics of time interval between two successive events provide information whether solar and stellar activities occur independently or with memory? Here we examine the waiting time distributions (WTDs) of solar flares and coronal mass ejections (CMEs), as well as the stellar flares observed by the Kepler mission. Based on the Kolmogorov-SmirnovK-Stest, we make a quantity analysis of the departure of WTDs from the Poisson process as predicted by the self-organized criticality (SOC) theory. We then fit the WTDs with three functions: the non-stationary Poisson distribution (Wheatland 2000; Li et al. 2014), the Levy function (Lepreti et al. 2001), and the Weibull function (Weibull 1951; Telloni et al. 2014). It is found that a certain amount of memory is characterized during periods of high solar activities, while the random Poisson process dominates during solar minimum.

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Shock Merging in the Chromosphere of Sunspots

Abstract Author(s): Kyeore Lee, Jongchul Chae

Institution(s): Seoul National University

Presentation: P4_087

Abstract

Our H observation of Fast Imaging Solar Spectrograph installed at the Goode Solar Telescope in Big Bear Solar Observatory shows that merging of shock waves in sunspots of the solar chromosphere occurred frequently. We made time-Doppler velocity map from H data to statistically analyze the shock merging phenomena. One of sunspots has 197 shock merging features during 84min of stable observation. Shock merging distributed at whole part of the sunspot and slightly concentrated on the boundary between umbra and penumbra. It is considered that one faster shock front catch up with a shock front ahead, therefore merging region can be not only one spot but also a front. We anticipated decrease of wave front by shock merging means increase of wave period, and verified it using wavelet method. It shows that a series of shock merging can double the wave period at edge of the sunspot region compared with center of the sunspot. Earlier studies using acoustic cutoff frequency theory explained well the wave frequency gap between 3min in umbra and 5min in penumbra with some assumptions, however, shock merging can account for both frequency gap and nonlinear features concisely.

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Data Processing for Multiple Solar Activity Cycles

Abstract Author(s): Ganghua Lin, Suo Liu, Xiaofan Wan, Xiao Yang, Xiangyun Zeng, Mei Zhang, Haimin Wang, Xun Yan

Institution(s): National Astronomical Observatories of China, Big Bear Solar Observatory

Presentation: P4_088

Abstract

We are proceeding the data processing for multiple solar activity cycles. These observation data were recorded in different times and are from more then 7 observatories in the world. The work final purposes in science are by combining a century solar Halphae data in the world, we look forward to study the statistical properties of solar filaments in multiple solar cycles, and thereby understand the unusual behavior of solar cycle 24, the global structures of solar eruptions, Moreton waves and sympathetic eruptions. The realization of scientific purposes are mainly rely on some incredible progresses on multi-parameters calibration method of Halpha data, automatic detection of solar activity features, and so on. In the presentation, we will show our some results in the project, for examples, automatic extraction of time stamp, standardized processing, flat field, automatic solar activity features extraction,etc.

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Influence of strong viscosity on convective energy transport

Abstract Author(s): Shota Arai, Hideyuki Hotta

Institution(s): Chiba University

Presentation: P4_089

Abstract

Many studies have suggested that current solar convection simulations would overestimate the convective velocity. This problem comes from lack of our understanding of the deep solar convection. Recent high-resolution magneto-convection simulations suggest that small-scale magnetic fields enhance effective viscosity and suppress convective velocity. Furthermore, this enhancement is stronger in the higher resolution and not numerically converged. This implies that effective viscosity would be significantly strong in the real Sun. This finding could contribute to the problem mentioned above. Inspired by this, we carry out a series of thermal convection simulations to investigate the influence of high viscosity on the convective energy transport by increasing kinematic viscosity. The convective velocity in the strongest viscous case is about 10% of that in the weakest viscous one at the bottom boundary. Instead of the significant reduction of the convective velocity, the decrease of the convective energy flux is relatively small. We attribute this to the changes of the structure of thermal fluctuation, leading to efficient convective energy transport. In this talk, we discuss how the structure of thermal fluctuation changes and the application of our results to the thermal convection with the strong magnetic field in the real Sun.

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Studies on the acoustic directionality of solar flare-induced quakes

Abstract Author(s): Alina Donea

Institution(s): Monash University

Presentation: P4_090

Abstract

Magnetic and non-magnetic photospheric simulations of seismic ripples generated by solar flares are presented. We have considered various spatial and temporal distributions of multiple seismic sources, by trying to imitate the observed solar quakes. As a result, the simulations reveal that the response of the photosphere to all flare perturbations present "acoustic directionality characteristics" that lead to a high degree of wave anisotropy. I will present the most conclusive cases of our analysis, which provide answers to some of the unsolved clues related to solar quakes and their not so ubiquitous existence.

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Merging Mosaics and Super-Mosaics of High Resolution Vector Magnetic Field Maps for Studies of Spatial Spectra of Solar Magnetic Field and Helicity

Abstract Author(s): K. Kuzanyan, K. Otsuji, T. Sakurai, N. Yokoi

Institution(s): IZMIRAN, Kyoto University, National Astronomical Observatory of Japan , The University of Tokyo

Presentation: P4_091

Abstract

Knowledge of spatial spectra of magnetic and velocity fields and their helicities (correlation of the field and its curl) in turbulent media are very important for understanding the underlying physics. In observations, likewise in numerical simulations, the significant restriction of revealing these quantities from available data is the limit of scale separation between the smallest resolved (or pixelized) scale and the largest scale of the available field of view. The vector magnetic field data obtained from SOT SP on-board Hinode provide high resolution maps with limited field of view. For practical studies, the field of view can be effectively increased up to the limits of the curvature of the solar surface (for application of models without account of projection). We proposed the procedure of matching the normal mode and fast mode high resolution maps of vector magnetic field for computation of larger field of view maps of magnetic energy and current helicity. A series of mosaic (matching two subsequent maps) and super-mosaic (matching a series of maps in vertical and horizontal dimensions) have been proposed for Hinode SOT observational program. The first results of analysis of the merged maps show interesting properties of the turbulence that occur near the edge of the resolution but still reliably resolved scales of order of solar granulation. These imply a possibility of the effect of bottle-neck in transport of energy and helicity across the scales of this range.

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Construction of a mean field model of the convection zone with turbulence transport coefficients parameterization based on 3D global simulations

Abstract Author(s): Ryuji Mineta, Hideyuki Hotta, Takaaki Yokoyama

Institution(s): The University of Tokyo, Chiba University

Presentation: P4_092

Abstract

In the solar turbulent convection zone, large-scale mean flows are observed. One of them is the differential rotation. The momentum and heat transports by small-scale turbulence are believed to be important processes to drive this large-scale flow. 2D axisymmetric mean field models, in which the turbulent transports are parameterized, have been used in order to reveal the origin of this large-scale flow. On the other hand, recent 3D global simulations can resolve the small-scale flow. However, the results of the 3D simulations are so complicated that it is difficult for us to investigate the important processes driving the large-scale flow obtained in the 3D simulation. In order to overcome this difficulty, we calculated the angular momentum using the simple axisymmetric model with the turbulent transport which is obtained from the analysis of the 3D global simulation. Through this new parameterization, 2D mean-field model itself should be improved by introducing more sophisticated turbulent transport effects. For the first step, we compared the result of the axisymmetric model with that of the 3D simulation to confirm that the turbulent transport is correctly included in the axisymmetric model.