Some thoughts on observing flares and starspots with new Japanese 3.8m telescope

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Observations of Superflare stars outside of flares

- High resolution (R>50,000) spectroscopy
  - Magnetic fields (Zeeman splitting)
  - Rotation rates (v sin i), find inclination from period
  - Confirm T and gravity
  - Doppler imaging with good time resolution
- With spectropolarimetry (like ESPaDOnS on CFHT)
  - Zeeman Doppler imaging to map starspots and magnetic fields
  - Polarimetry hard with Nasmyth focus

  http://www.cfht.hawaii.edu/Instruments/Spectroscopy/Espadons/Espadons_description.html

Spectroscopic observations of flares on superflare stars I. low resolution

With R<5000 spectrograph, can observe flare continuum evolution

- M dwarfs - Balmer continuum increases during flare, blue-hot blackbody continuum strong in impulsive phase, red continuum in gradual phase. Is this the same in GK dwarfs superflares? Very important to know for flare models!
- Need good spectrophotometric flux calibration (wide slit)
- Need good time resolution, continuous spectra < 1 minute exposure time, short readout time
- Need large wavelength coverage, 3500-9000A
- Need a large amount of observing time!
  - M dwarfs, flare rate (of big flares) 1-2/day, need one week to get good flare
  - G dwarfs, flare rate 0.1-0.2/day (of superflares), need about 10 weeks!!
- Important to have simultaneous photometry, at least U-band but multi-color if possible. Can use small telescope, must have very good precision ~ 0.01mag. Need to connect spectra to light curve behavior.

Spectroscopic observations of flares on superflare stars II. High resolution

- Should have R>20,000 at least
  - Observe H Balmer, Ca II, He I, II, and other lines during flares
  - Is similar Stark broadening and timescales of line evolution observed in GK superflares compared to M dwarf flares? (H Balmer slower than white light, Ca II slower than H Balmer)
  - Do lines show velocities from condensation and evaporation regions predicted by models?
  - Observe Balmer edge near 3600-3800A, compare to model predictions of Landau-Zener effects, diagnose electron density in flare emitting regions
  - Line observations very important for constraints on flare models!

Flare campaigns

- World-wide campaigns to observe flares with new 3.8m telescope
- Include many ground-based telescopes (e.g. APO 3.5m and photometric telescopes, and Subaru!)
- Include X-ray satellites and HST (UV) and radio telescopes
- How to find a star that will flare during the campaign??!