

## Chromospheric Crinkles and Pre-Flare Crackles with H $\alpha$ imaging spectroscopy: Project Details

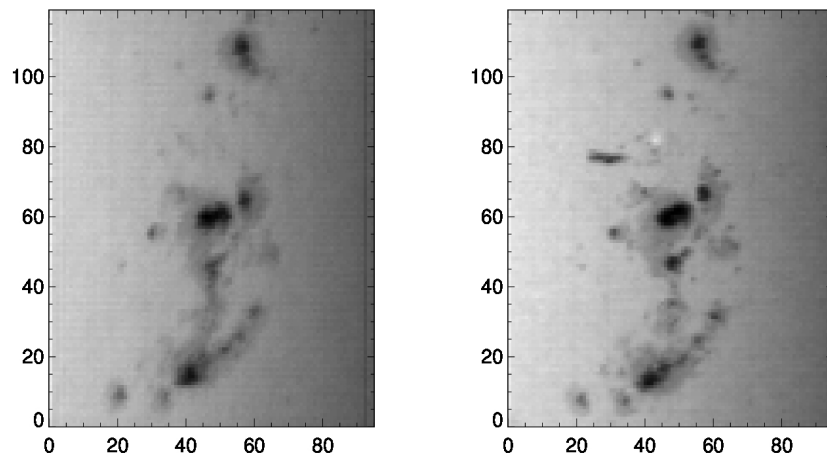
What do we have?

- H $\alpha$  data: x,y, $\lambda$ ,t
  - M CCD = non-acronym short name for “The Mees Solar Observatory CCD Imaging Spectrograph”
    - low/moderate spatial sampling (generally 2", instrument resolution was higher)
    - high temporal cadence ( $\approx 20$ sec/scan)
    - moderate spectral resolution ( $R = 200,000+$ )
    - high spectral coverage ( $\pm 10\text{\AA}$ ) at moderate sampling ( $0.4\text{\AA}/\text{pix}$ )
  - Active-region centered (in general)
  - generally “sit & stare” observations
  - 10+ years of data
- Event lists
  - Flares from NOAA GOES event catalogs  
(/data/SOLMAG/AUX\_DATA/FLARE\_EVENT\_LISTS)
  - CMEs
    - “ERU” flag in NOAA catalogs
    - SoHO/LASCO event catalogs (details: TBD)
    - Radio burst catalogs (details: TBD)

What do we want?

- Parameters: single numbers which each describe some characteristic of the data.
- Parameters will be constructed to describe the physical state regarding:
  - Dynamics
  - Heating
  - Reconnection events
  - Overall activity level
  - \_\_\_\_\_
  - \_\_\_\_\_
    - Extensive Parameters are f(size of [active region, scan performed, *etc.*])
      - *e.g.*: total magnetic flux of an active region
    - Intensive Parameters: NOT a f(size of [active region, scan performed, *etc.*])
      - *e.g.*, mean magnetic field strength in an active region
  - Parameters can be based on:
    - An image at a particular wavelength
      - Intensity (brightness)
      - Distribution of intensity
      - \_\_\_\_\_
    - A time-series of images
    - Analysis of the H $\alpha$  spectral line over the image(s)
      - Doppler shift
      - Line width
      - Line depth (emission = -1\*absorption or *vice versa*)
      - Line asymmetry

- Stark wings or similar non-thermal signatures
- Relative to:
  - a specified  $t_0$
  - the quiet sun (away from sunspots or H $\alpha$  activity)
- Parameters should *avoid* variation with respect to:
  - instrumental or local observing effects
    - instrument set-up
    - time of local day (instrument temperature, atmospheric seeing, insolation; see Figures 1,2)
  - observing angle (distance from disk-center to location on the disk of the AR)
  - \_\_\_\_\_
- Expecting maybe a few hundred parameters in the end.



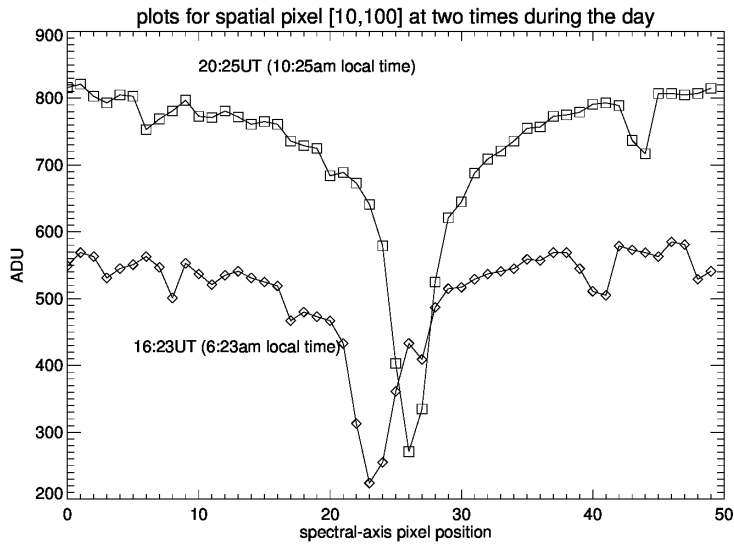
*Figure 1: Images made from spectral position 2 at 16:23 and 20:25UT, scaled the same. Note the better seeing slightly later, and the overall increased brightness. Both images display a left/right brightness gradient but also the later image is indeed brighter. For example, a “total brightness parameter” wants to catch the additional absorption feature at 20:25 that is part of the CME, but does not want to include the overall brightness differences.*

Needed for Statistical Analysis:

- Designate samples as being from Pre-Event and Pre-Quiet populations
  - Q: Definitions of Events (note plural)?
    - flare/CME
    - size
    - timing
    - \_\_\_\_\_
  - Q: Randomized time (“forecast mode”) vs. super-posed epoch analysis?

### Code Design considerations:

- Modular code to be able to process lots of data automatically, and add in new parameters or edit and re-run easily.
  - model after nwra\_mag stuff, perhaps. Possibly not in IDL.



*Figure 2: line-shift and varying noise levels in the spectra as a function of the observing time. Note the overall lower intensity, hence the increased noise, the additional telluric lines appearing, and the overall line-center position shift between early-morning and mid-morning data. See [/data/SOLMAG/ANALYSIS/FLARES/MC CD/idl\\_log\\_160612\\_2118](#) for how to produce this plot.*