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Study Solar Activity in the Backside of the Sun

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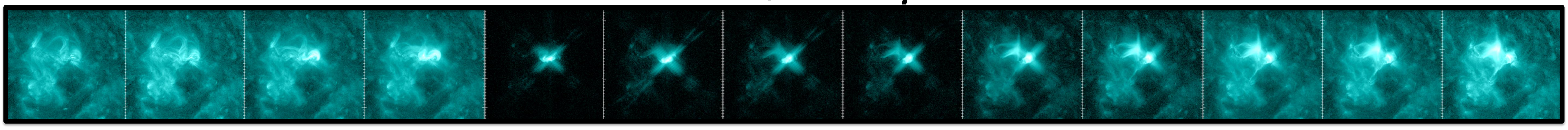


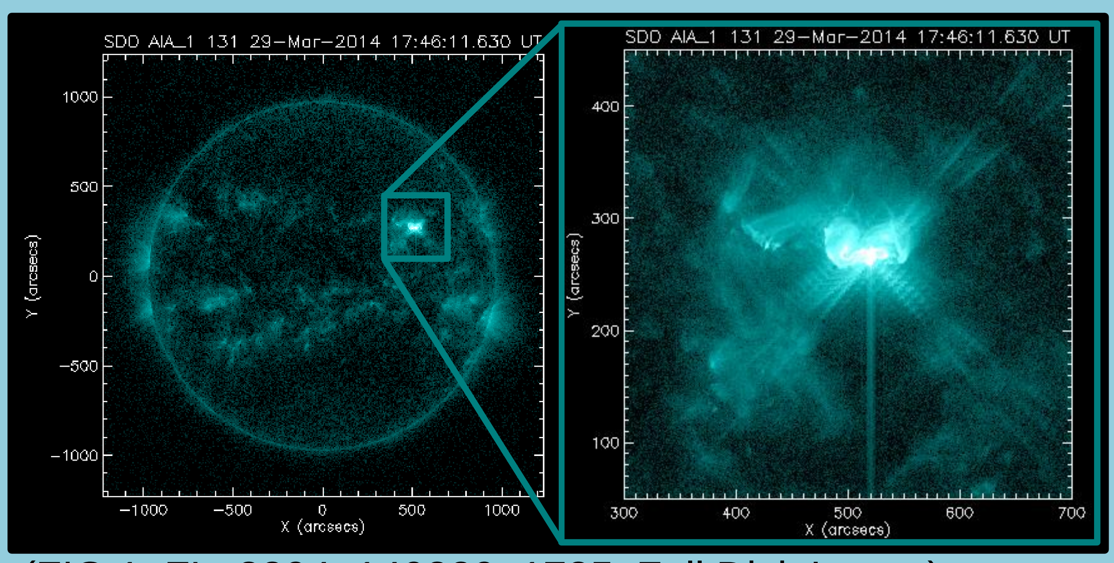
Overview

Understanding solar flares is essential to space weather forecasting. Solar flares occur where there are strong magnetic fields. Magnetic fields dominate the evolution of the Sun's active regions. In determining flare classes, Soft X-ray observation is used. Currently Soft X-ray observations are all from front side. So classes of backside flares can not be obtained. If front side X-ray data can be correlated to other data (EUVI) which are also available for backside events, more accurate space weather forecasts could be generated. This study begins the correlation by carefully examining the relationships using front side observations of EUV imaging and X-ray measurements.

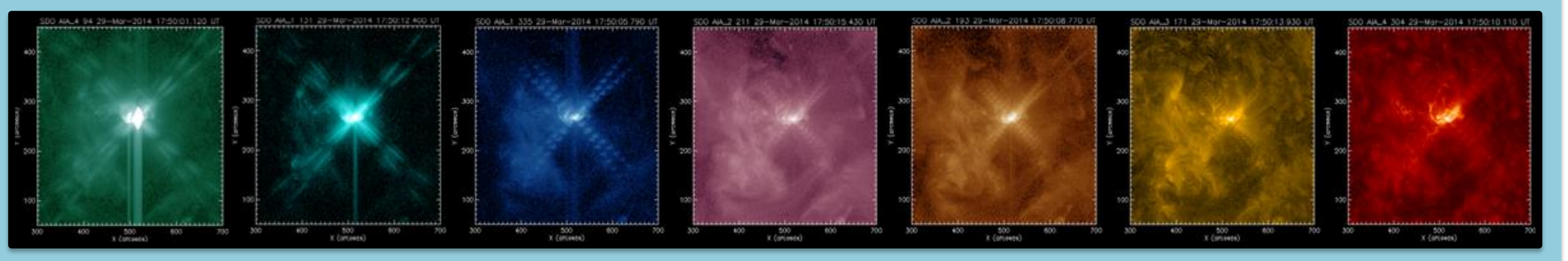
Key Findings

The focus is on large solar flares because these are space weather related. All C 5.5 and above flares from October 2010 through February 2015 that occurred in the central disk region were examined. A total of 297 flares are included in the study. They broken down to follows: 12 X-class flares, 121 M-class flares, and 164 C-class flares.

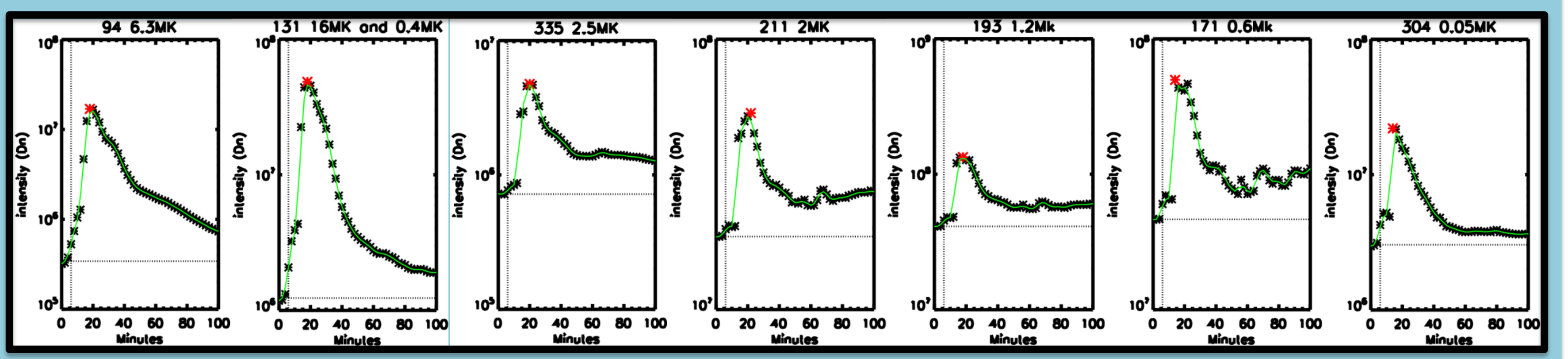
Steps:
- -Download the flare
- -Process the flare
- -Check images
- -Create light curve
- -Check duration
- -Check against GOES



(FIG 1: FL_3894_140329_1735, Full Disk Image)



(FIG 2: FL_3894_140329_1735, 20th Minute Images by AIA wavelength)

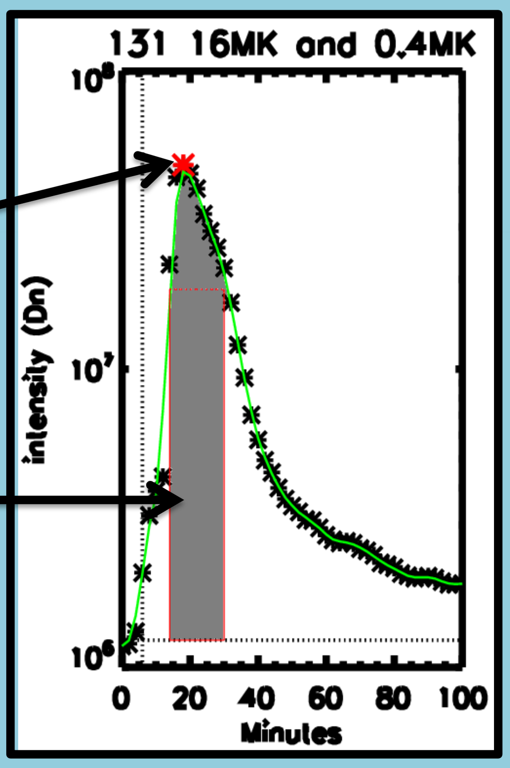


(FIG 3: FL_3894_140329_1735, Light Curves by AIA wavelength)

The values for all seven AIA wavelengths were calculated against GOES values for peak and luminosity.

Peak

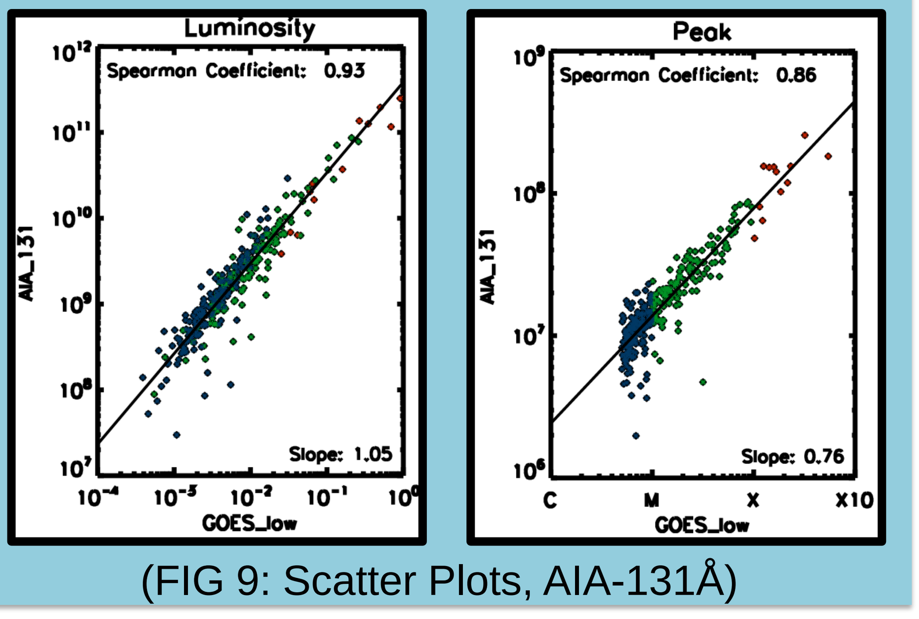
Luminosity is the area under the curve. Only a defined section of the curve was used in order to more accurately compare different flares. The luminosity is defined as the total integrated intensity for: (Peak-Background Level)/e.



(FIG 8: Example for Luminosity and Peak, FL_3894_140329_1735, AIA-131Å

The AIA-131Å wavelength showed the strongest correlation

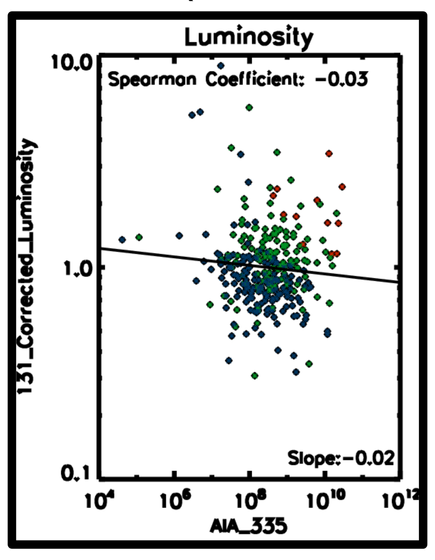
Spearman Coefficient (rho) is a rank coefficient that measures the strength of the relationship between two variables.
- ρ = 1; perfect association
- ρ = 0; no association
- ρ = -1; perfect negative association



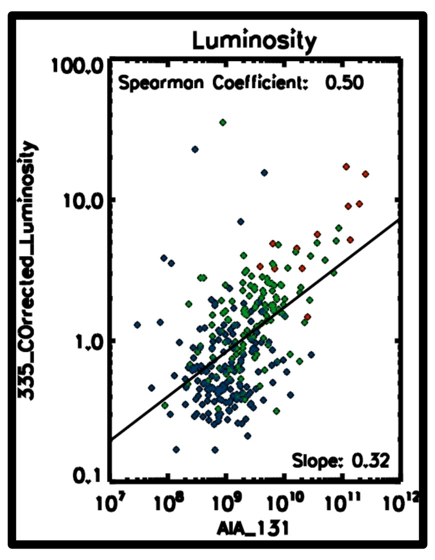
(FIG 9: Scatter Plots, AIA-131Å)

Explanation

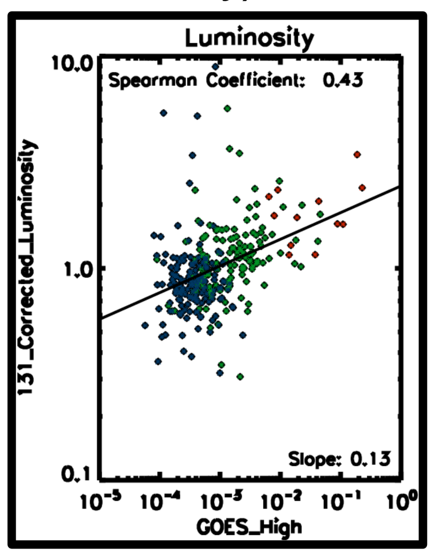
(FIG 10, 11, 12: Scatter Plots, Results for Luminosity)



(FIG 10)



(FIG 11)



(FIG 12)

* The AIA-131Å to AIA-335Å plot shows no correlation for luminosity after the AIA-131Å data is corrected for Luminosity (FIG 10).

* The AIA-335Å to AIA-131Å plot shows a slight residual correlation pattern for luminosity after the AIA-335Å data is corrected for Luminosity (FIG 11).

* The AIA-131Å to GOES-High also shows a very slight residual correlation pattern after the AIA-131Å data is corrected for Luminosity (FIG 12). Possibly this is because the AIA-131Å wavelength is cooler than the GOES-High. So a combination of AIA-131Å and GOES-High could give a better indication of GOES-Low than AIA-131Å alone.

(Note: Corrected for Luminosity means that the GOES intensity was divided by the fit of the line for that wavelength.)

Impact

The next step is to compare the results to the flare intensity in the STEREO wavelengths. It is expected that the results will be similar to the AIA-335Å and AIA -211Å results from this study because they are close in temperature to the STEREO-284Å. This data can then be used lead to more accurate prediction of X-ray measurements.

Acknowledgements

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