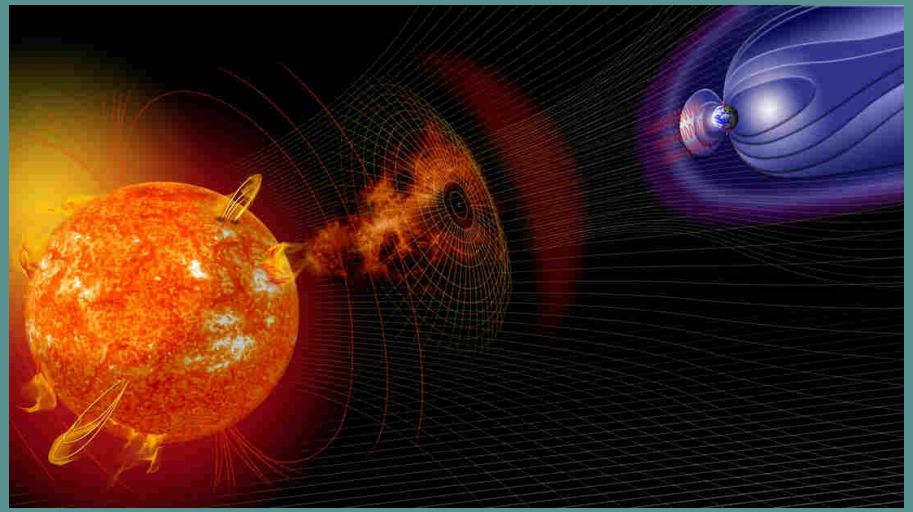
Stealth CME Detection



The Story of our Project

- Shawn works at LASP
- We reached out to scientists at LASP to ask “What’s going on? How can we help?”
- That led us to our SME’s

James Mason - CU Graduate

CURRENT POSITION

I used to work at University of Colorado Boulder, Stanford University, and University of California Santa Cruz

NASA Goddard Space Flight Center

NASA Postdoctoral Program Fellow

2017 September – Present

I write open source code in python, IDL, and other languages to analyze large amounts of data collected by satellites observing the sun. Plus I'm still involved in satellite development and operations; and sounding rockets.

Don Woodraska - CU Expert

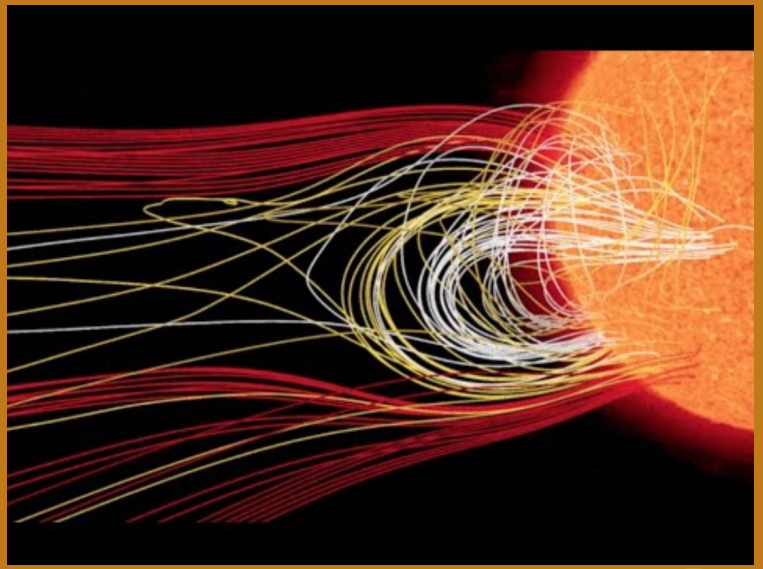
Current Institution

University of Colorado Boulder | CUB
Laboratory for Atmospheric and Space Physics (LASP)
Boulder, CO

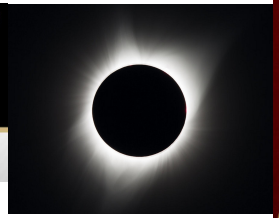
Current position
Professional Research Assistant

Our Project

- Detect “Stealth CMEs”!



The Science



Solar Eruptive Events: Coronal Dimming and a New CubeSat Mission

Date of Award
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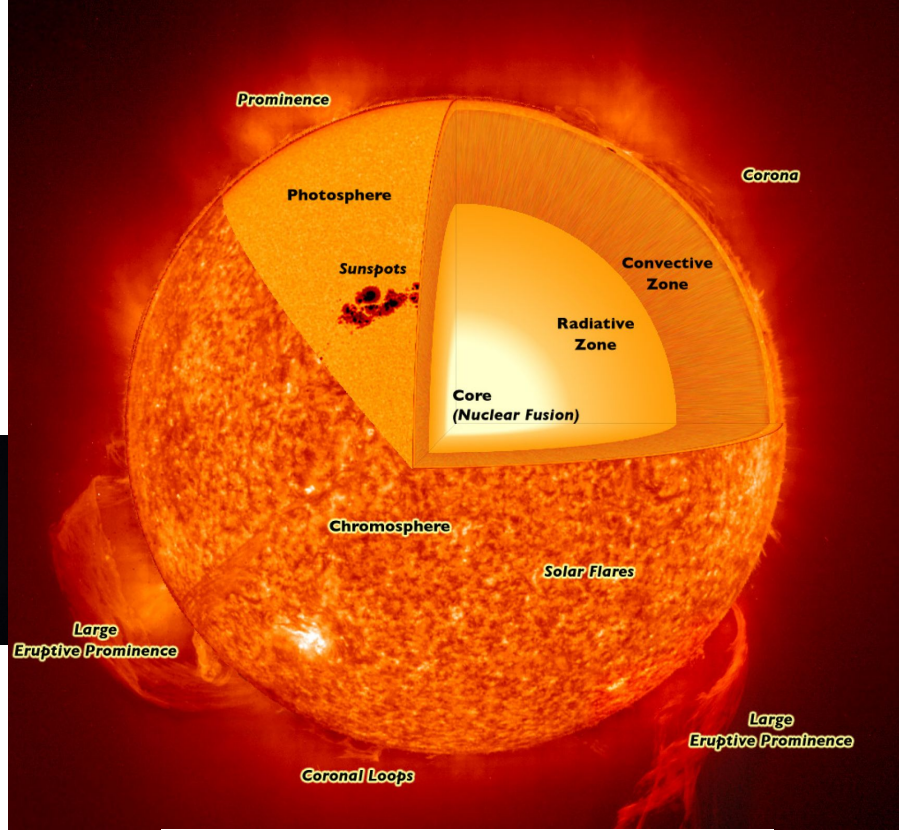
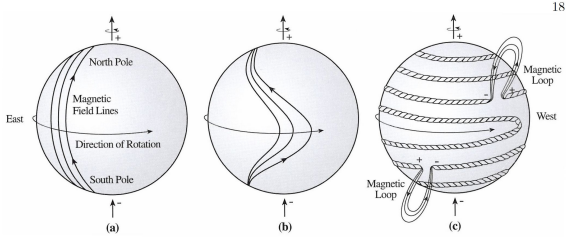
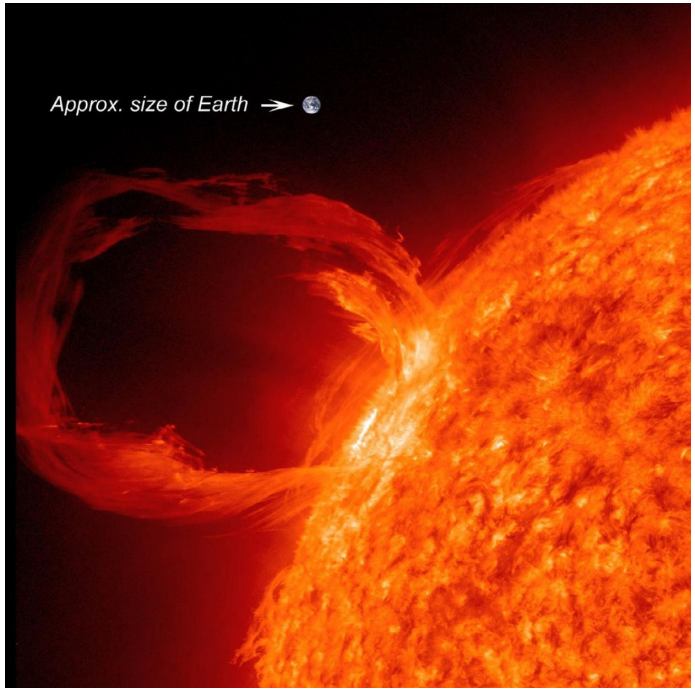
Document Type
Dissertation

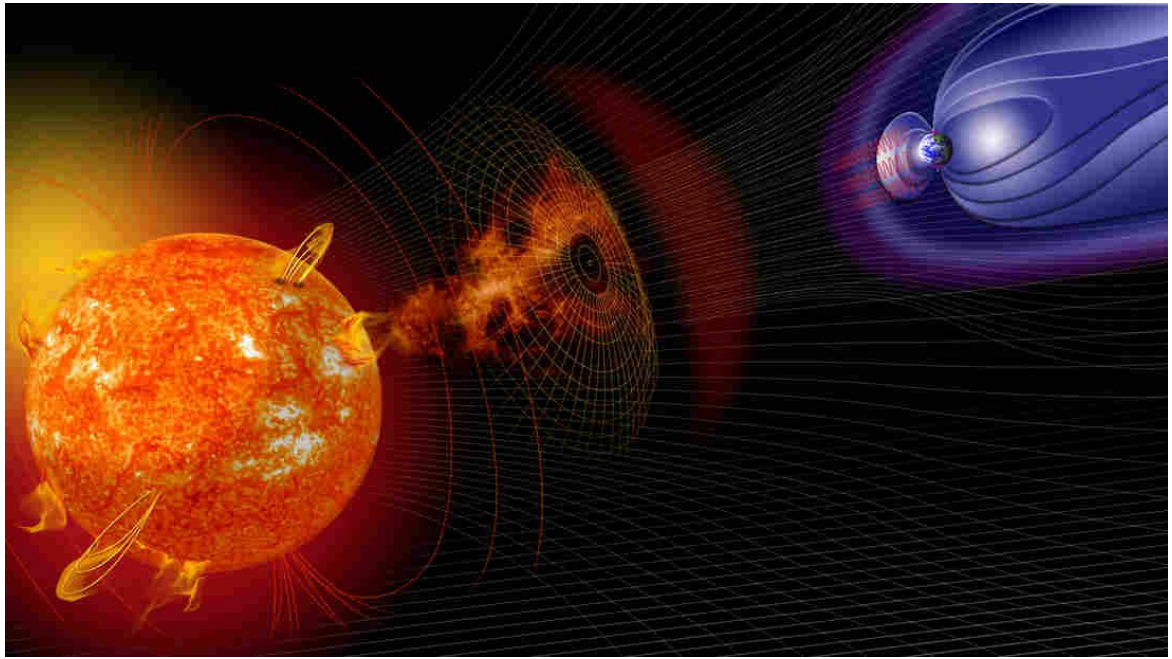
Degree Name
Doctor of Philosophy (PhD)



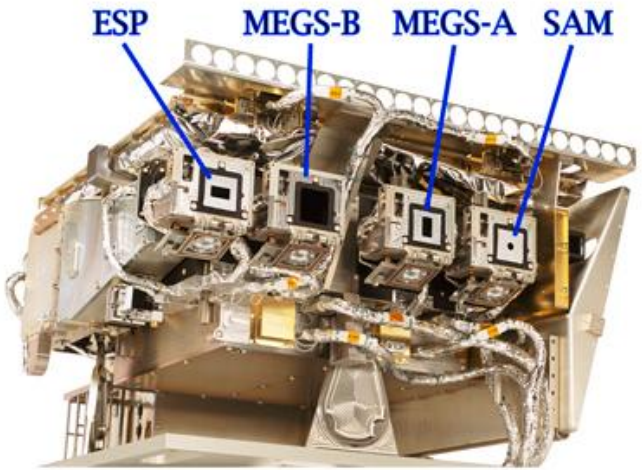


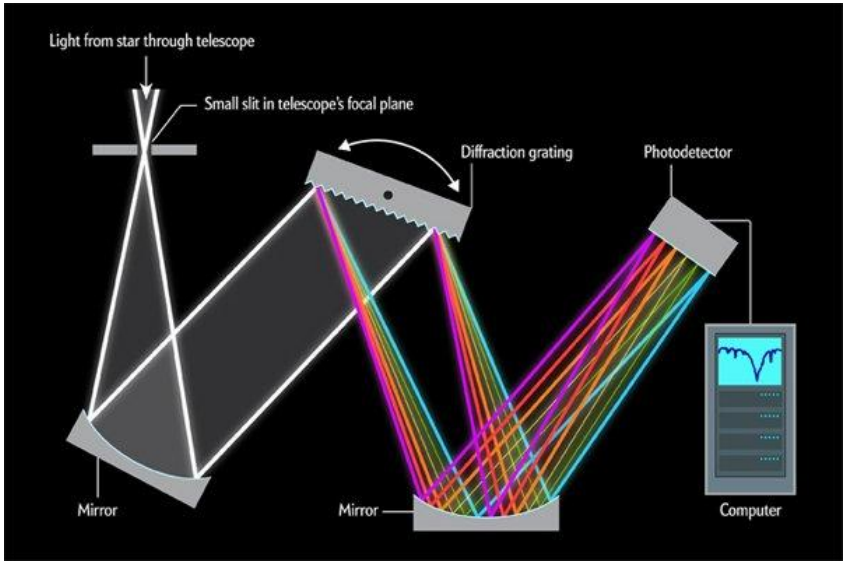
The Science (cont.)



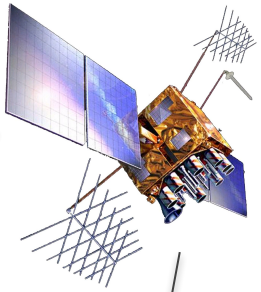


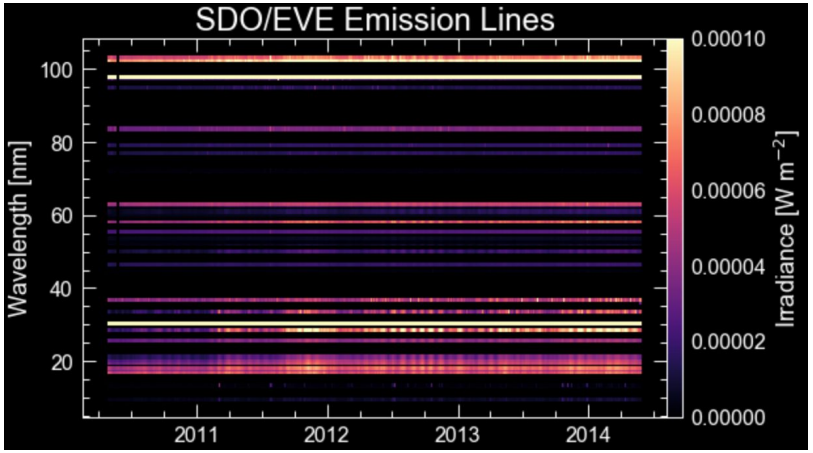
The Instrument - SDO EVE

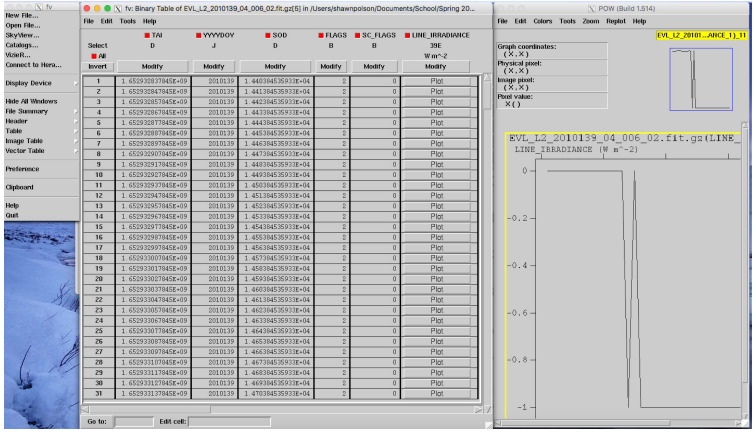


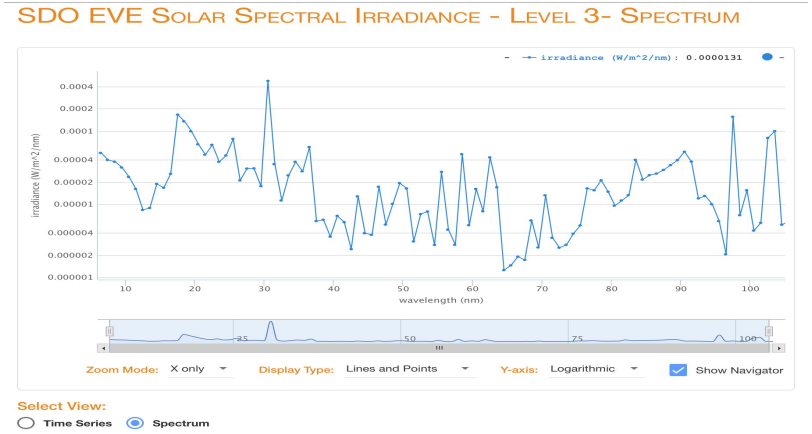


Flow of Data




SDO/EVE Emission Lines
Wavelength [nm]
100
80
60
40
20
2011
2012
2013
2014
Irradiance [W m^{-2}]
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000


fv: Binary Table of EVL_L2_20101139_04_006_02.fit.gz[5] in /Users/shawnpolson/Documents/School/Spring 20...
File Edit Tools Help
TAI
YYYYDOY
SOD
FLAGS
SC_FLAGS
LINE_IRRADIANCE
Select
All
Invert
Modify
W m^-2
Plot
Go to:
Edit cell:
POW (Build 1.514)
File Edit Colors Tools Zoom Replot Help
Graph coordinates:
(X,Y)
Physical pixel:
Image pixel:
Pixel value:
X()
EVL_L2_20101...ARCE_1)_11
EVL_L2_20101139_04_006_02.fit.gz(LINE_
LINE_IRRADIANCE (W m^-2)
0
-0.2
-0.4
-0.6
-0.8
-1


SDO EVE Solar Spectral Irradiance - Level 3- Spectrum
irradiance (W/m^2/nm): 0.0000131
irradiance (W/m^2/nm)
0.0004
0.0002
0.0001
0.00004
0.00002
0.00001
0.000004
0.000002
0.000001
10
20
30
40
50
60
70
80
90
100
wavelength (nm)
Zoom Mode: X only
Display Type: Lines and Points
Y-axis: Logarithmic
Show Navigator
Select View:
Time Series
Spectrum

Our Goals

- Be the first humans to catalog Stealth CME events
- Detect coronal dimming events in SDO/EVE emission line time series data without the use of GOES solar flare event times to trigger the search
- Help advance real space science!
- Characterize the detected dimming events in terms of slope and depth.

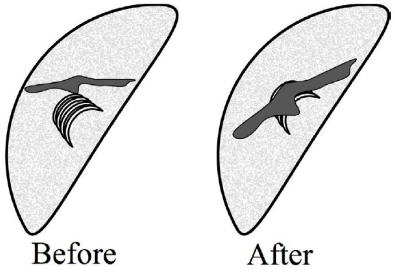


Figure 3.5: Schematic depicting the process of obscuration dimming. A filament previously obscuring only the quiet sun (left) expands and moves in front of a flare arcade (right). This results in a decreased observed emission from the flare arcade in wavelengths where the filament is optically thick.

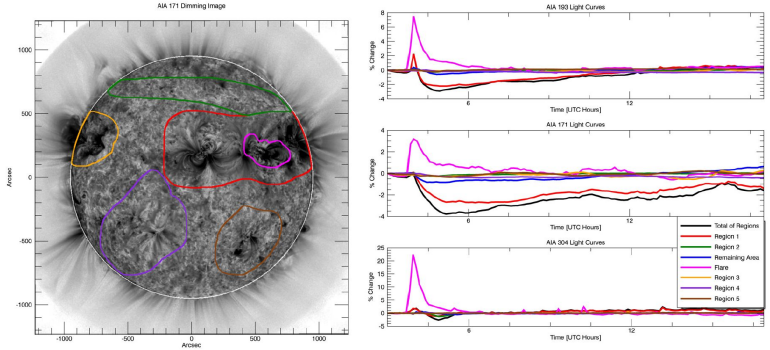


Figure 4.9: Same as Figure 4.8 but with new contours selected and no point spread function correction applied. Also the 304 Å emission time series is now complete in this later analysis using more recent AIA data products.

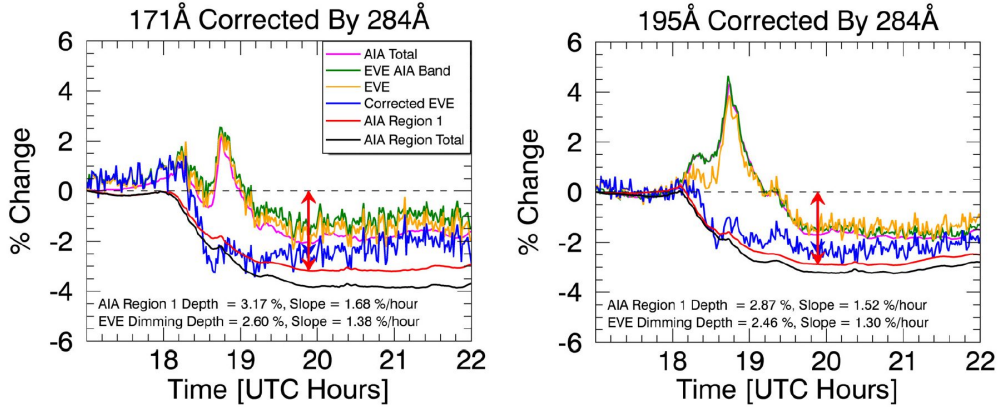
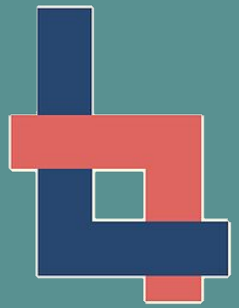


Figure 4.14: Both plots are similar to Figure 4.12 but provide more detail. The left shows results from 171 Å and the right is for 193 Å (AIA) / 195 Å (EVE). The red vertical arrow indicates the point where depth is computed and overlaps a blue vertical arrow indicating the end time of slope computation. The slope range begins at 17:50 UT.

How are we going to work with our data?

IDL



- Line ratios for slopes
- New lines temporarily appearing in spectrum
- Other signifiers?
- Work closely with SMEs to evaluate results

Questions?