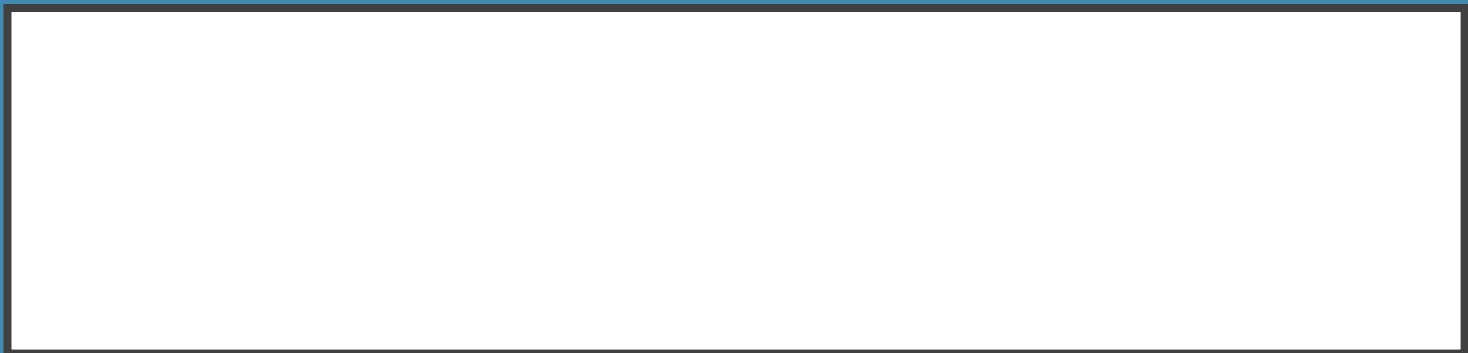


Sleuthing Stellar Filament Eruptions Using He 1083 nm: A Solar Test

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IMPORTANCE OF CMES

Mass Loss

- important for dynamo, evolution

Angular Momentum Loss (?)

- how well/long connected?

Helicity Loss

- important for dynamo

Effects on (exo)Planets

- particle flux
- atmospheric erosion

IMPORTANCE OF CMES

On Sun, strong flares almost always have CMES

- for X flares, close to 100% (Yashiro +06)

So flares and flare-inspired methods (e.g., Radio) often used as a “signal”

But do these miss something?

WHAT ABOUT FLARE-LESS FILAMENT ERUPTIONS (FFES)?

= “Quiet” CMEs

- no flare associated (by definition)
- some CME methods (Radio, flare-flag) wont work (or not as well)
- on Sun, 80% of FEs lead to a CME (Schmeider+12)
- most efficient trigger = torus instability (not flare!)
- flares (when present; 76%; Sinha+19) usually come *after* FE
- So ~23% FEs are flare-less

WHAT ABOUT FLARE-LESS FILAMENT ERUPTIONS (FFES)?

Stars have filaments (prominences)

- Doppler imaging (Collier-Cameron*)
- seen in $H\alpha$ vs Ca II HK: increased HK can lead to $\pm H\alpha$
 - * + $H\alpha$ = plage, flare
 - * - $H\alpha$ = filament, prominence

Searching for FFEs - need diagnostic that:

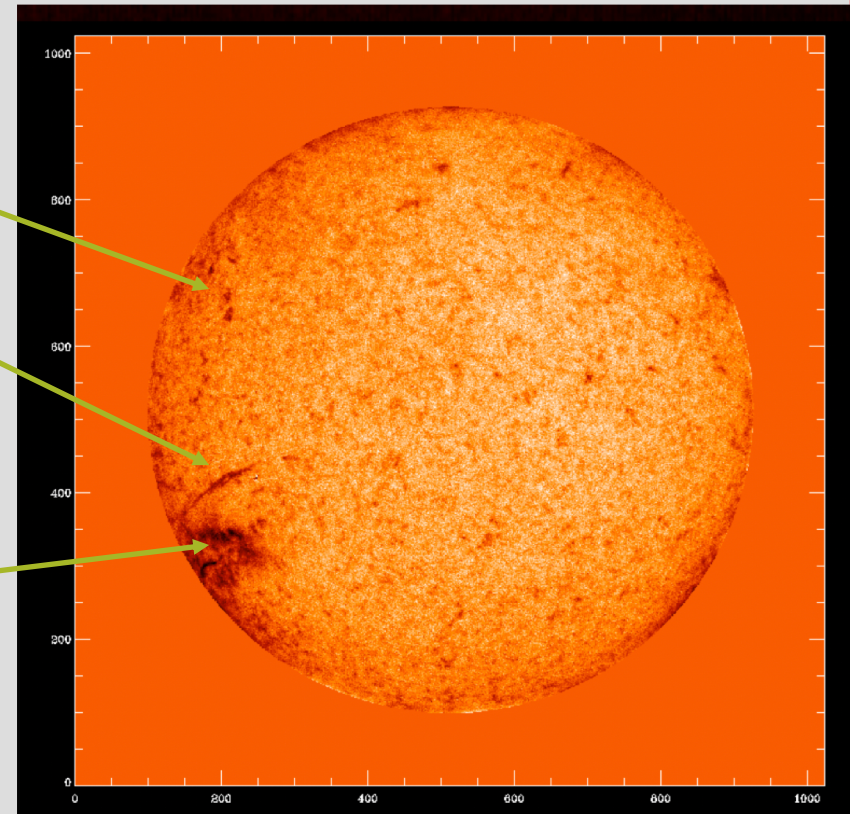
- “sees” filaments, but is
- less sensitive to flares

FFES AS SEEN BY HE I 1083 NM

MLSO CHIPs instrument (CHromospheric Imaging Photometer)

- Filaments dark
- plage/CBP dark too (unlike $H\alpha$),
but change slowly
- Reduced flare sensitivity
- Screen out limb (alignment issues)
- Look for rapid ($< \text{few hours}$)
increase in I_{1083}
- + no rapid return to original level
(flare)

CBP
filament
plage

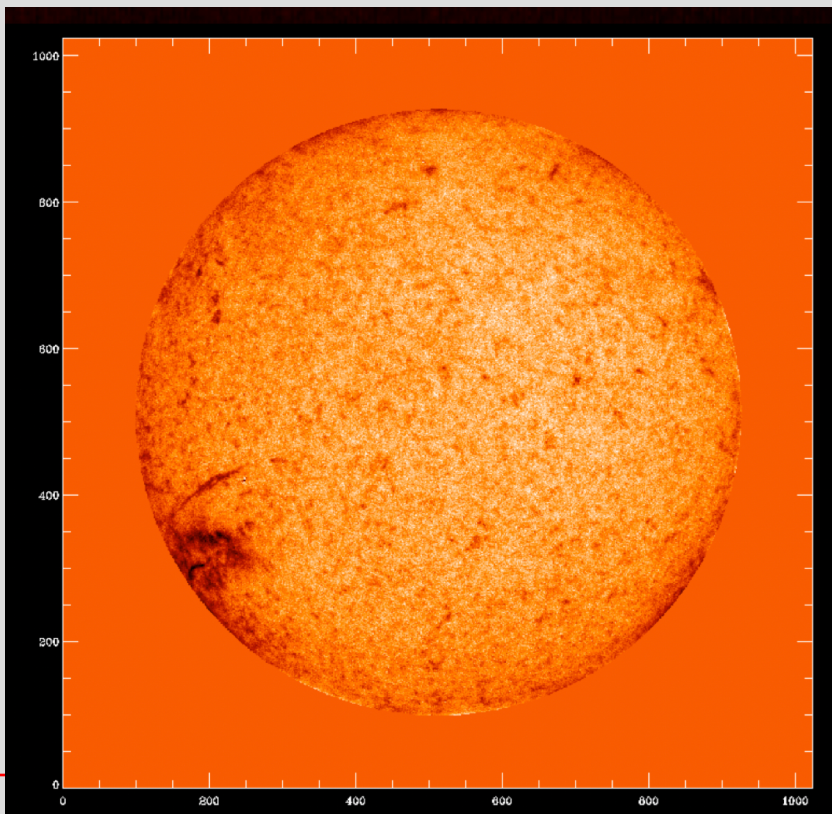


10/10/2010 19:06 UT

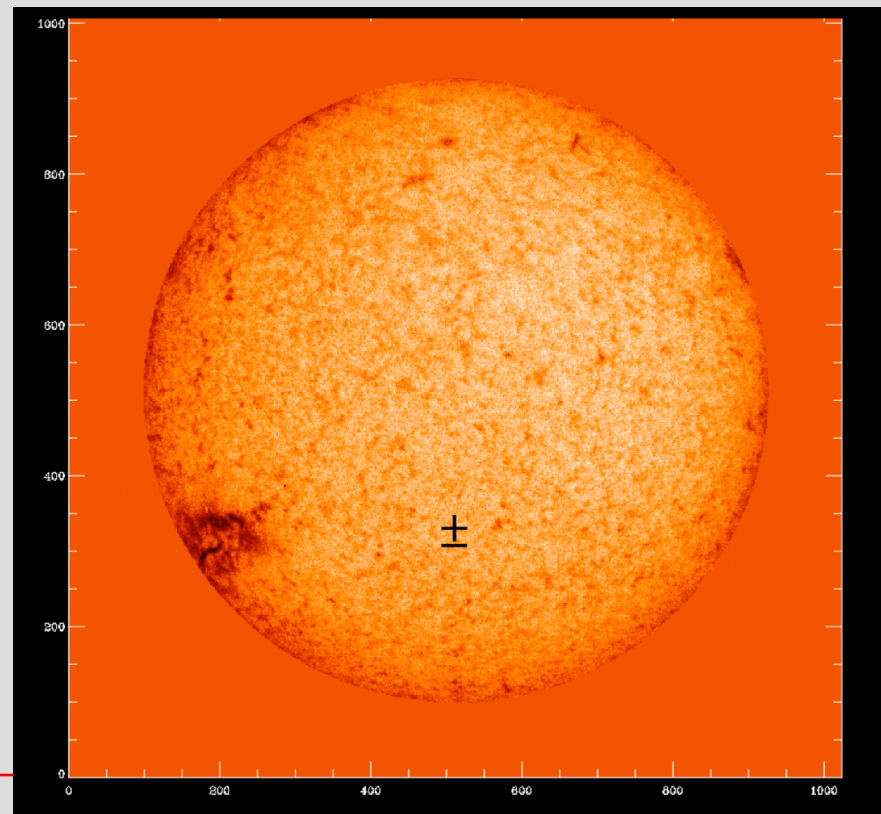
FFES AS SEEN BY HE I 1083 NM

FE #0101 from AIA FE catalog (McCauley+15)

- disappears in ~27 mins, Area ~ 0.3%



10/10/2010 19:06 UT

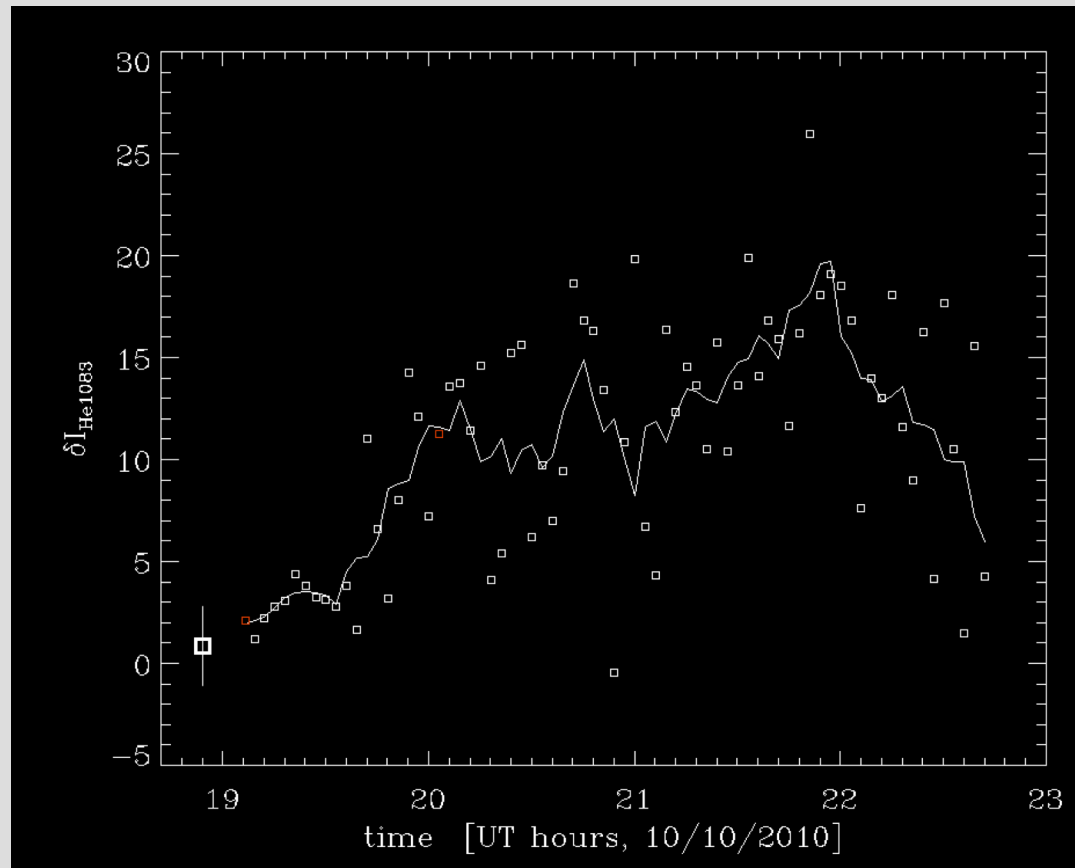


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FFES SEEN BY HE I 1083 NM

Analysis

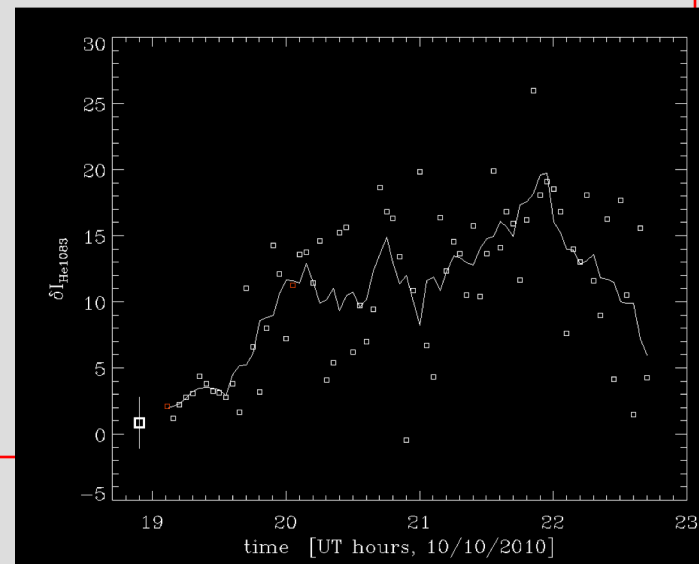
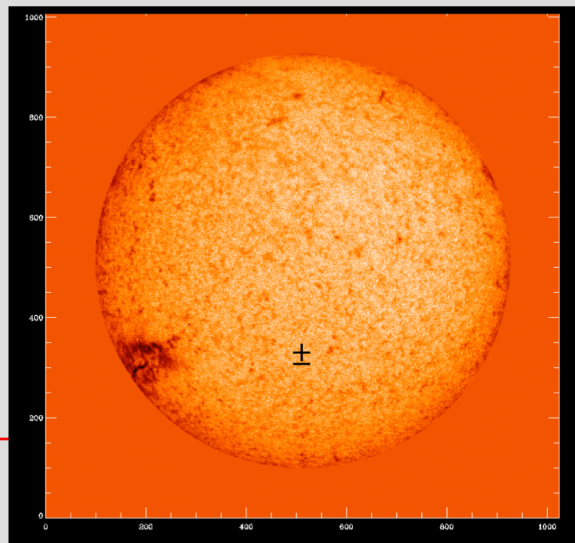
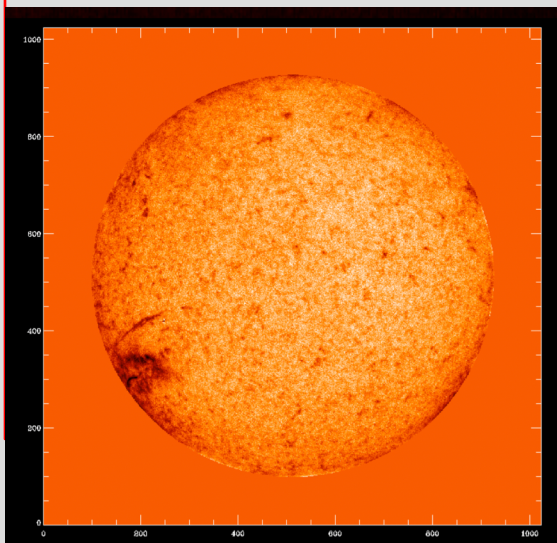
- Change in $I_{1083} \sim +0.2\%$
over ~ 30 min
- pre-FFE I_{1083} similar 18 hrs
earlier (<30 min>; box)
- $I_{1083} \sim$ constant next 2 hrs
($\sigma \sim 0.09\%$)
- Decay at end – sky
transparency issues?
- Δv from CHIPs proved not
useful (limit < 40 km/s)



FFES SEEN BY HE I 1083 NM

Experiment:

- Select FEs from AIA FE catalog (MacCauley+15; 10/2013 – 8/2015) at least 150'' ($\sim 0.08R_{\odot}$) long (large enough for significant I_{1083} signal)
- Analyse corresponding day of CHIP data for FFE triggers
- Compile results



RESULTS (N = 62)

	FFE found	possible FFE	FFE not found
FFE present	55 %	42 %	3 %
No FFE	27 %	-----	-----

(PARTIAL) SUCCESS!

For filaments $L > 0.08 R_{\odot}$

- Definitely detect 55%, see hints of 42%
- But mis-ID 27% - need to work on that....
- Generally detect longer, more opaque filaments, and those from quiet Sun

Looking forward:

- Improve algorithm, reduce mis-IDs
- Estimates of mass loss
- Tests on stars!

