THE ROLE OF CORONAL DIMMING IN LARGE-SCALE EUV WAVES

Springschool Wroclaw

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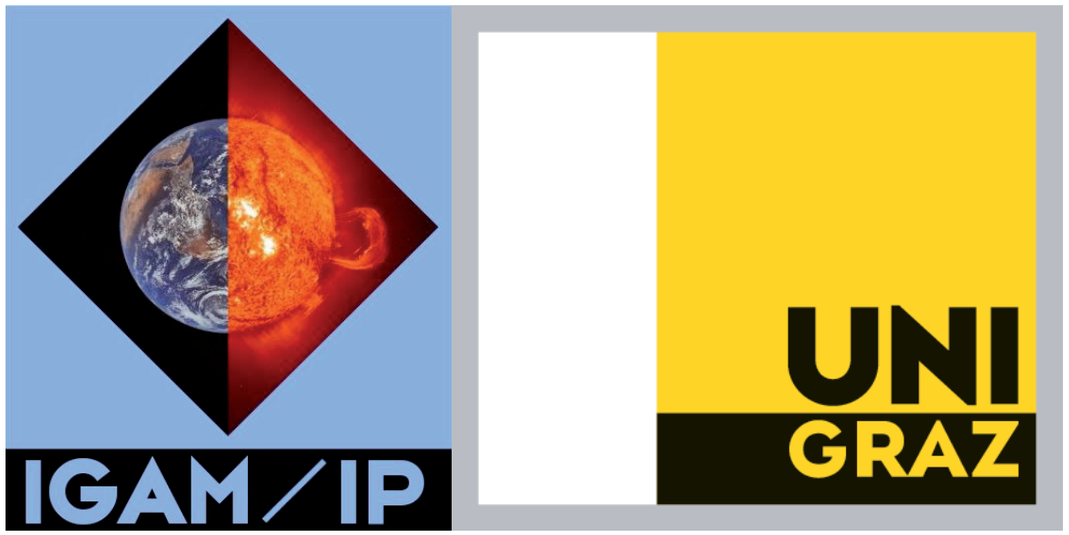
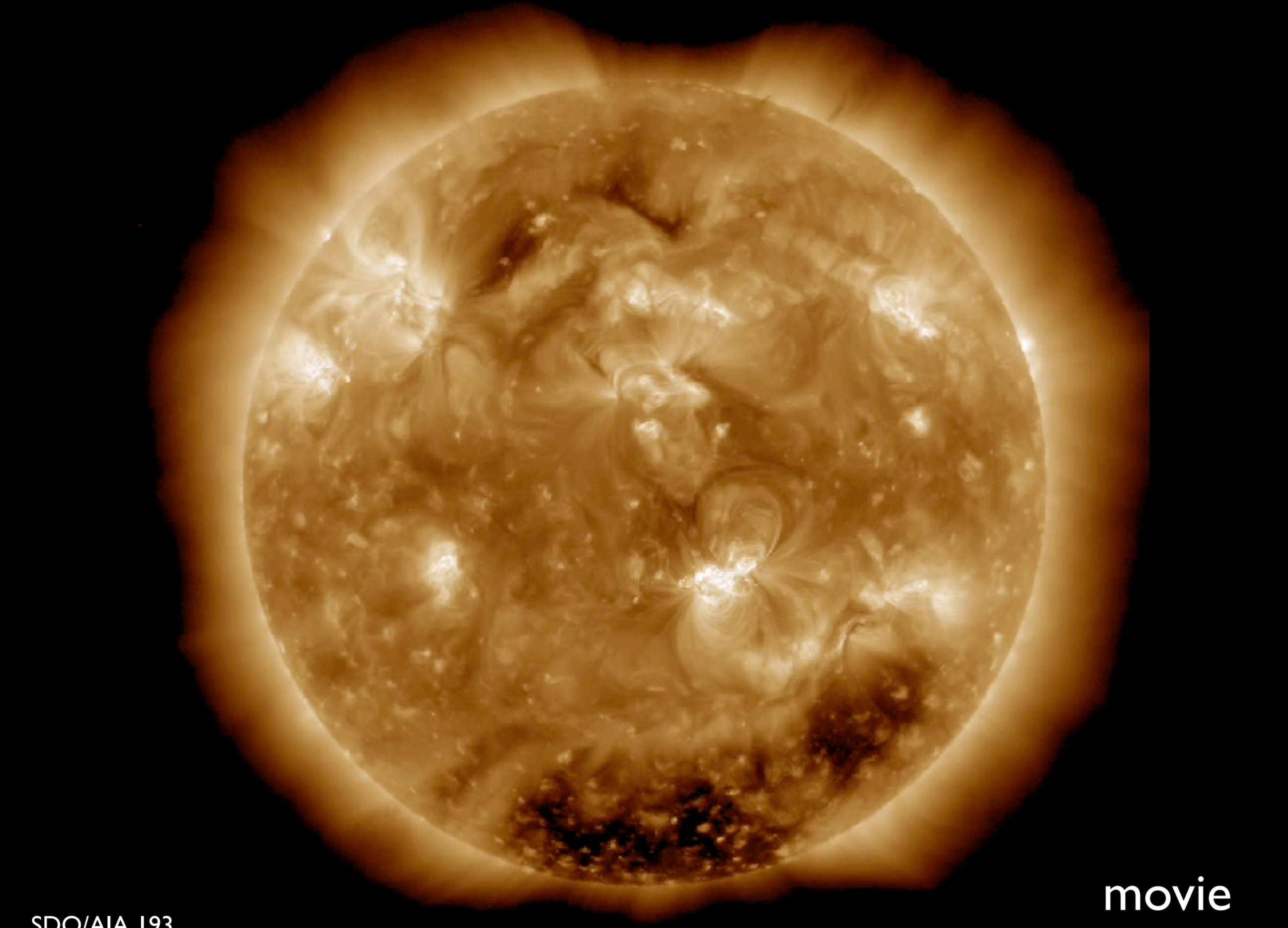
27.03.2014



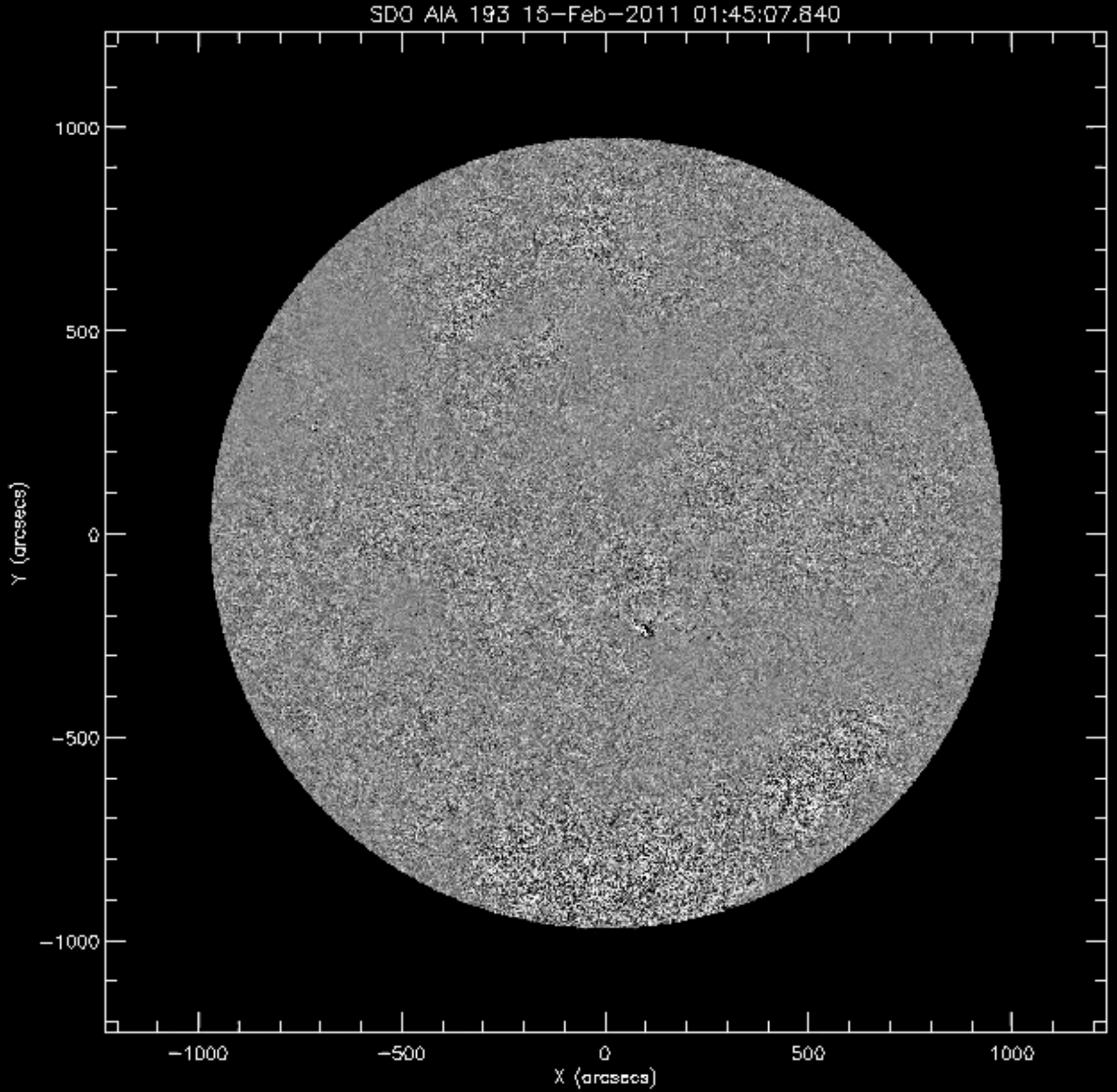
Outline

- Introduction to EUV waves and coronal dimmings
- Research questions
- First Results
- Outlook



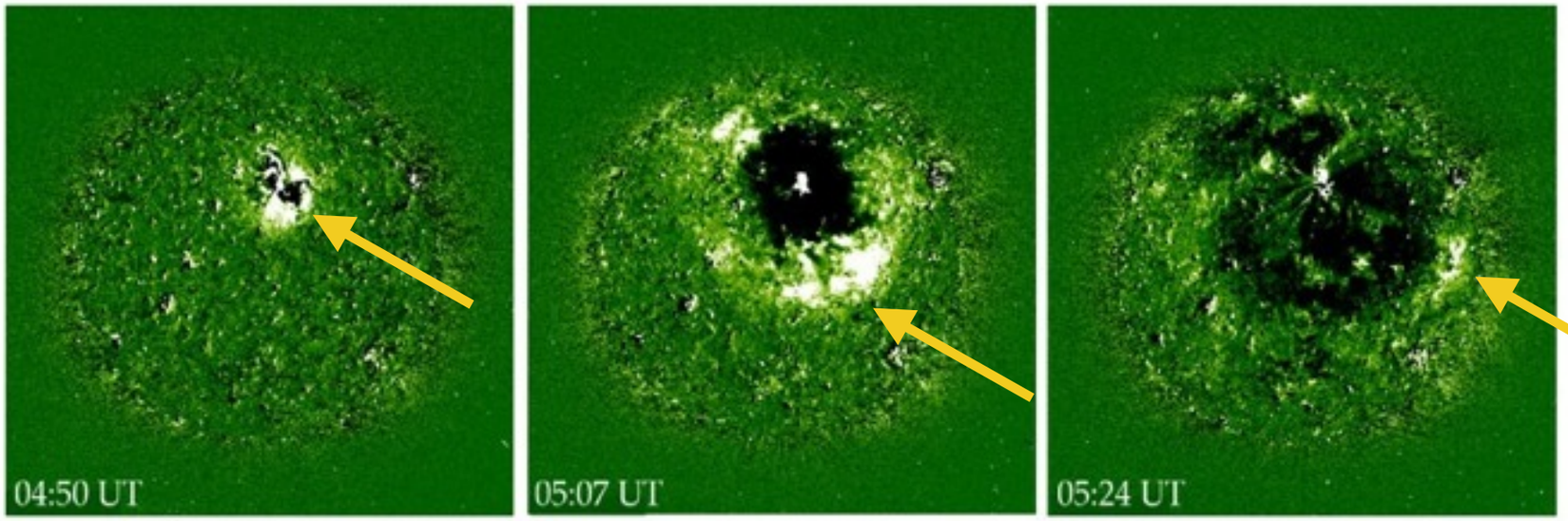
SDO/AIA 193

movie


SDO AIA 193 15-Feb-2011 01:45:07.840
1000
500
0
−500
−1000
Y (arcsecs)
−1000
−500
0
500
1000
X (arcsecs)

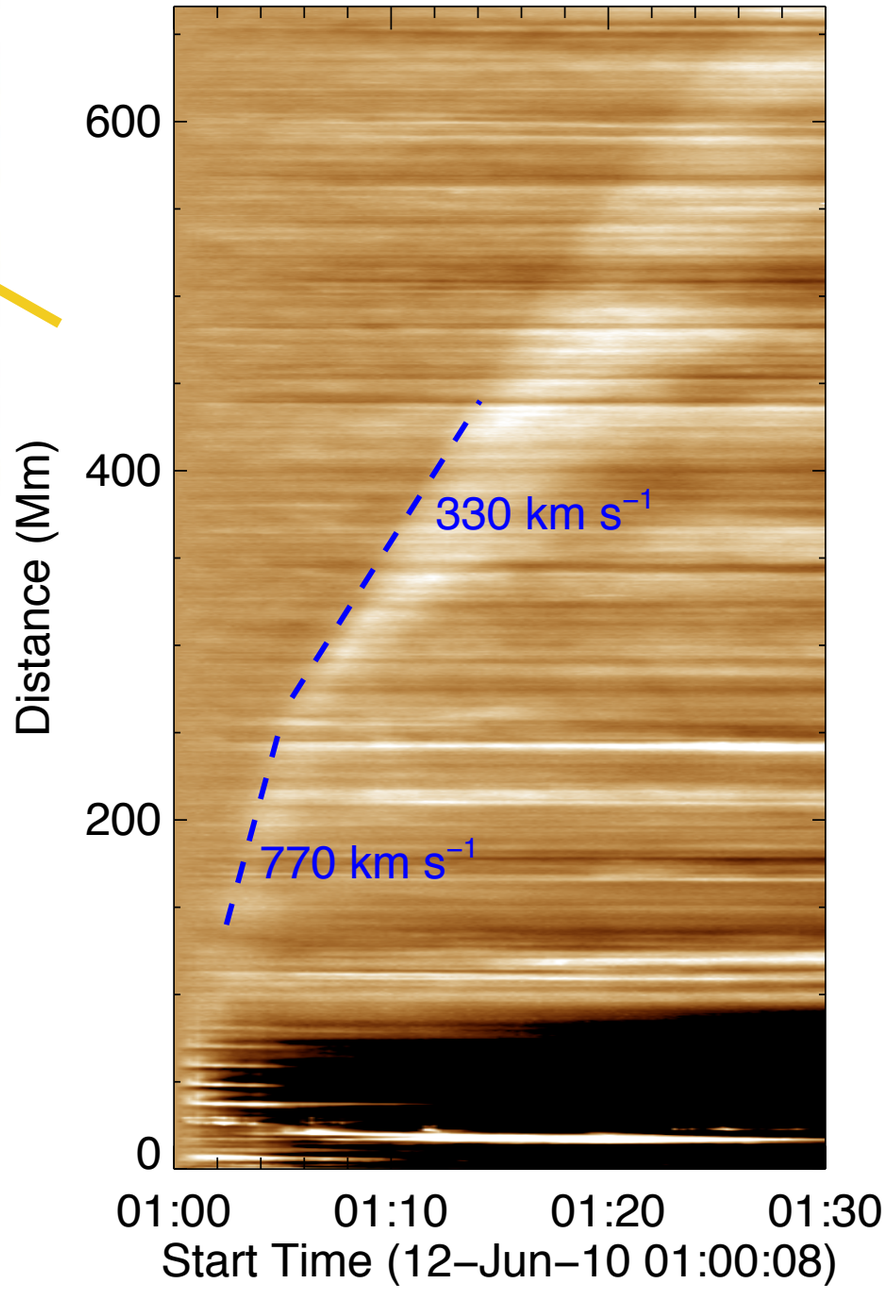
movie

EUV waves



http://soi.stanford.edu/results/SolPhys200/Gurman/

- large-scale disturbance in the solar atmosphere, observed in EUV wavelengths
- in association with flares and CMEs



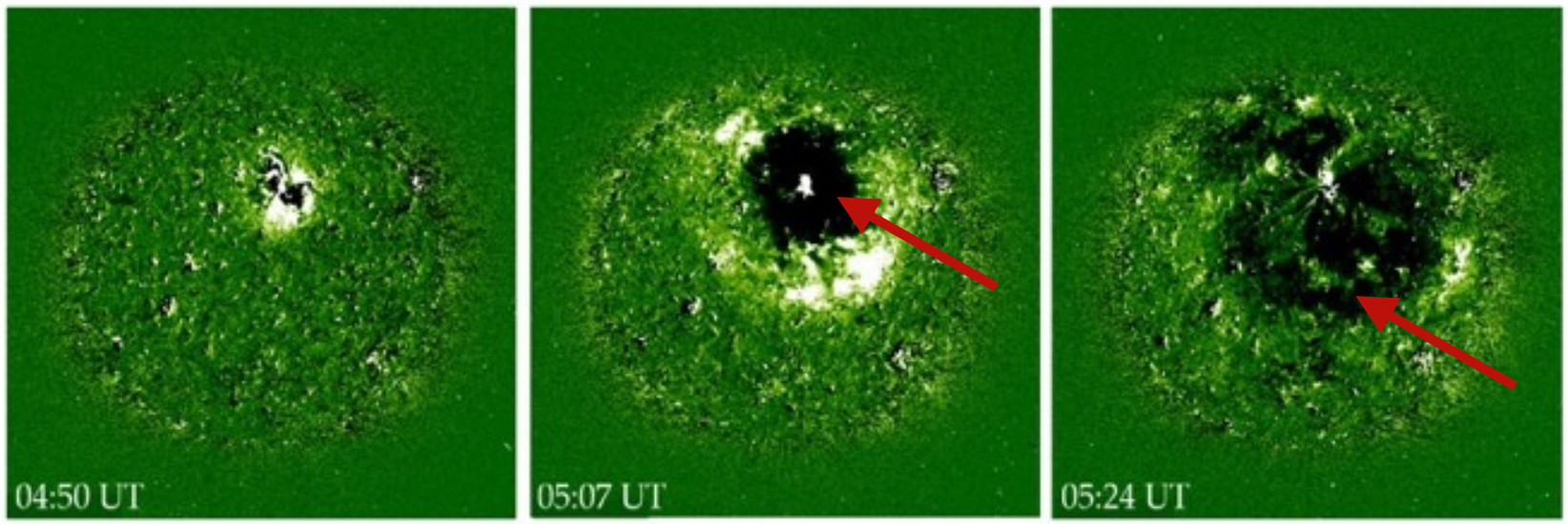
Li et al. 2012, RAA 12,1

EUV waves - Observations

- speeds ranging from 200 to over 700 km s^{-1}
- decelerate to 200-300 km s^{-1} fast mode speed in quiet sun
- avoid regions of high Alfvén speed → reflection at coronal hole boundaries and active regions
- dimmings

Coronal Dimming

- regions with decreased intensity in EUV data and soft X-rays
- dimming is density depletion caused by evacuation of plasma during an eruption
- dimming is a CME signature in the EUV corona



http://soi.stanford.edu/results/SolPhys200/Gurman/

Is it possible to obtain information about associated CMEs from the study of coronal dimmings?

IGAM/IP

UNI GRAZ

The literature says YES …

- volume of the dimming → CME mass Sterling and Hudson, 1997
- spatial extent of the dimming → angular extent of the CME Thompson et al., 2000
- evolution of dimmings (during recovery phase) → evolution of CME post-eruption Attrill et al., 2006
- …

Can coronal dimming tell us something about the driver of the EUV wave?

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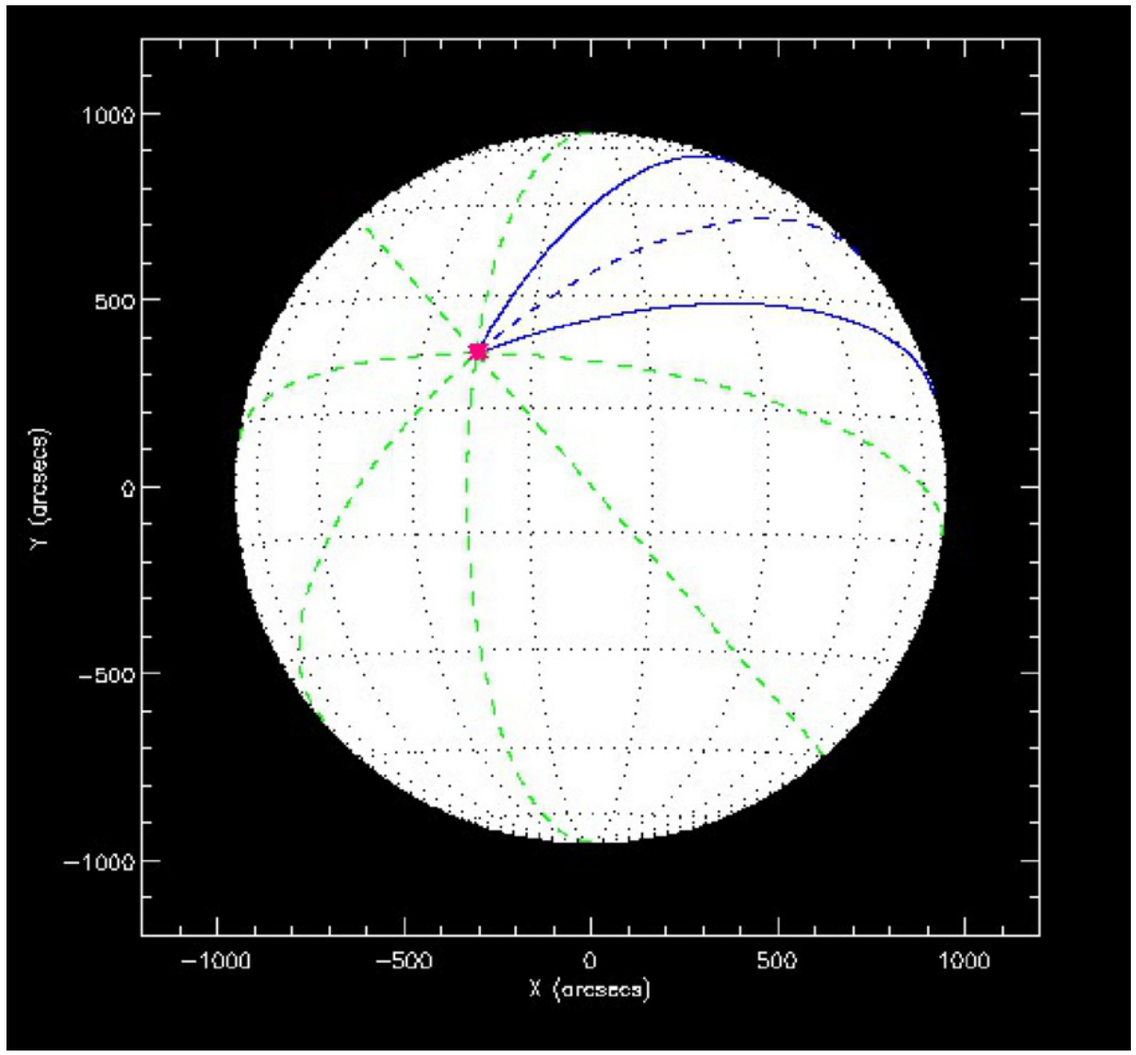
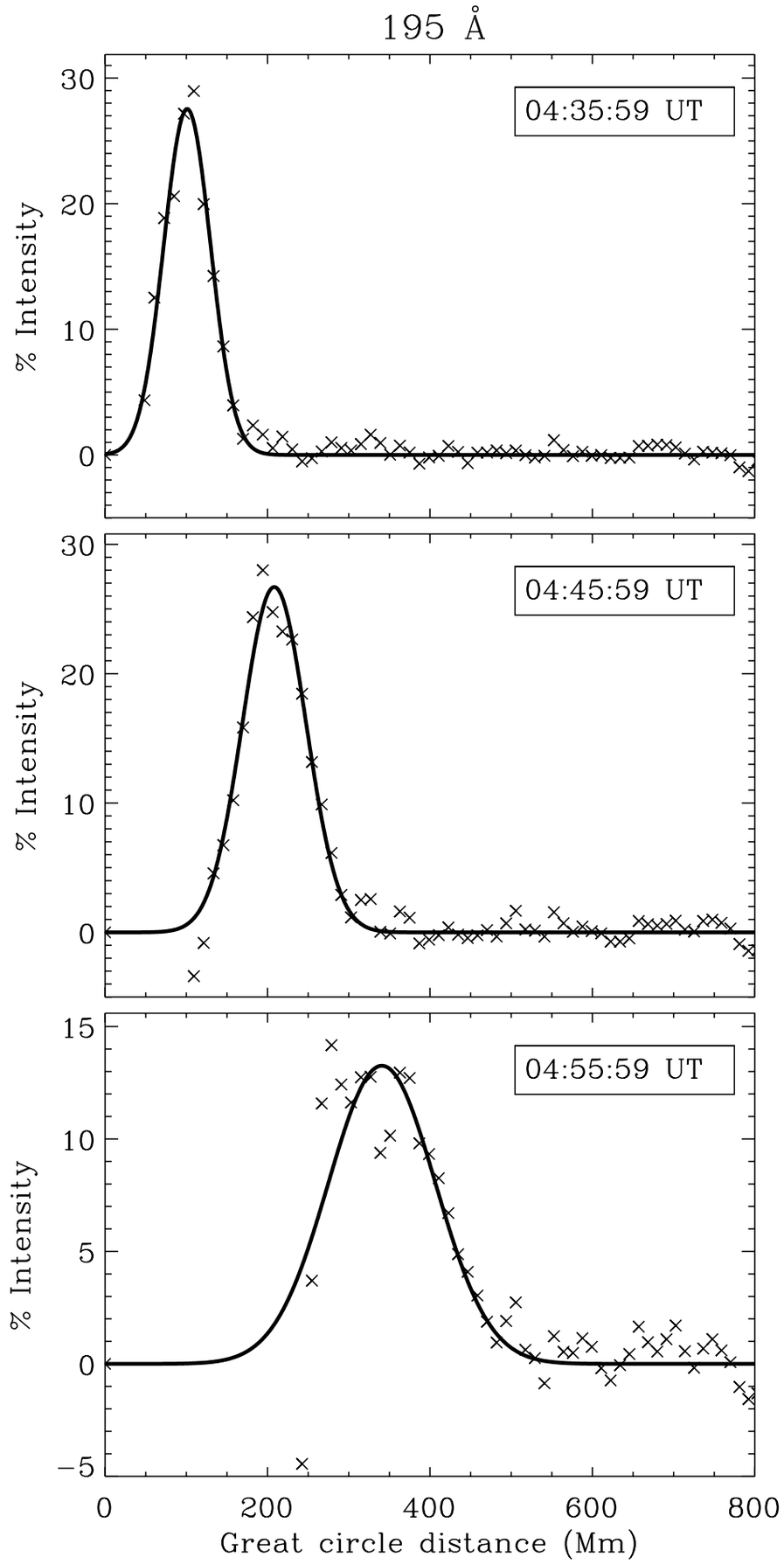
START: Identify the EUV wave and the coronal dimming

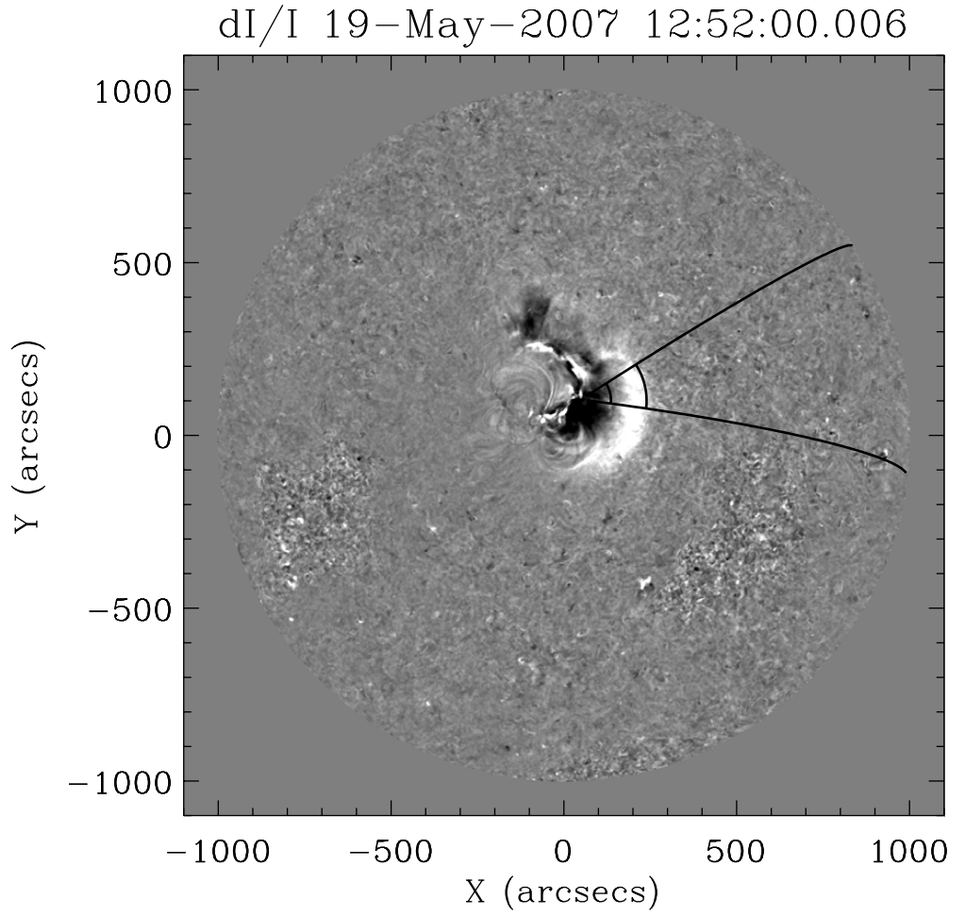
Perturbation Profiles

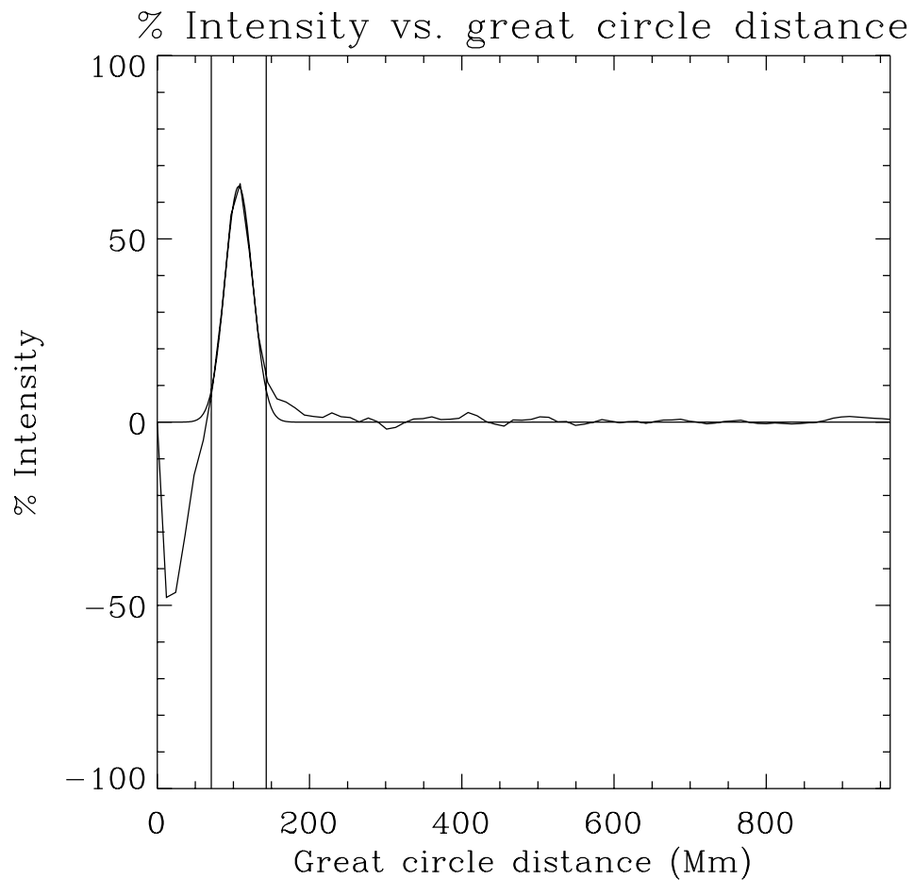
- sums the intensity values of all pixels in a selected sector
- mean intensity as a function of distance from the wave center
- time evolution of the EUV waves and the dimmings



Muhr et al. 2011, ApJ 739:89







Long et al. 2011

6th September 2011

- X2.1 flare @ 22:12 UT
- EUV wave, direction north
- associated CME

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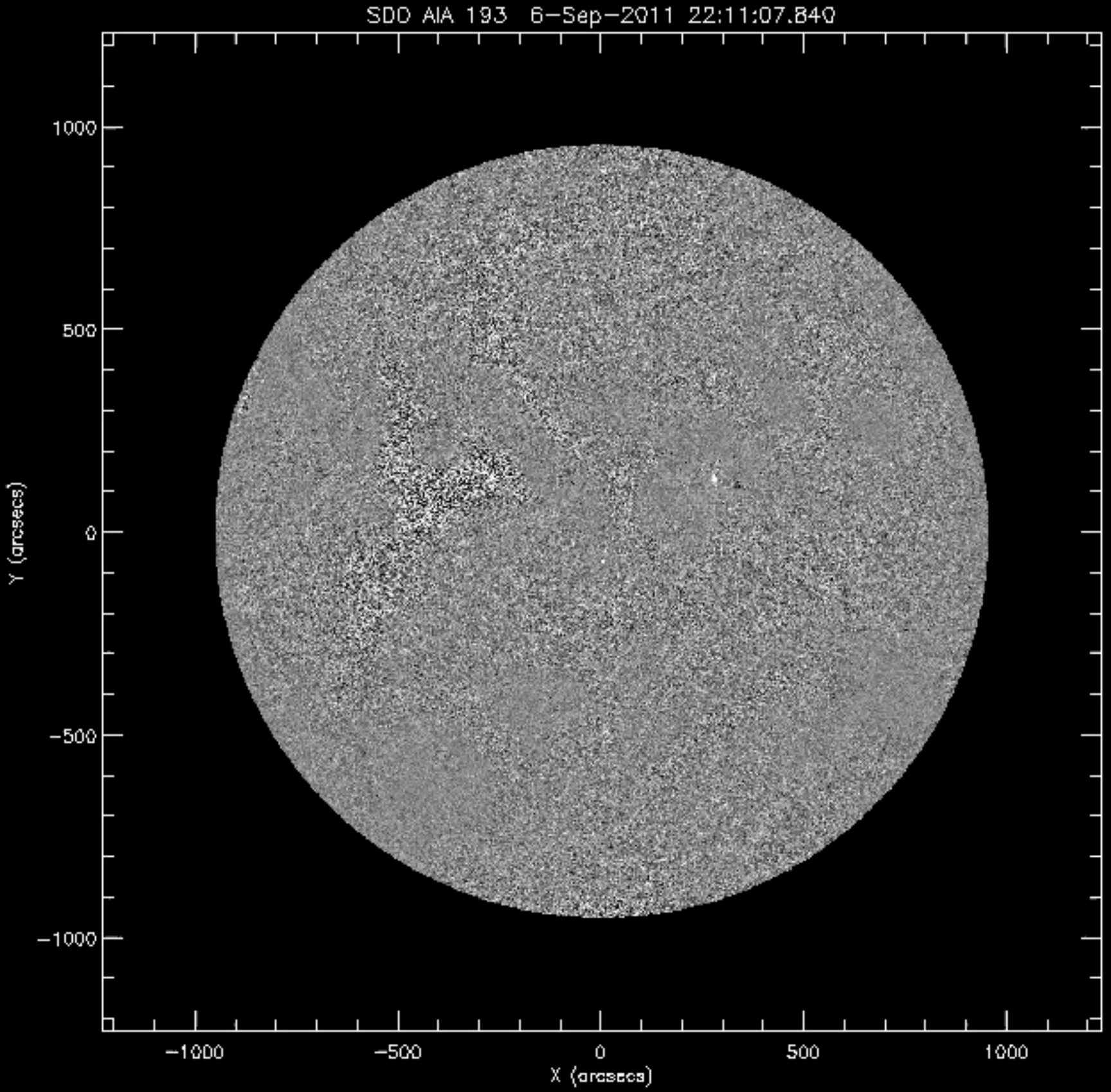
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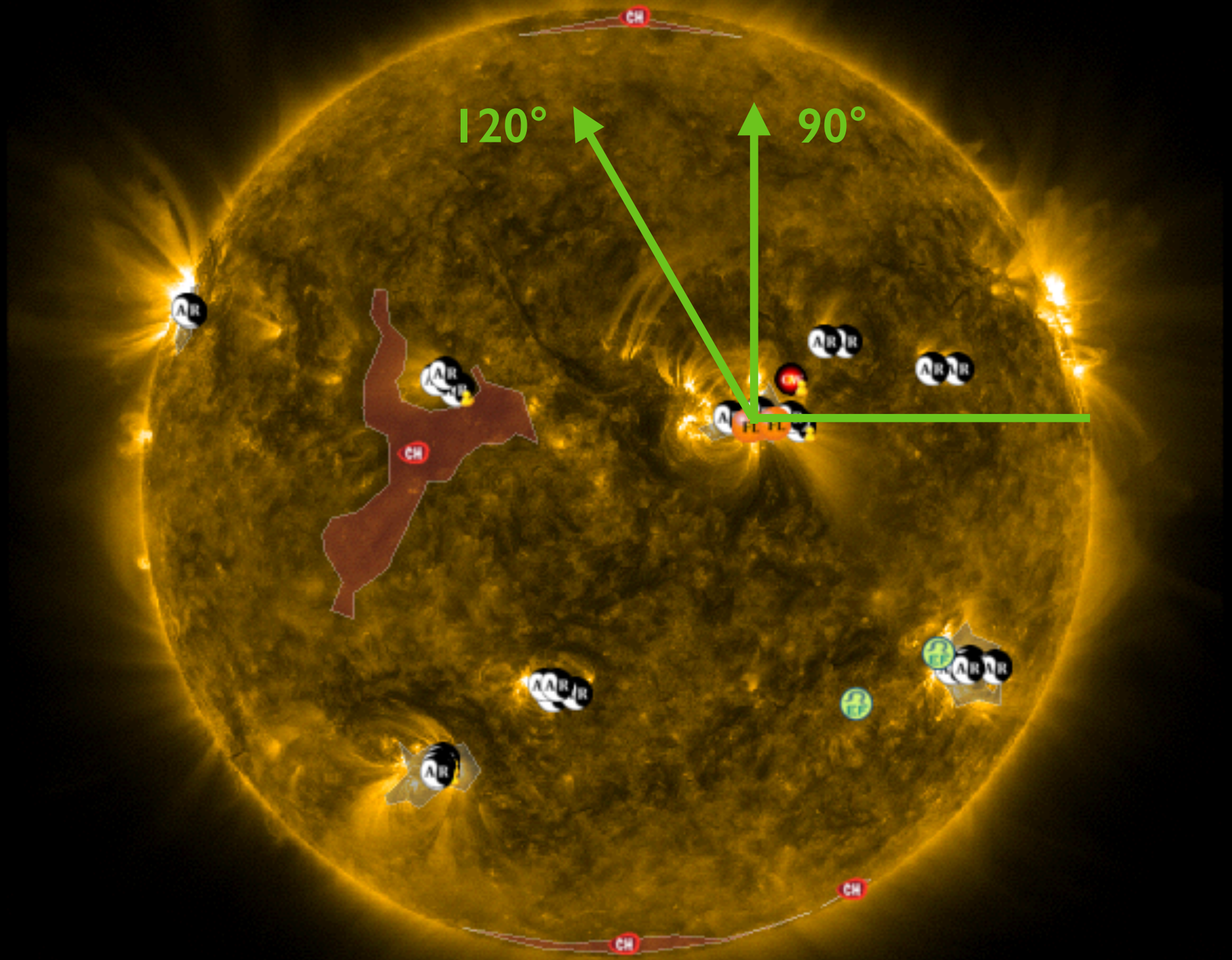
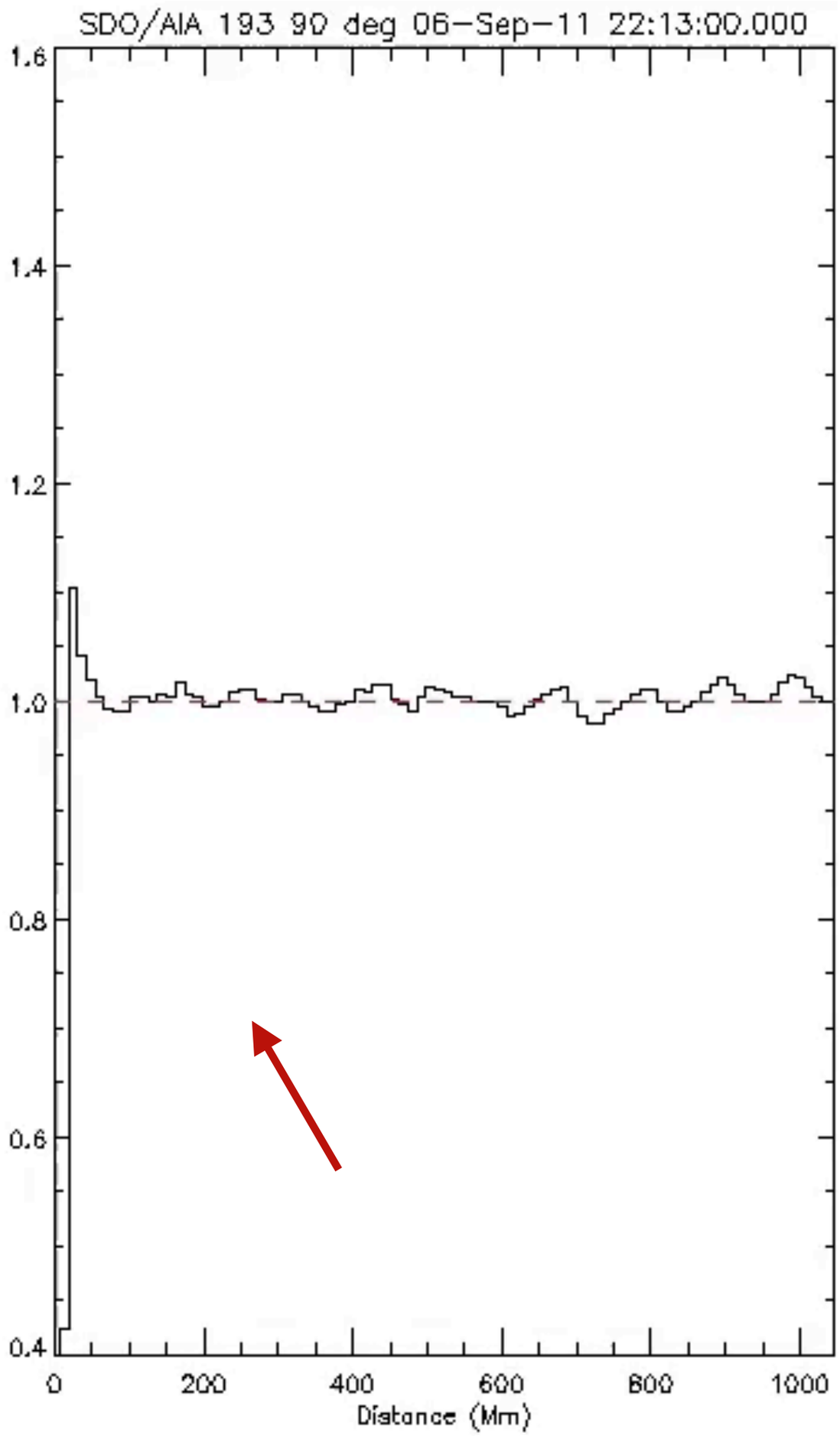
1000
500
0
−500
−1000
Y (arcsecs)
−1000
−500
0
500
1000
X (arcsecs)

movie

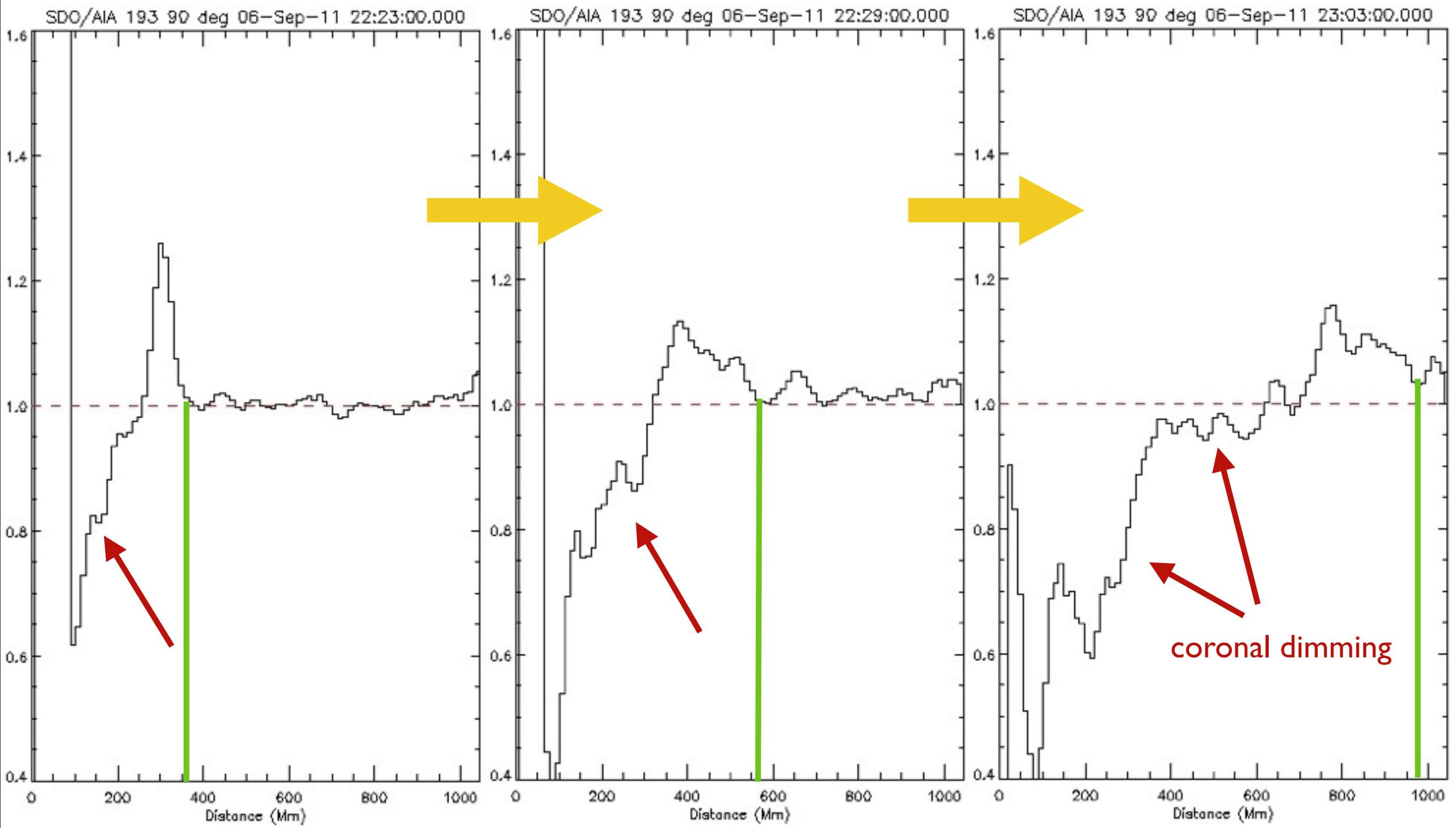
06-Sept-2011

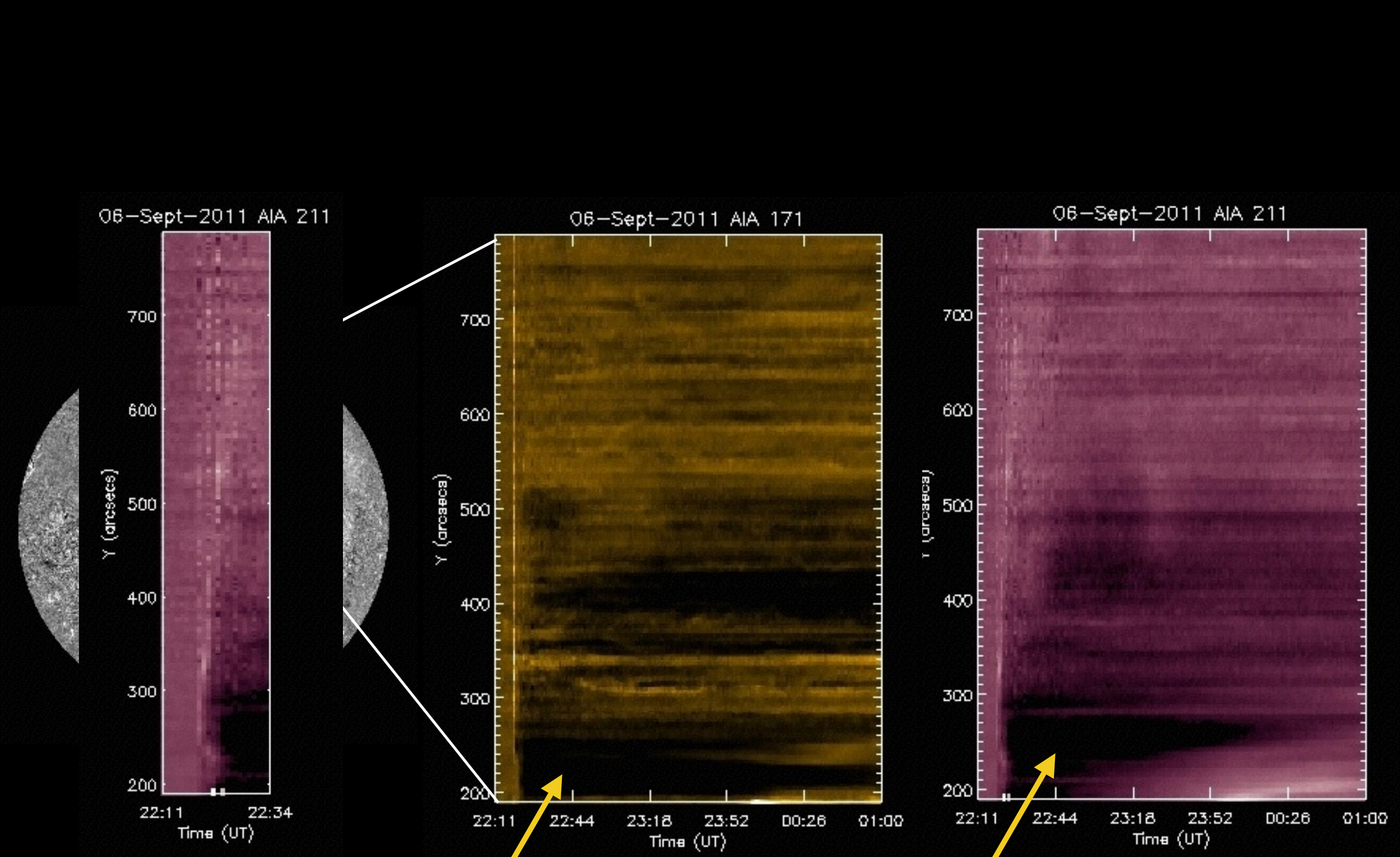


SDO/AIA 171


SDO/AIA 193 90 deg 06-Sep-11 22:13:00.000
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0
200
400
600
800
1000
Distance (Mm)

movie


SDO/AIA 193 90 deg 06-Sep-11 22:23:00.000
SDO/AIA 193 90 deg 06-Sep-11 22:29:00.000
SDO/AIA 193 90 deg 06-Sep-11 23:03:00.000
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0
200
400
600
800
1000
Distance (Mm)
coronal dimming


06-Sept-2011 AIA 211
06-Sept-2011 AIA 171
06-Sept-2011 AIA 211
Y (arcsecs)
700
600
500
400
300
200
22:11
22:34
22:44
23:18
23:52
00:26
01:00
Time (UT)

dimming

Outlook

- CME connection
- STEREO in quadrature, 3D structure?
- improve methods (stack plot along great circle…)
- more events