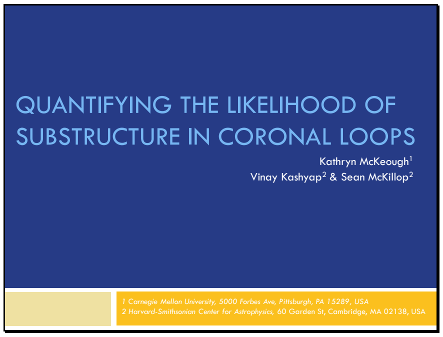
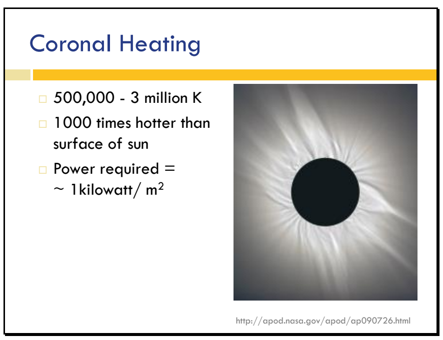
Slide 1



What can we see at very small spatial scales that help constrain the theories of coronal heating

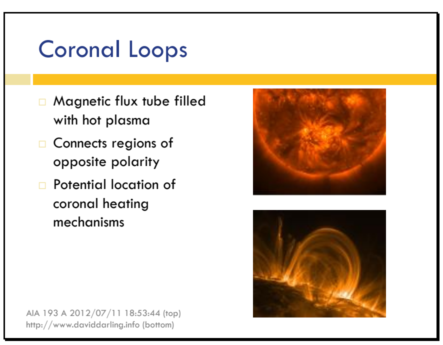
Temperature range of Corona
Temperature of AIA
How far the sun is from earth
What wavelength AIA we are looking at (HiC is same)
Radius of the sun

Slide 2

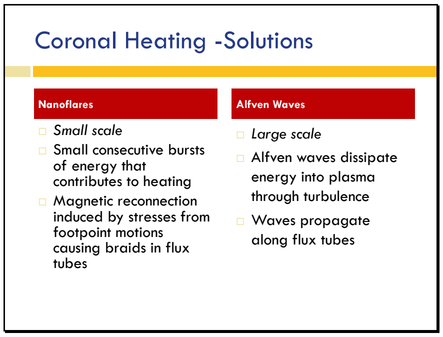


Surface area of the sun 6.09*10^12 km^2
Corona, transition, chromosphere, photosphere….
where energy is coming from how it is being deposited (understandable because corona is lower density)

Slide 3



Slide 4

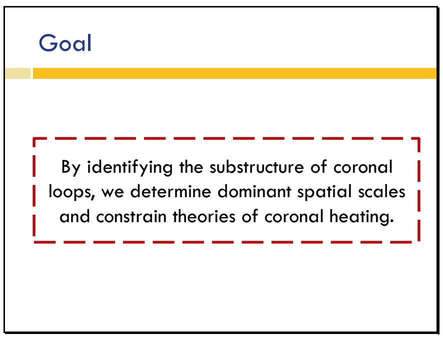


two types small scale v. large scale
Nanoflares – small compared to across the loop
Alvfen Waves- long compared to the length of the loop
-propogate from center, but can be reflected back

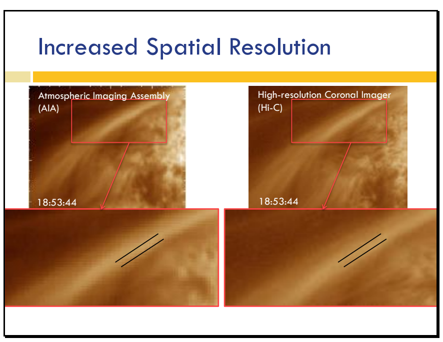
- Not all energy caused by turbulance
- AW 0.08 m

footpoint= where loop enters chromosphere

Slide 5

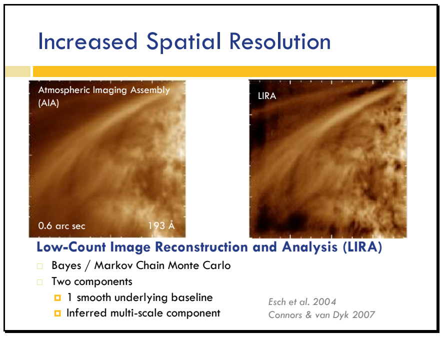


Slide 6



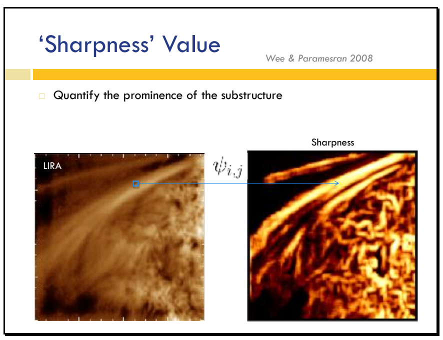
Model smooth variations of image
Beyesian multiscale method that uses MCMC
AIA on SDO since 2010

Slide 7



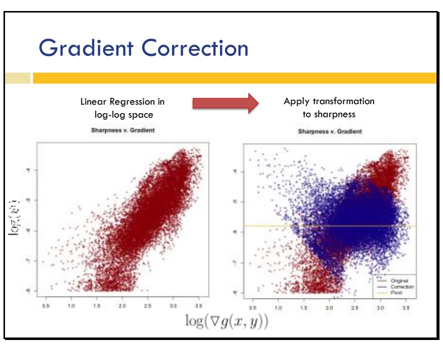
Model smooth variations of image
Arc second resolution of each
AIA is 1.3 arc min (77 arc sec) across
Beyesian multiscale method that uses MCMC
----- Meeting Notes (8/13/14 12:06) -----
Forward modeling process (start with source, push through instrument to compare to data)

Slide 8



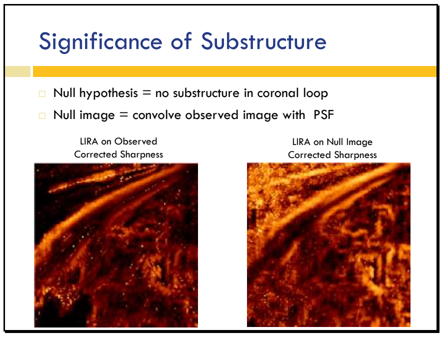
----- Meeting Notes (8/13/14 12:06) -----
retitle LIRA on... --> sharpness
qualitatively explain sharpness value

Slide 9

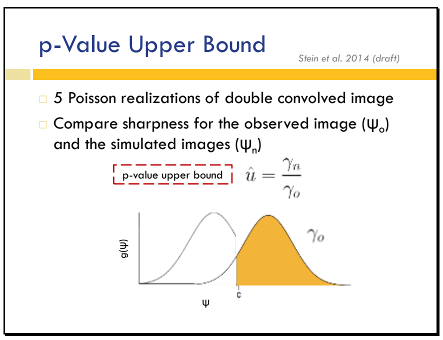


Detecting too many edges
Pivot data about horizontal using function of gradient & linear regression fit of sharpness v gradient in log-log space

Slide 10

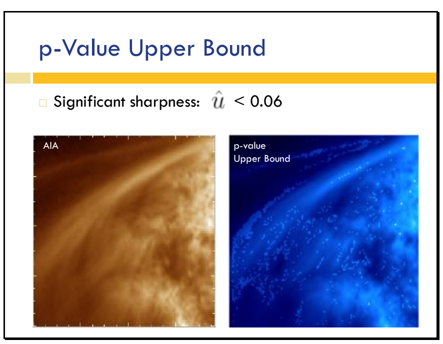


Slide 11

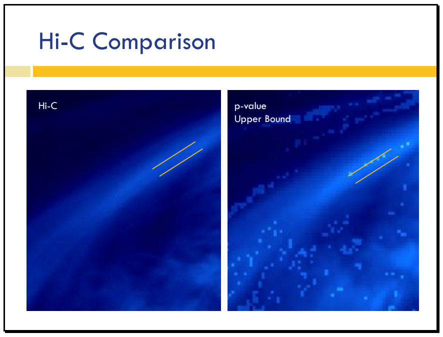


QUESTION
Adjacent sharpness are correlated
P-value test is independent?
Draw gamma_o curve
what we chose for gamma_n (=0.05)

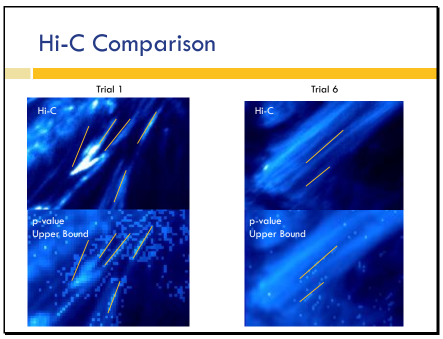
Slide 12



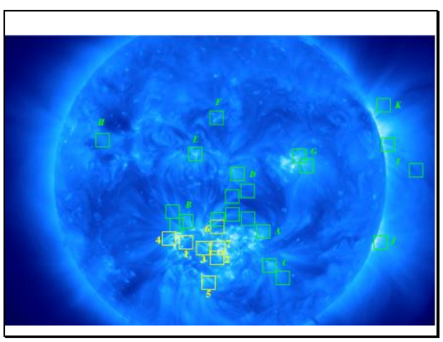
Slide 13



Slide 14



Slide 15

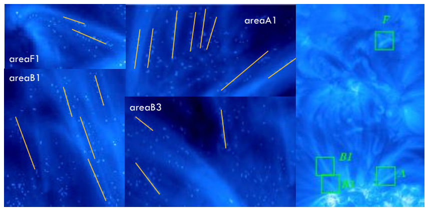


For each of the loops, we are able to see if there is substructure
If all loops come up with substructure – strands everywhere (low lying, upper corona etc.)

Apply to different regions of the sun to determine where along the loops substructure exists and therefore where we expect to see these coronal heating phenomena.

Slide 16

Detected Loops



Those that don't may have not been detected
those that do have strong indication of substrands
More likely to be heated by nanoflares in future

Slide 17

Summary

- Developed method to search for substructure in solar images
- Found evidence for substructure in AIA images that we observe in Hi-C
- Similar evidence of substructure in AIA loops outside of Hi-C region:
  - Loops with strands appear to be ubiquitous
  - Supports nanoflare model
- Not all loops found to have substructure – unclear if statistical or physical explanation
- Isolated points possibly result of Poisson artifacts

Slide 18

Future Work

- Results are preliminary
  - Quantify false positives and non-detections
  - Increasing power could expand detection regions
- Understand implications of results
  - Relation between bright points and detections – compare significant pixel light curves
  - Why some loop complexes show no detections

quantify= poisson artifacts
Power = simulations

Slide 19

Acknowledgements

We acknowledge support from AIA under contract SP02H1701R from Lockheed-Martin to SAO.

We acknowledge the High resolution Coronal Imager instrument team for making the flight data publicly available. MSFC/NASA led the mission and partners include the Smithsonian Astrophysical Observatory in Cambridge, Mass.; Lockheed Martin's Solar Astrophysical Laboratory in Palo Alto, Calif.; the University of Central Lancashire in Lancashire, England; and the Lebedev Physical Institute of the Russian Academy of Sciences in Moscow.

Vinay Kashyap acknowledges support from NASA Contract to Chandra X-ray Center NAS8-03060 and Smithsonian Competitive Grants Fund 40488100HH0043.

We thank David van Dyk and Nathan Stein for useful comments and help with understanding the output of LIRA.

Slide 20

Bibliography

Brooks, D. et al. 2013, ApJ, 722L, 19B

Cargill, P., & Klimchuck, J. 2004, ApJ, 605, 911C

Connors, A., & van Dyk, D. A. 2007, Statistical Challenges in Modern Astronomy IV, 371, 101

Cranmer, S., et al. 2012, ApJ, 754, 92C

Cranmer, S., et al. 2007, ApJS, 171, 520C

DeForest, C. E. 2007, ApJ, 661, 532D

Esch, D. N., Connors, A., Karovska, M., & van Dyk, D. A. 2004, ApJ, 610, 1213

Pastourakos, S., & Klimchuk, J. 2005, ApJ, 628, 1023P

Raymond, J. C., et al. 2014, ApJ, 788, 152R

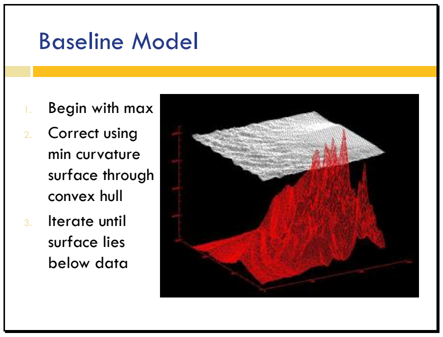
Viall, N. M., & Klimchuck J. 2011, ApJ, 738, 24V

Wee, C. Y., & Paramesran, R. 2008, ICSP2008 Proceedings, 978-1-4244-2179-4/08

Slide 21

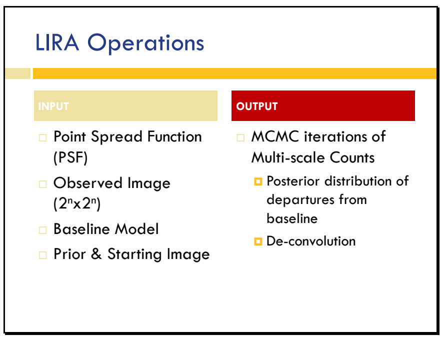
Extra Slides

Slide 22

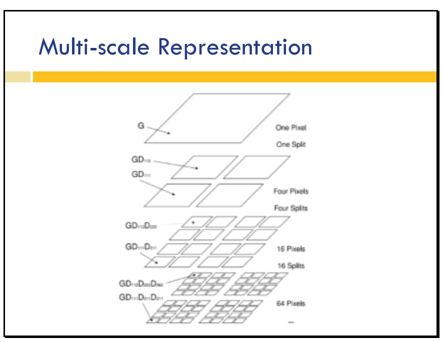


Correction never more than 5%
----- Meeting Notes (8/13/14 12:06) -----
BYE BYE SLIDE

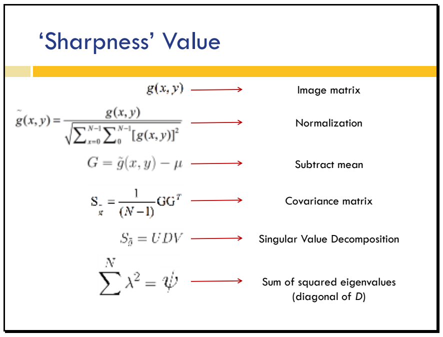
Slide 23



Slide 24

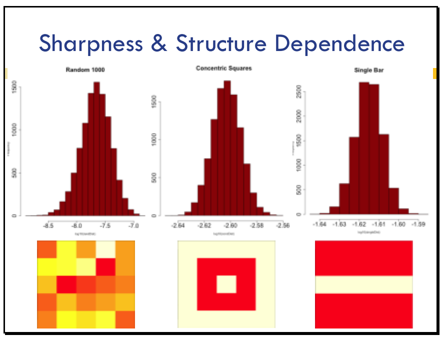


Slide 25



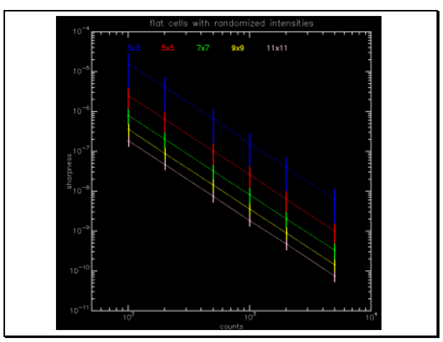
----- Meeting Notes (8/13/14 12:06) -----
EXTRA SLIDE

Slide 26

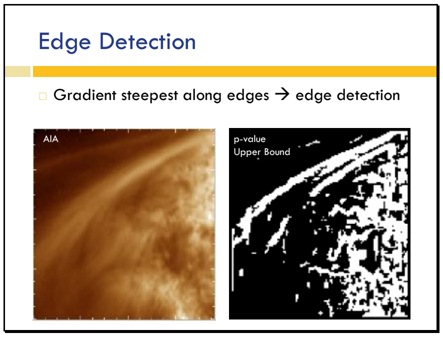


Random, X and randomized

Slide 27



Slide 28



Slide 29