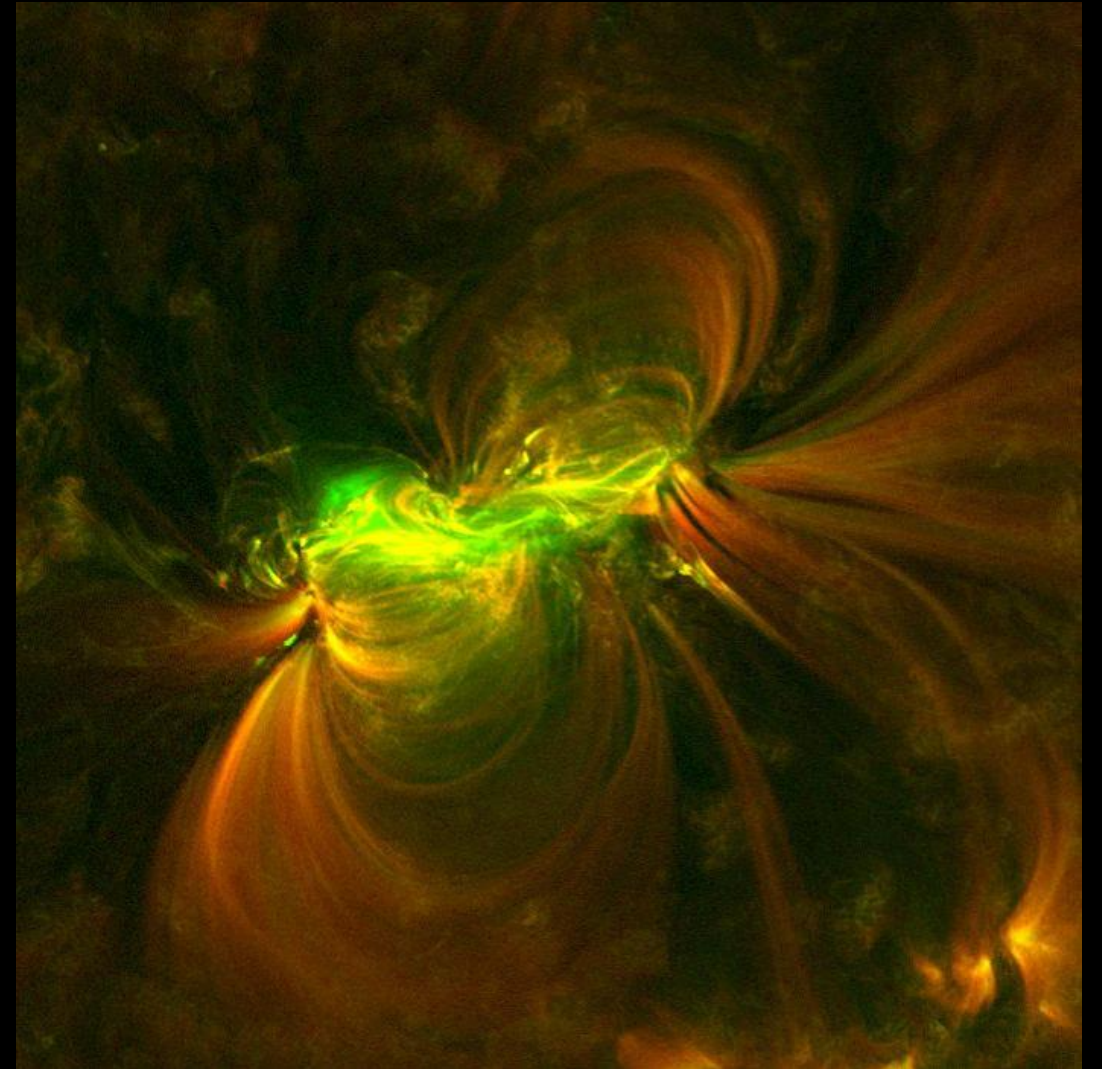
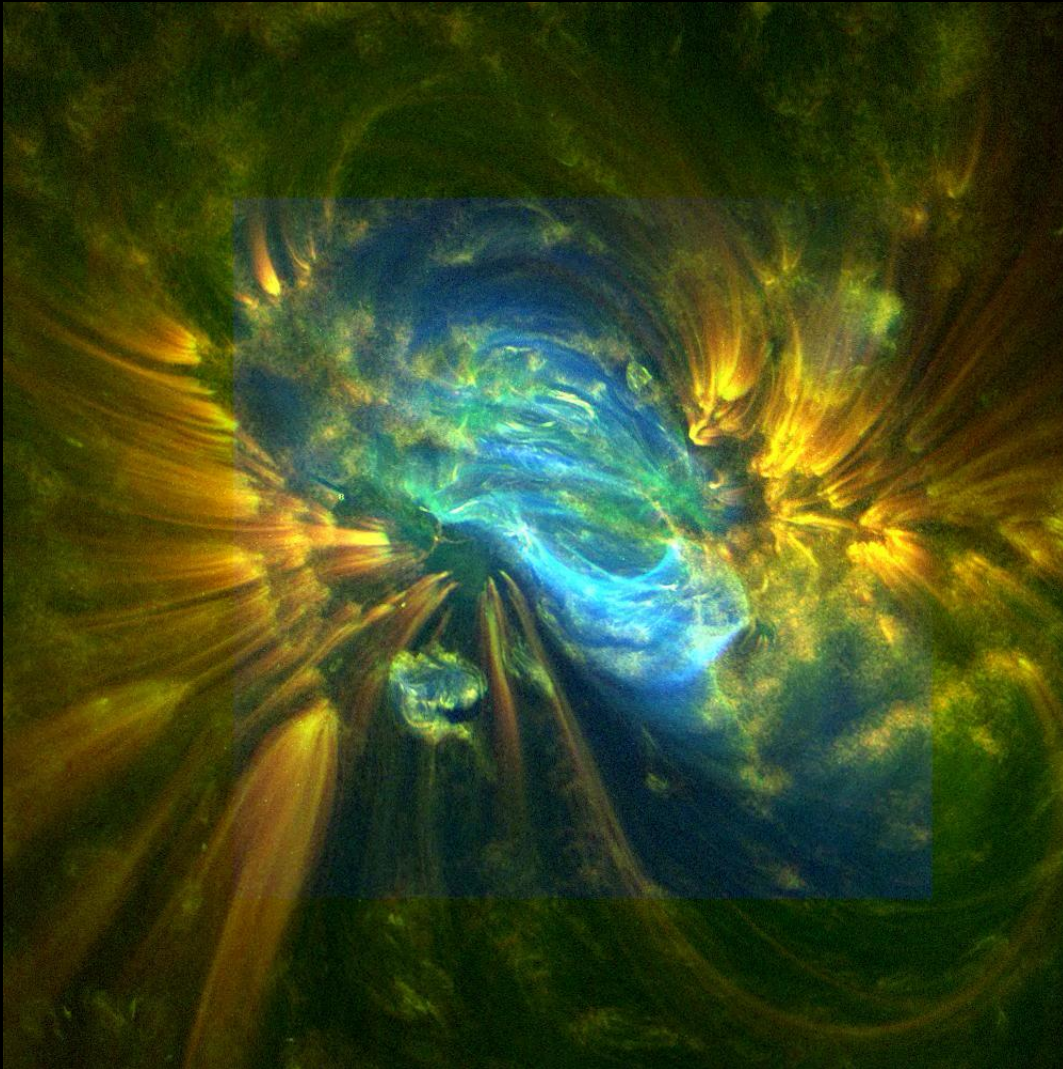


Using AIA Emission Measure Inversion Failures to Track Interesting Flare Physics

A. R. Winebarger¹, L. Mallett², P. S. Athiray^{1,3}

¹NASA MSFC, ²Harvey Mudd College, ³University of Alabama - Huntsville

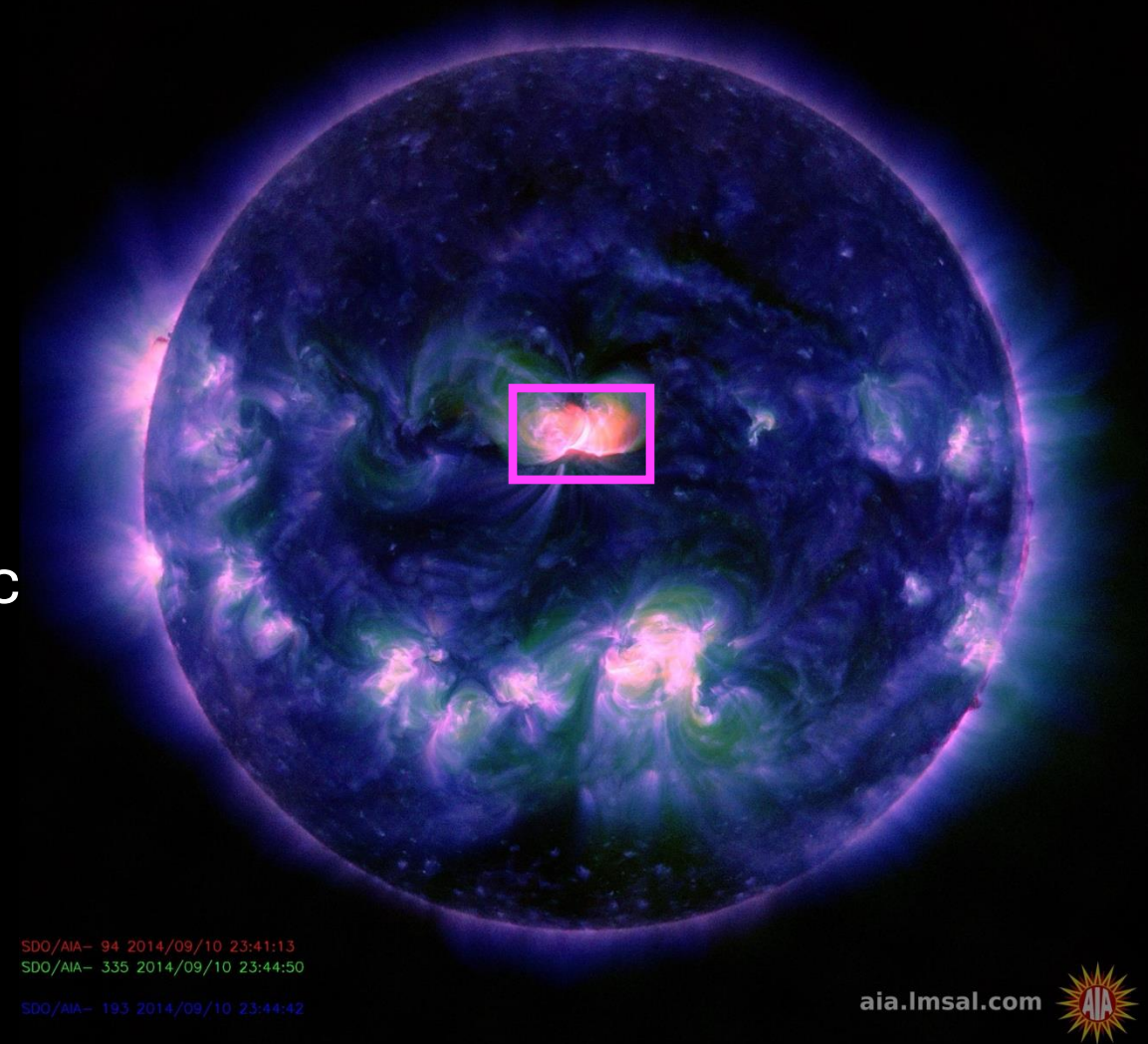
Can AIA be used to determine the evolution of high temperature plasma in solar flares?



Case study – X1.6 flare

Data summary & preprocessing

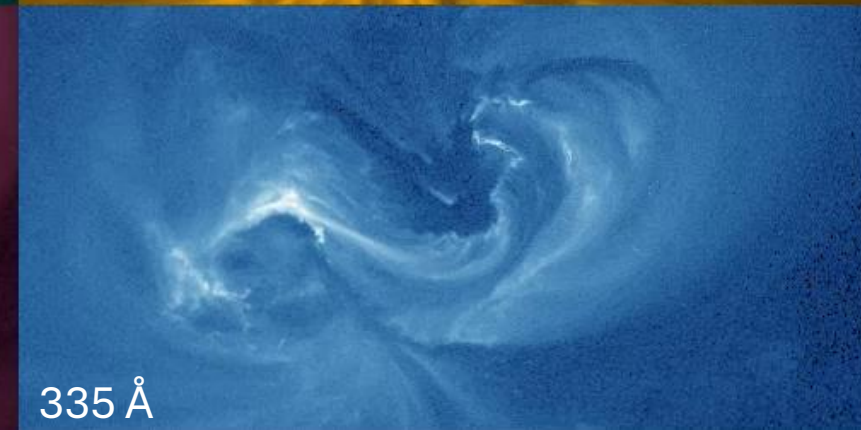
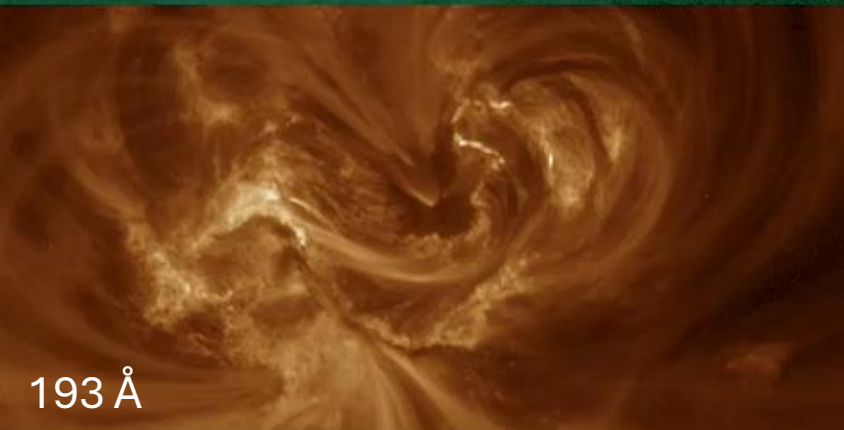
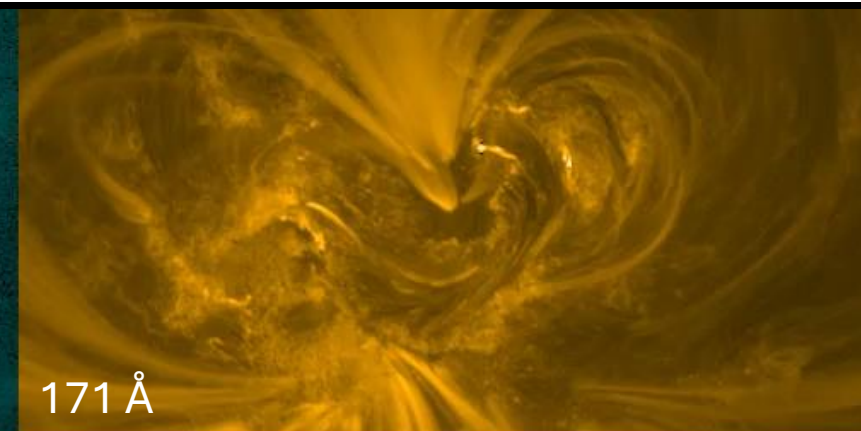
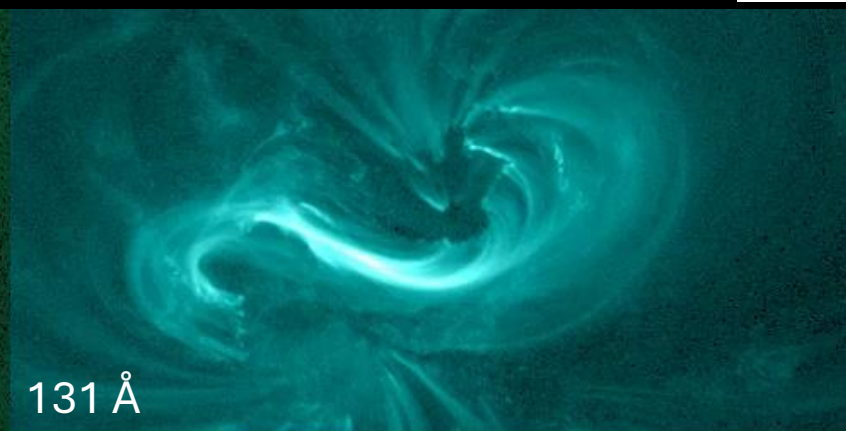
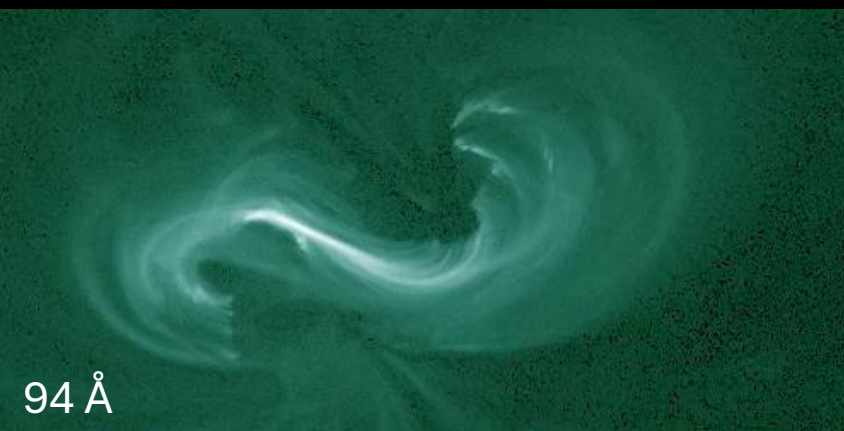
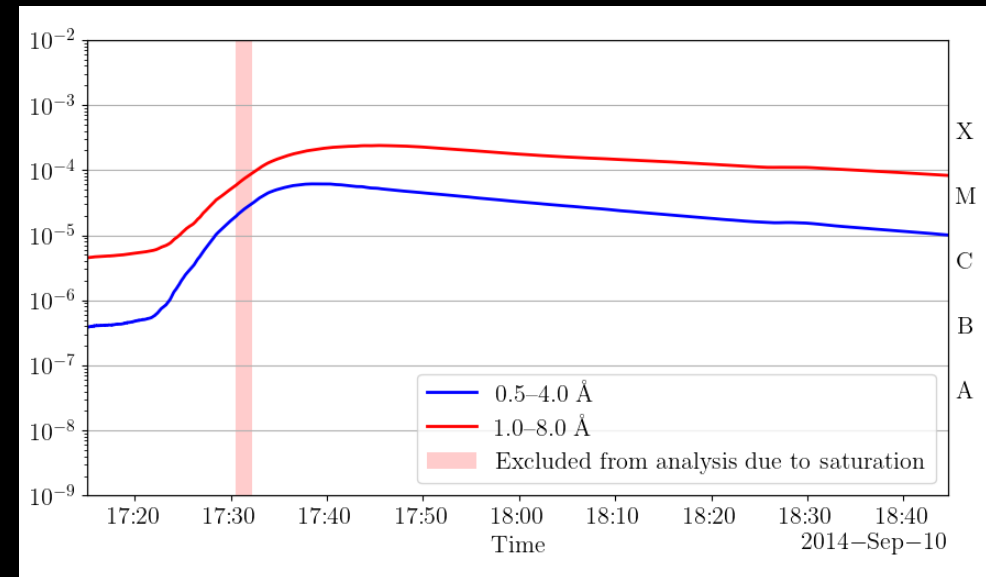
- X1.6 : 10 Sep 2014 (~17:00 to 19:00 UT)
- Select data with shortest exposure in 171Å and gather data within +/- 12 sec
- Apply dark current subtraction
- Apply PSF deconvolution via Richardson Lucy method
- Apply aia_prep for coalignmnet



Flare 1 X1.6 : 10 Sep 2014

Case study – X1.6 flare

AIA data



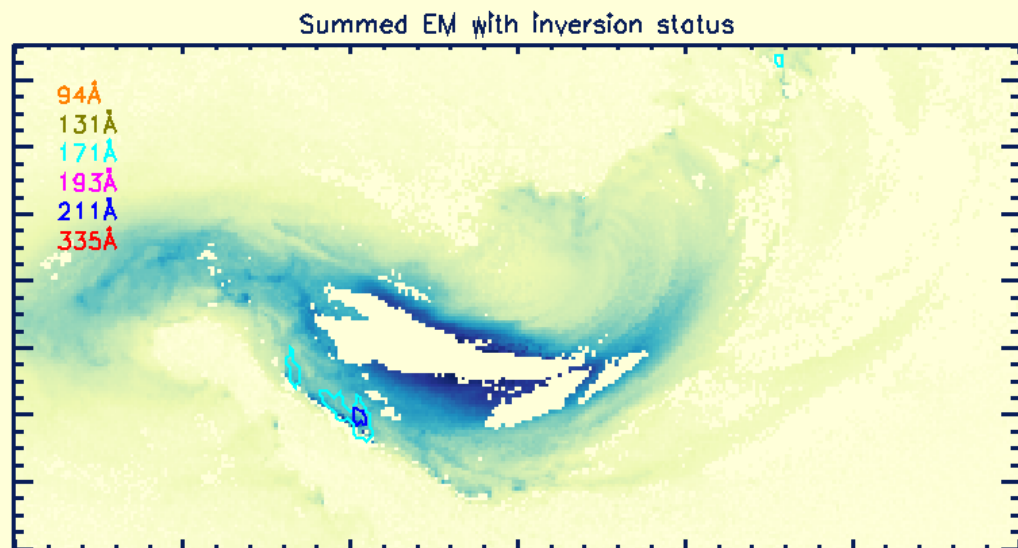
EM inversion

- SPARSE EM inversion employs SIMPLEX algorithm with IDL implementation (Cheung et al. 2015)
- SIMPLEX algorithm results in four possible outcomes of the inversion status
- Here, we study the status of the inversion and examine ‘when and where’ successful and unsuccessful inversions occur during a flare evolution.

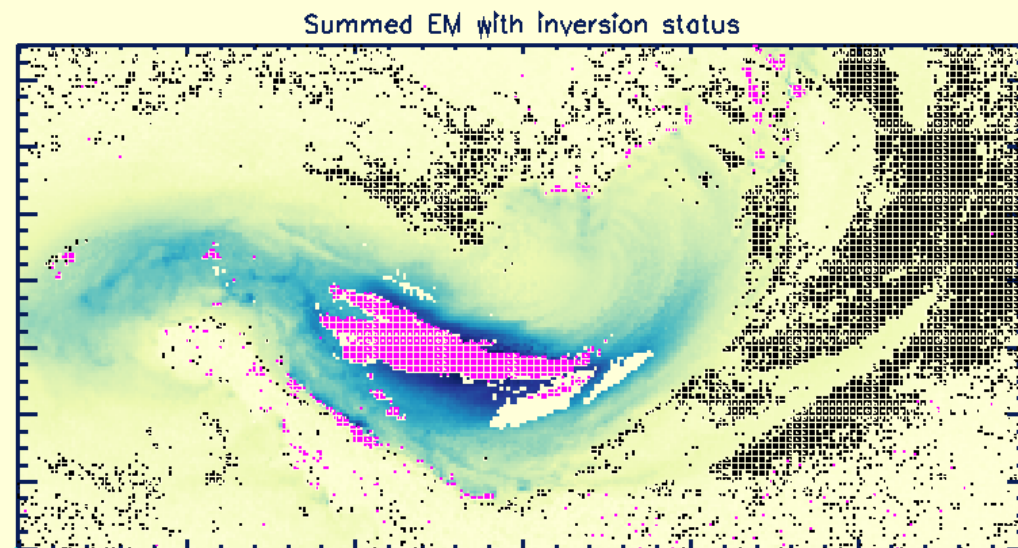
Status	Description
0	Successful completion.
1	The objective function is unbounded.
2	No solution satisfies the given constraints.
3	The routine did not converge.

EM inversion results

- Summed EM maps compared with pixel saturation map suggest EM failures do not ‘always’ occur at these pixels
- Unsuccessful inversion occurs over different parts of the flaring loop at different times during the evolution
 - Inversion status 1 rarely occur over the loop structures
 - Inversion status 2 chiefly occur over the flaring loops
 - Inversion status 3 chiefly occur at the periphery of the AR.



2014-09-10T17_38_02



1 - Unbounded 2 - No solution 3 - Did not converge

2014-09-10T17_38_02

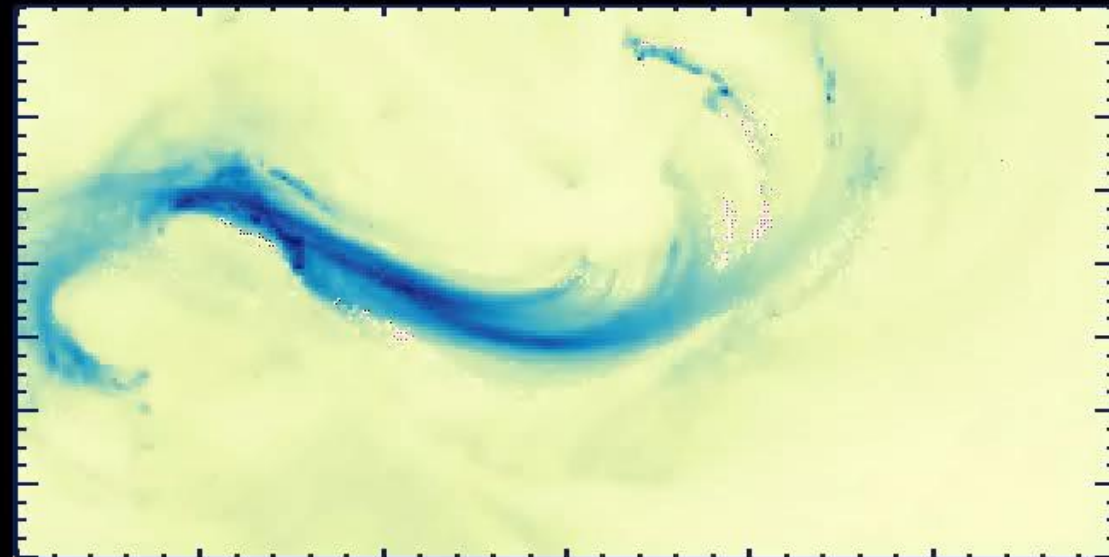
EM inversion results

2014-09-10T17_12_02

Summed EM with saturation control



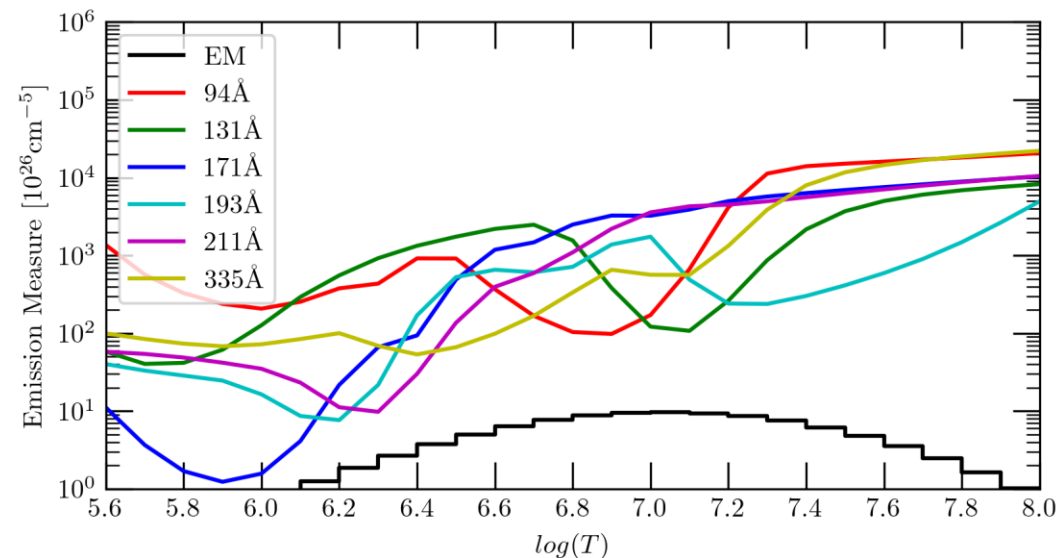
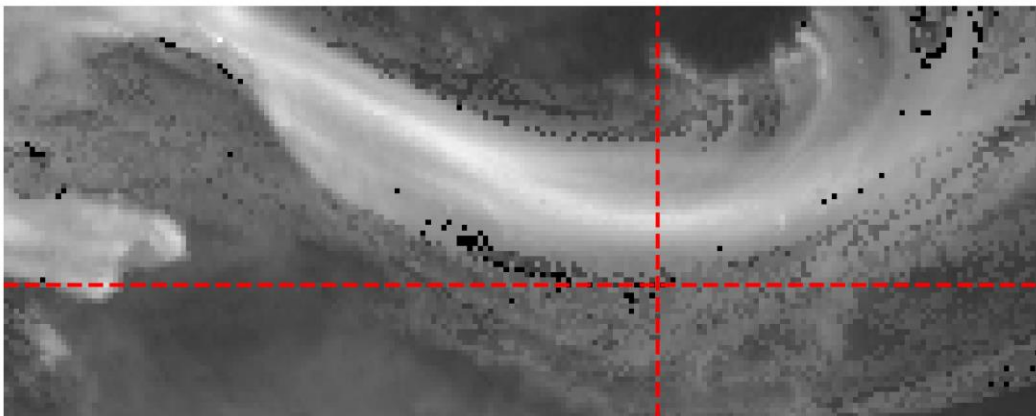
Summed EM with inversion status



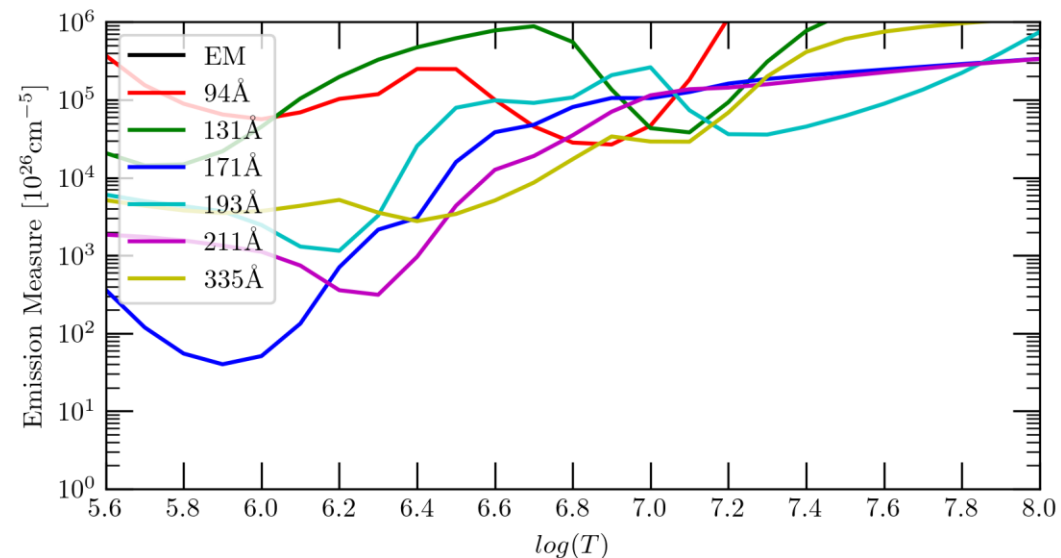
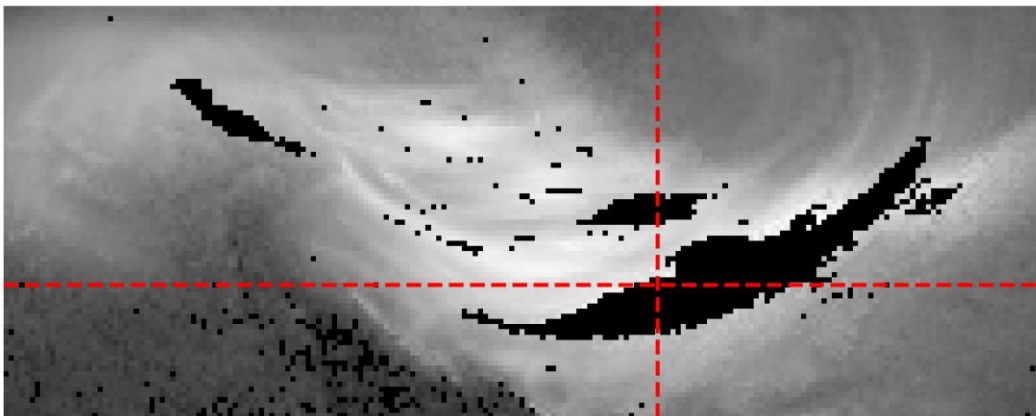
1 – Unbounded 2 – No solution

Why do the EM inversions fail?

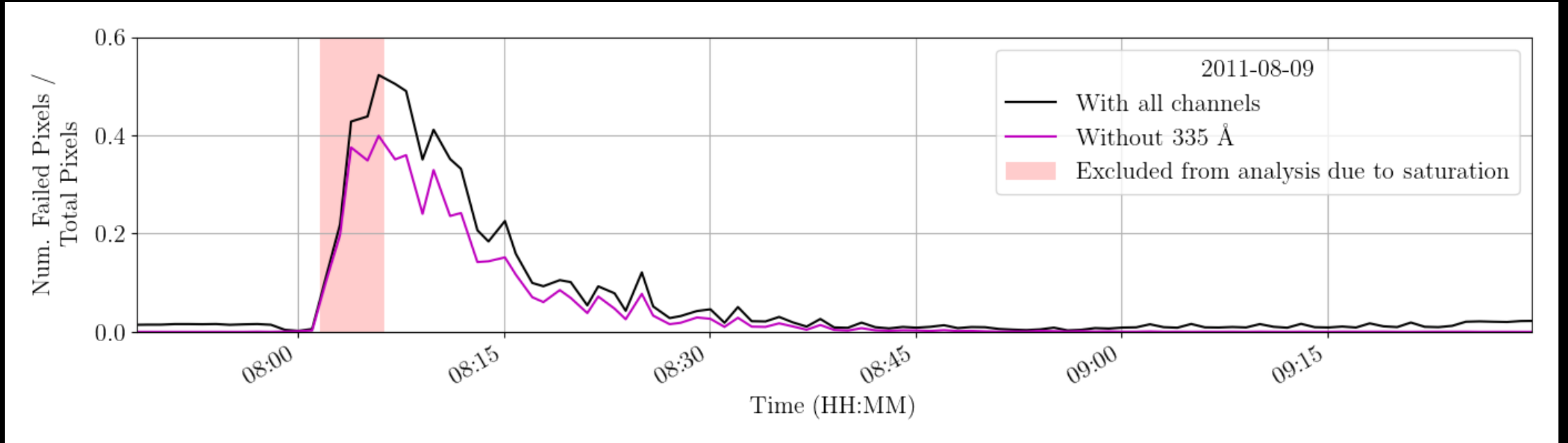
Converging Example



Failed Example



What happens when we leave out 335?



Why are these failures interesting?

- Failure of EM inversions are primarily at loop tops and footpoints
- Failures are not at the brightest pixels
- Failures could be
 - A signature of non-thermal electrons
 - Due to departure from ionization equilibrium
 - Due to the presence of high bulk velocities shifting lines in AIA passbands
 - Due to rapid changes in the plasma (non-simultaneous AIA data in all channels)
 - Due to an instrumental effect, such as cross-talk between AIA channels (335 vs 131)

Failures may be used to trace interesting physics! More to come.

