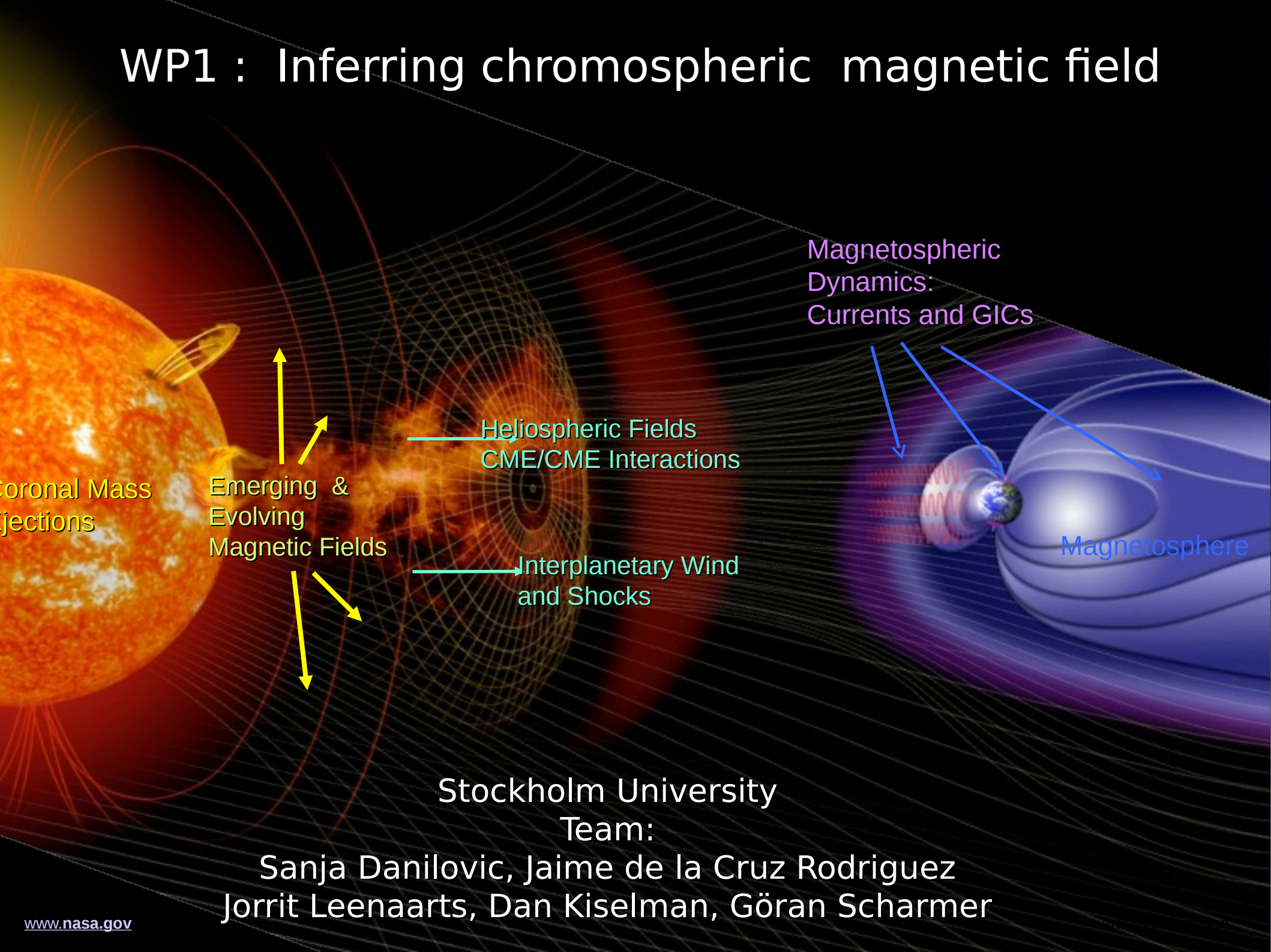
WP1 : Inferring chromospheric magnetic field



Stockholm University
Team:
Sanja Danilovic, Jaime de la Cruz Rodriguez
Jorrit Leenaarts, Dan Kiselman, Göran Scharmer

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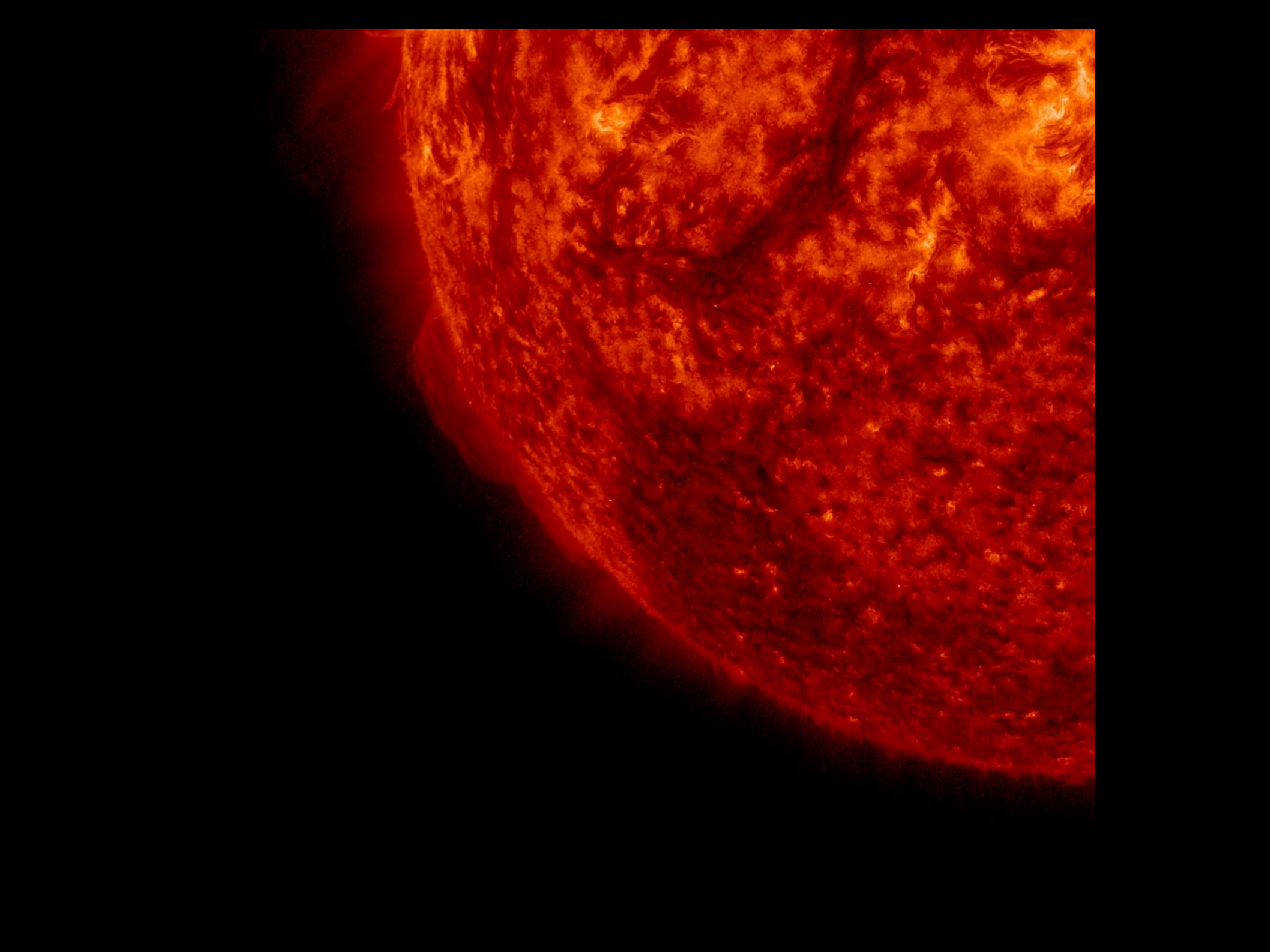

COSPAR Roadmap notes:
“Goal SH-1a: Specify magnetic structure of space-weather sources associated with active regions”

“REQUIRE: Vector boundary condition at a force-free layer, e.g., the top of the solar chromosphere”

Challenges

Problem

Chromospheric physics is difficult to model

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Solution Use STiC code to retrieve information on magnetic field

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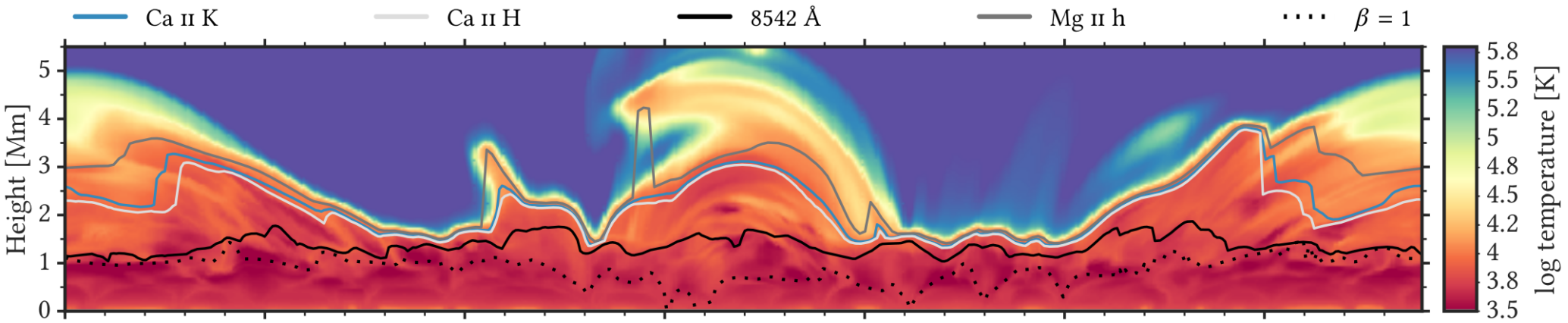
Problem Formation height of chromospheric observables varies



Bjørgen et al. 2017

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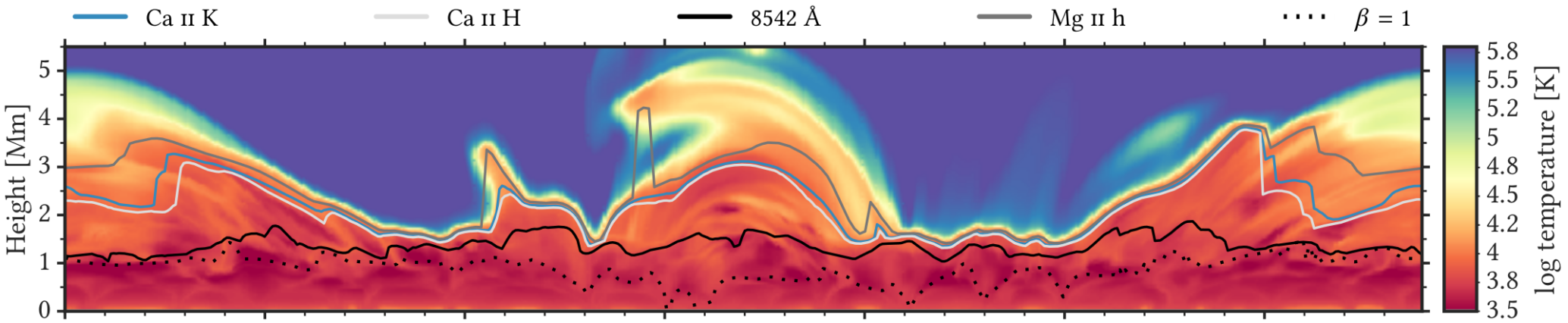
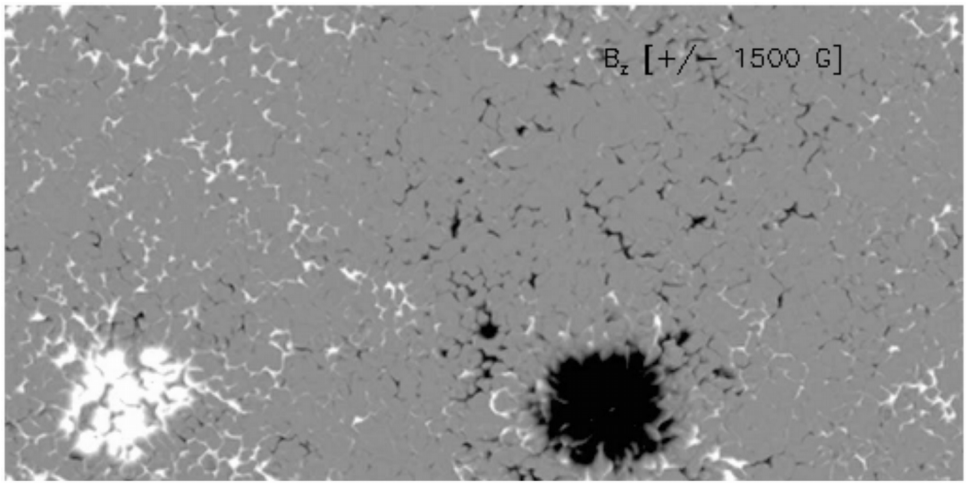


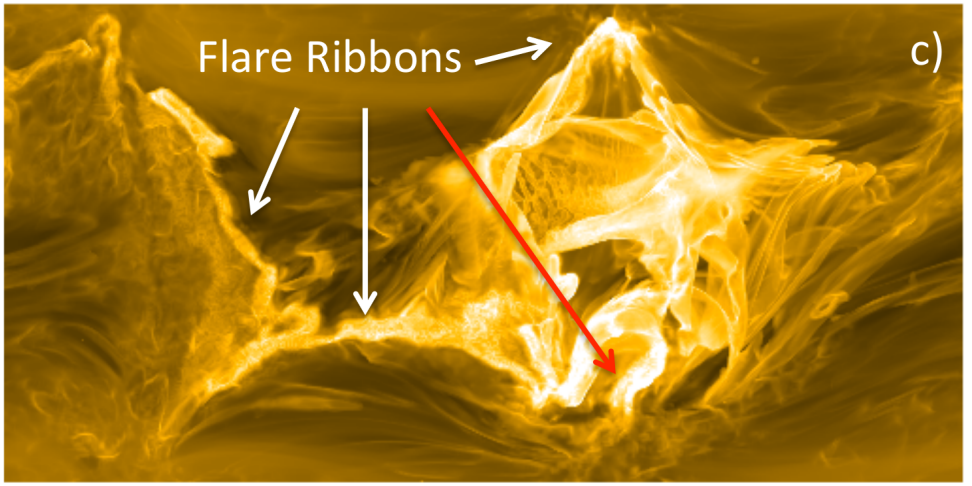
Bjørgen et al. 2017

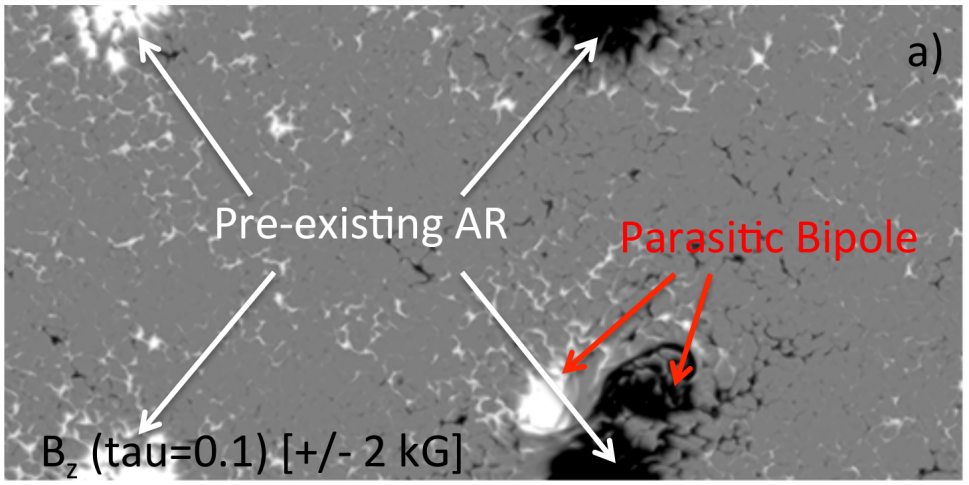
"Realistic" MHD Simulation

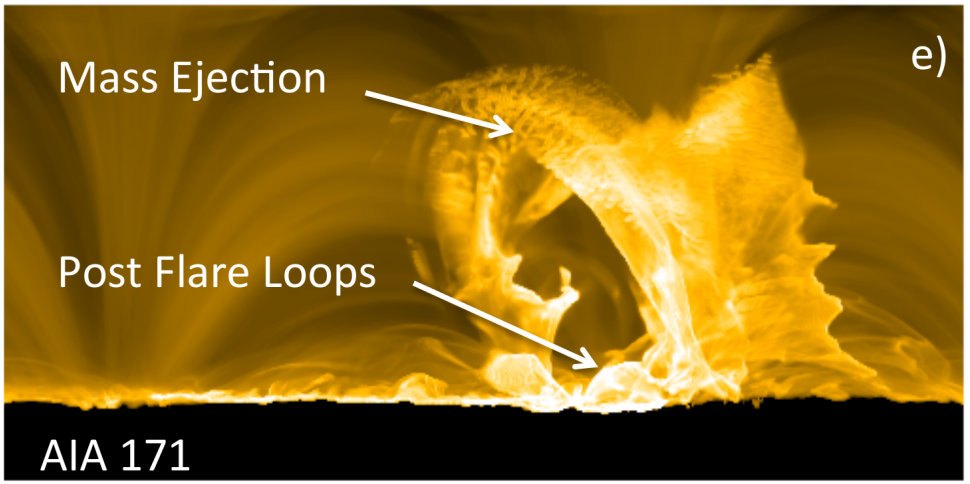
– Consider relevant physics required for modeling of synthetic observables, such as EUV, soft and hard X-ray

– A setup that produces a flaring corona naturally through flux emergence driven by subphotospheric dynamics









Setup inspired by NOAA Active Region 12017

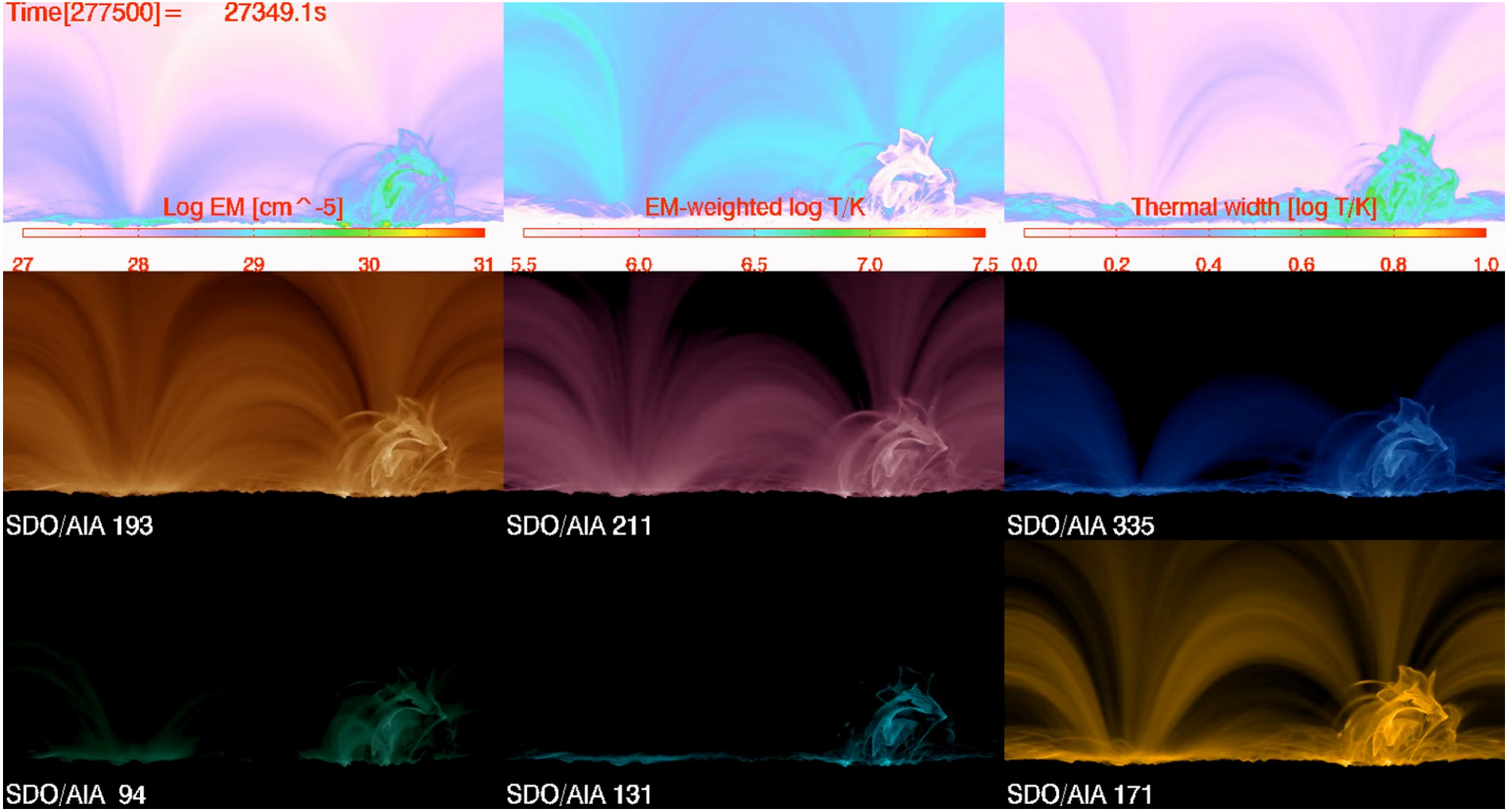
– 1X-class, 3 M-class, 20+ C-class flares

– Parasitic bipole emerges near leading polarity

Courtesy M. Rempel & M. Cheung

Simulations – a side view

Different panels show synthesized coronal observables that trace different temperature regimes



Cheung et al. 2017

Challenges

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Problem — Synoptic chromospheric observations limited/non-existing

Available or will be:

Photospheric magnetic field:

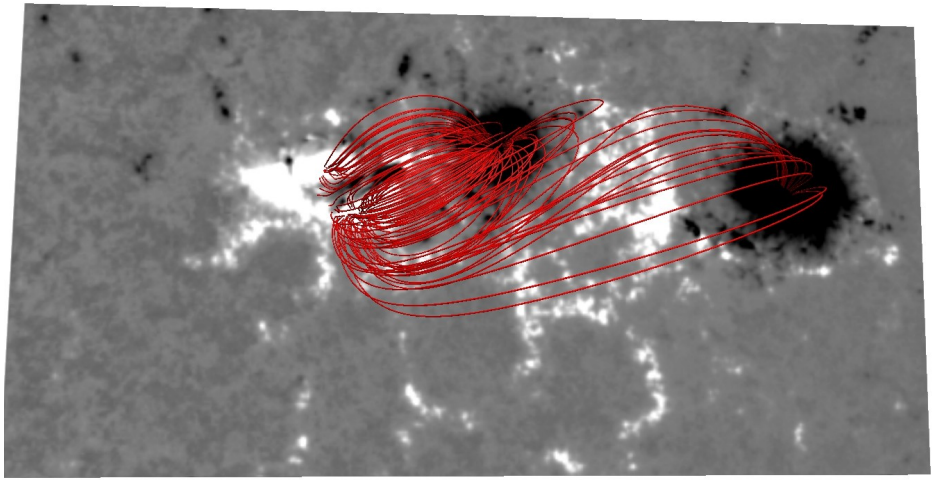
- SDO/HMI – full disk vector magnetogram every 12 min, resolution 1”, single line
- GONG upgraded – full disk, near-real time, resolution 5”, single line

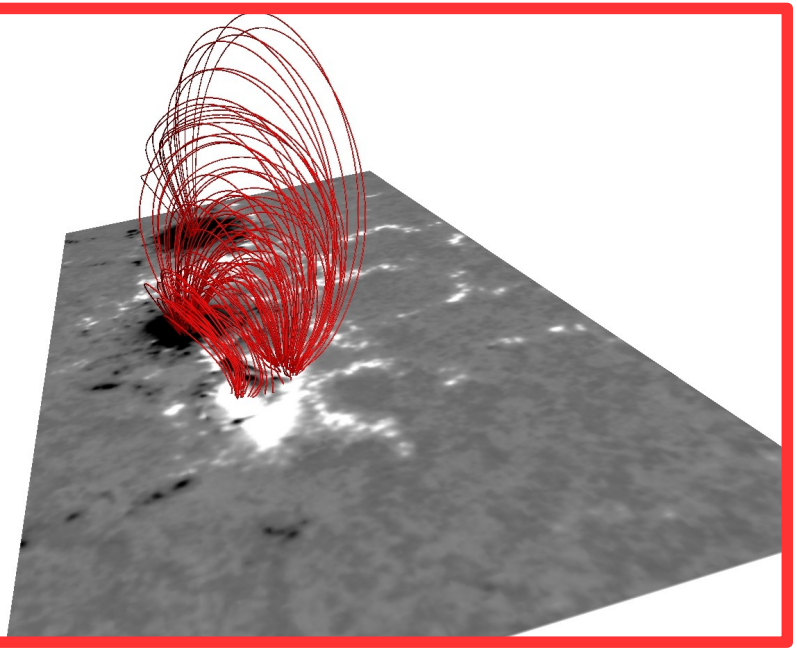
Chromospheric magnetic field:

- Solis/VSM – full disk magnetogram, one per day, resolution 2”, single line
- CHROMAG – full disk, near real time, multiple lines – not operational
- SPRING – new generation GONG, vector magnetogram every 60s, resolution 1”, multiple lines, operational from 2025
- SST/CRISP and CHROMIS – resolution 0.08”, limited field of view, multiple lines

Work in progress an example

SDO/HMI observations
with potential field extrapolations





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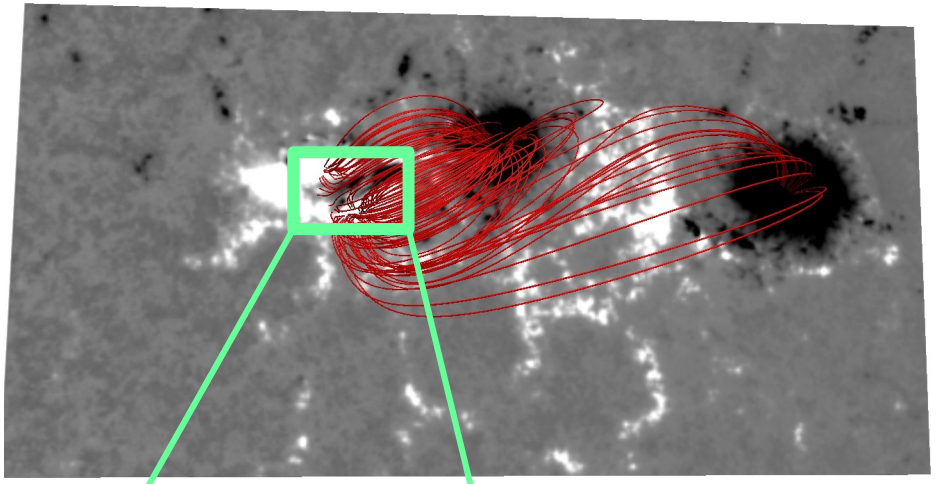
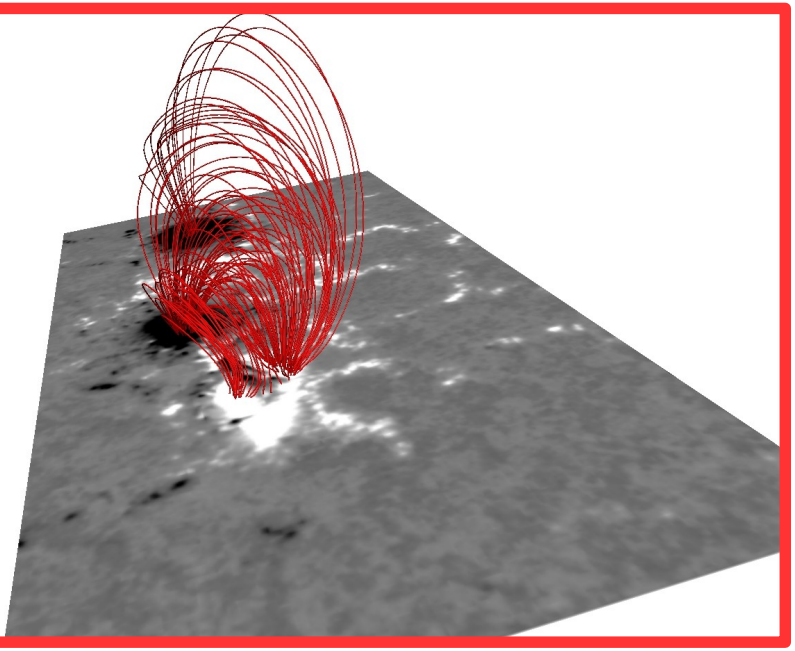
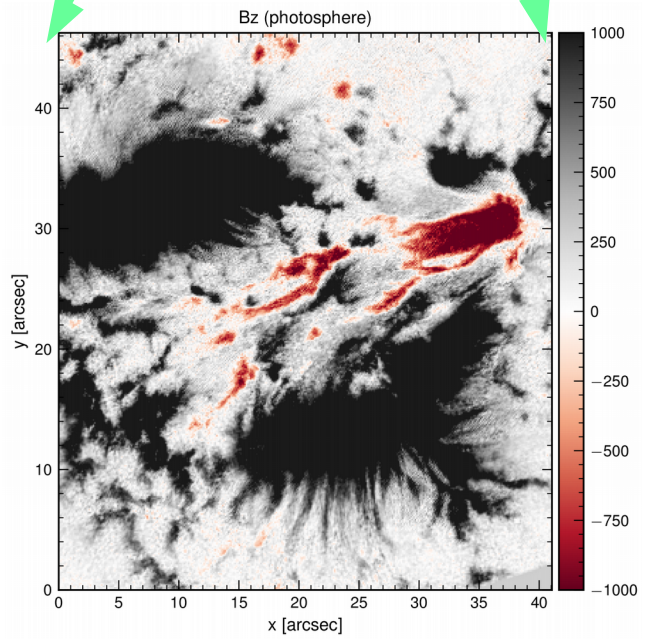
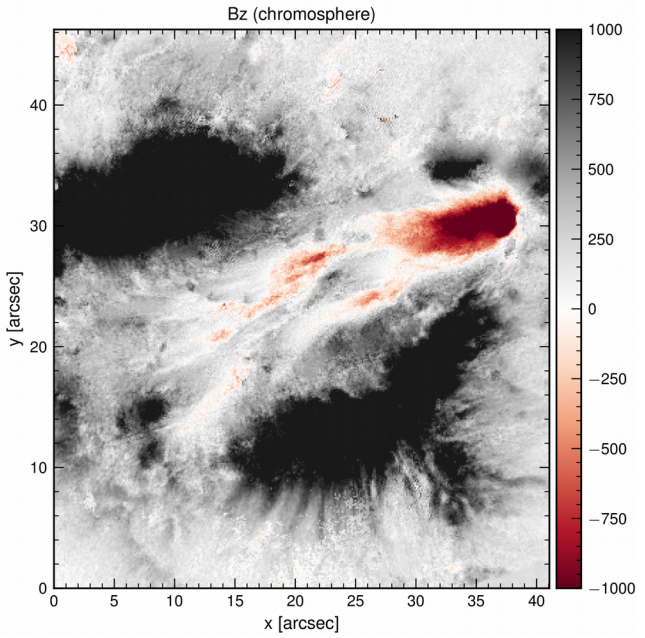
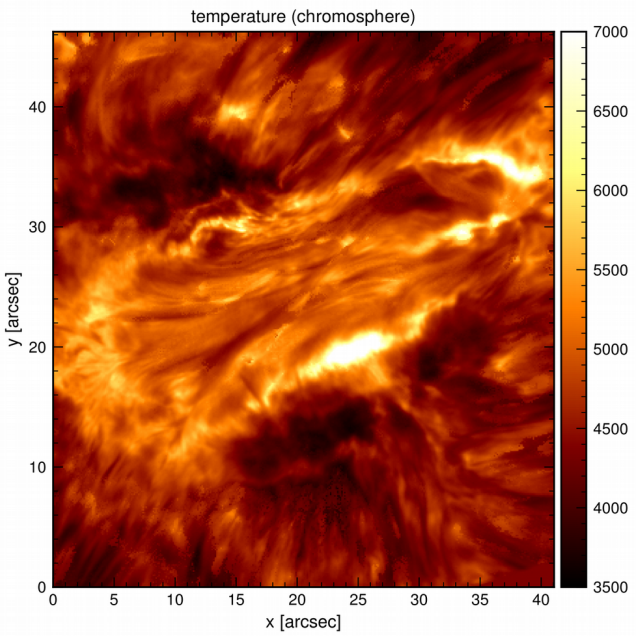


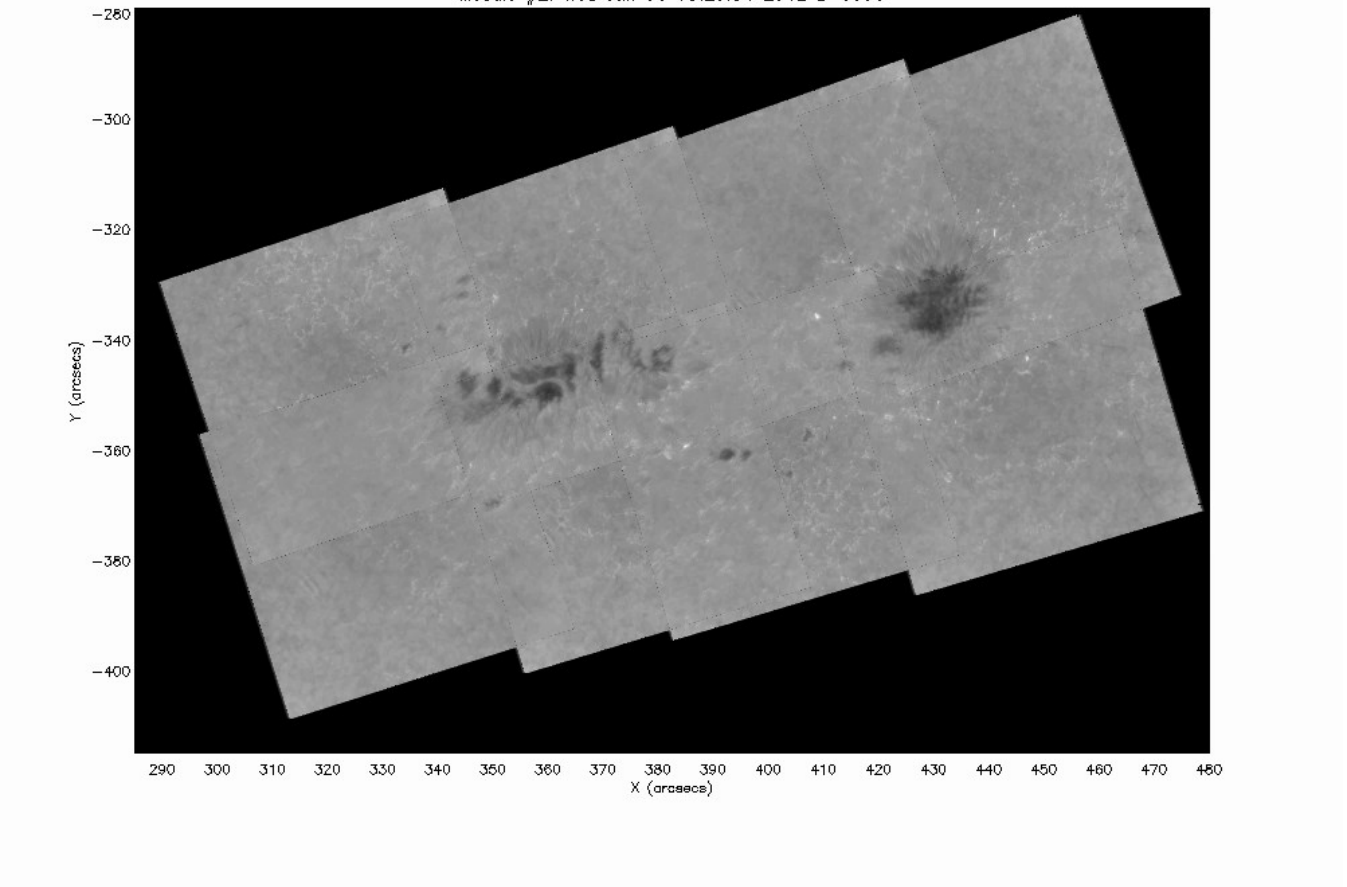


SST/CRISP observations
Preliminary inversion results









Use it for NLFF modeling:

- compare chromospheric and photospheric data
- assess the changes the preprocessing does to the photospheric data - help from chromospheric data

Use it for data-driven modeling:

- more reliable velocity field
- better constrained electric field for lower boundary conditions

Check how lower spatial resolution of the future synoptic instruments affects the inversion results

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Final outcome:
-user-friendly tool for chromospheric field inference
-freely available to the community
-ready to use when good synoptic data become available