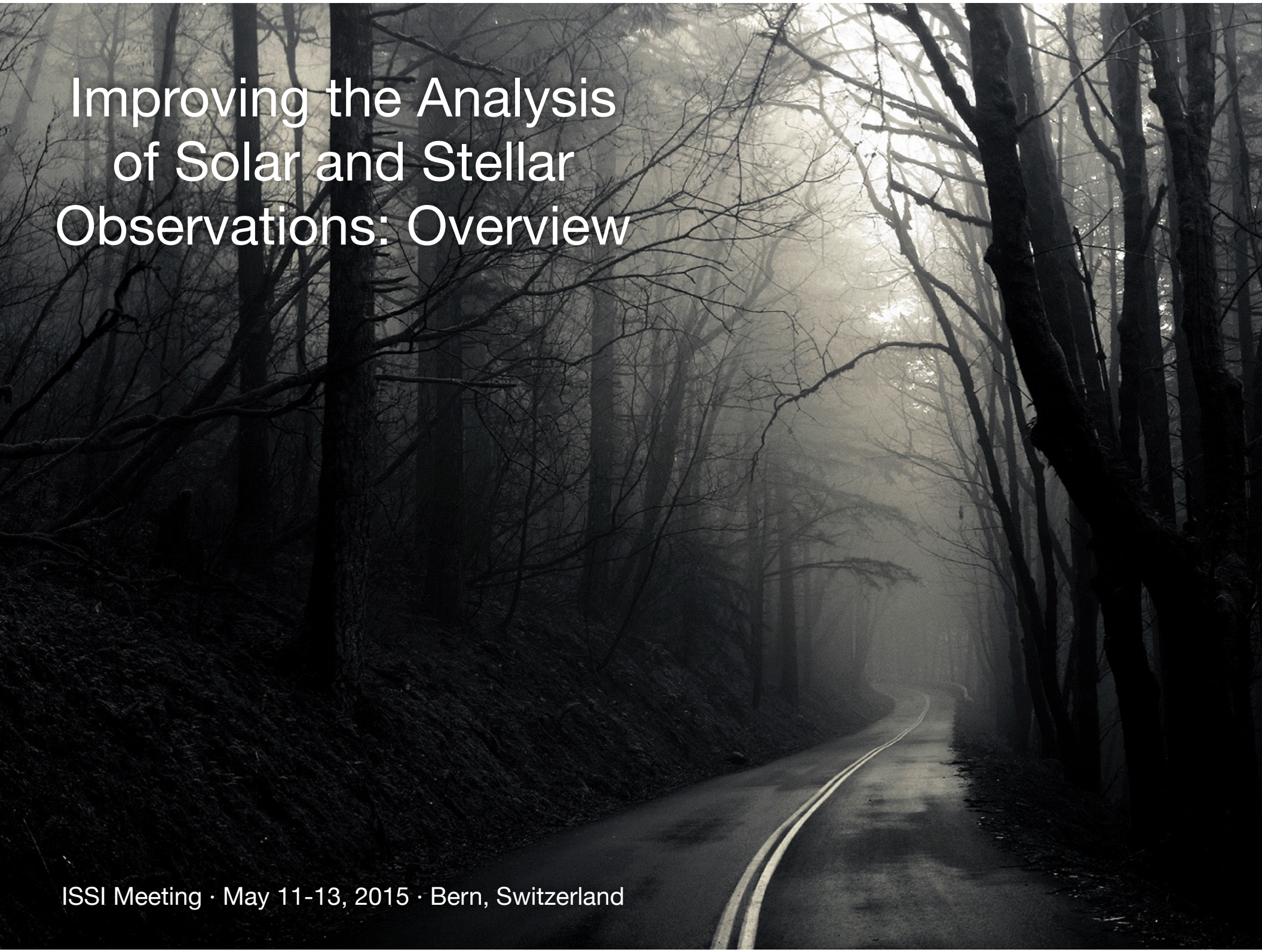
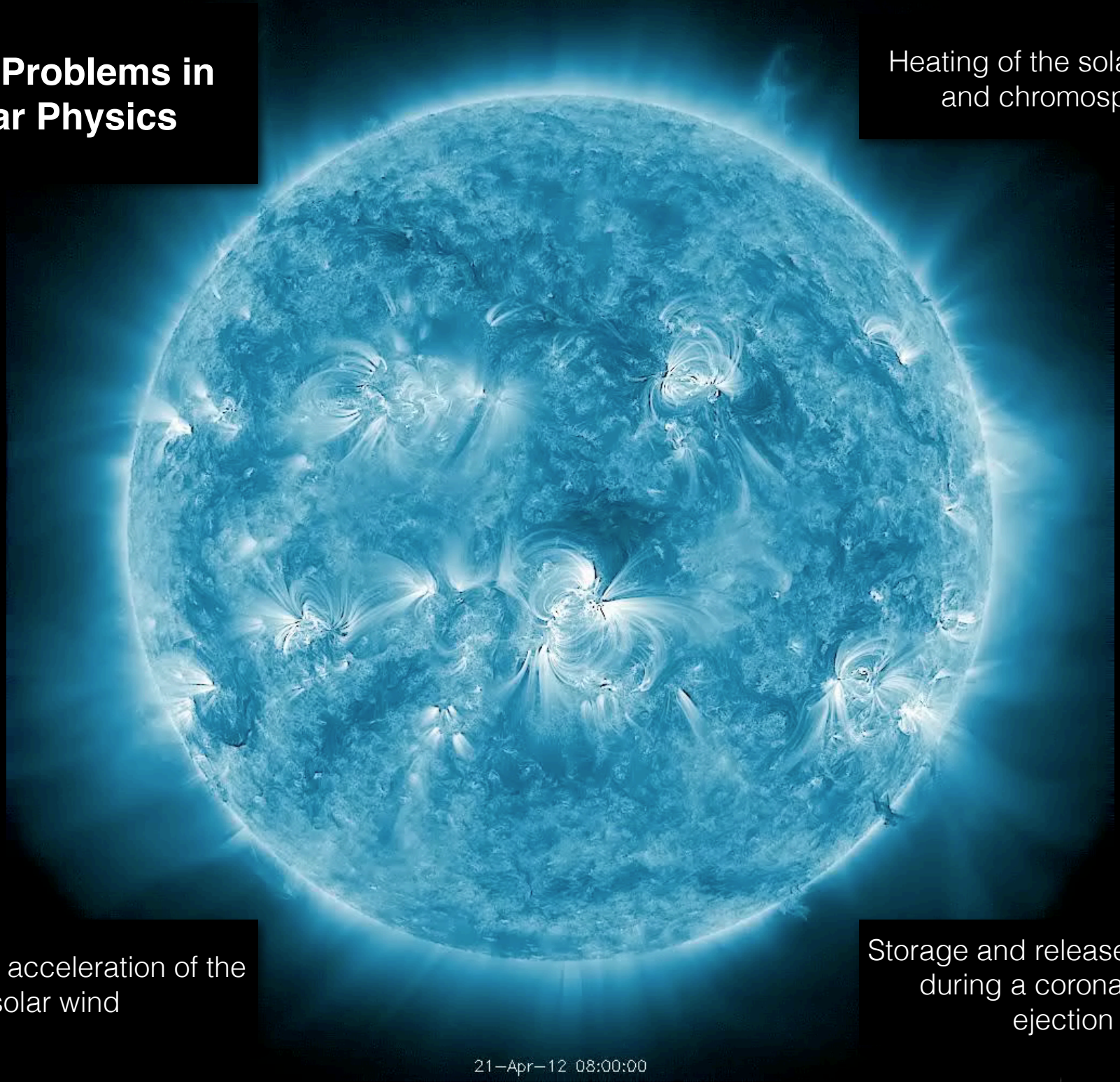


Improving the Analysis of Solar and Stellar Observations: Overview

ISSI Meeting · May 11-13, 2015 · Bern, Switzerland

Open Problems in Solar Physics

Heating of the solar corona and chromosphere



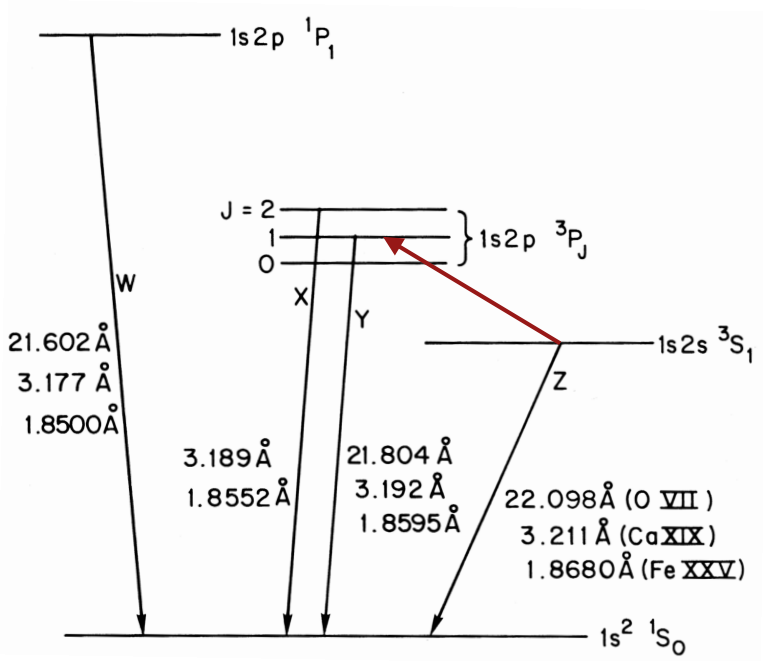
Origin and acceleration of the solar wind

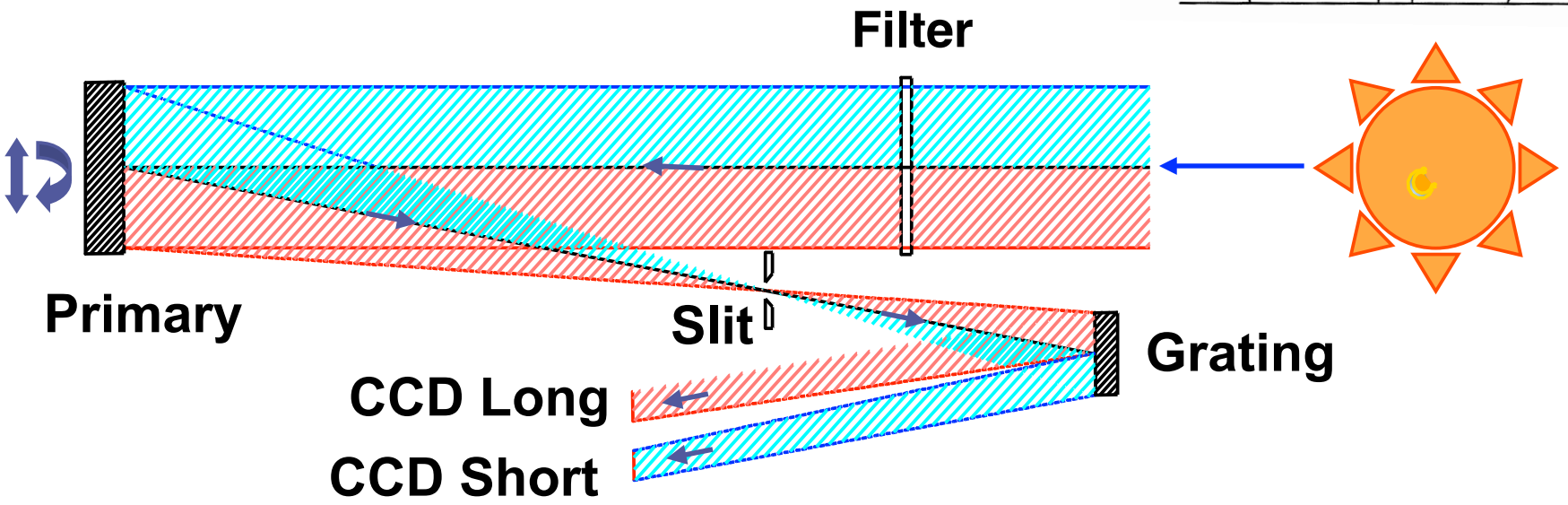
Storage and release of energy during a coronal mass ejection

The Problem in a Nutshell

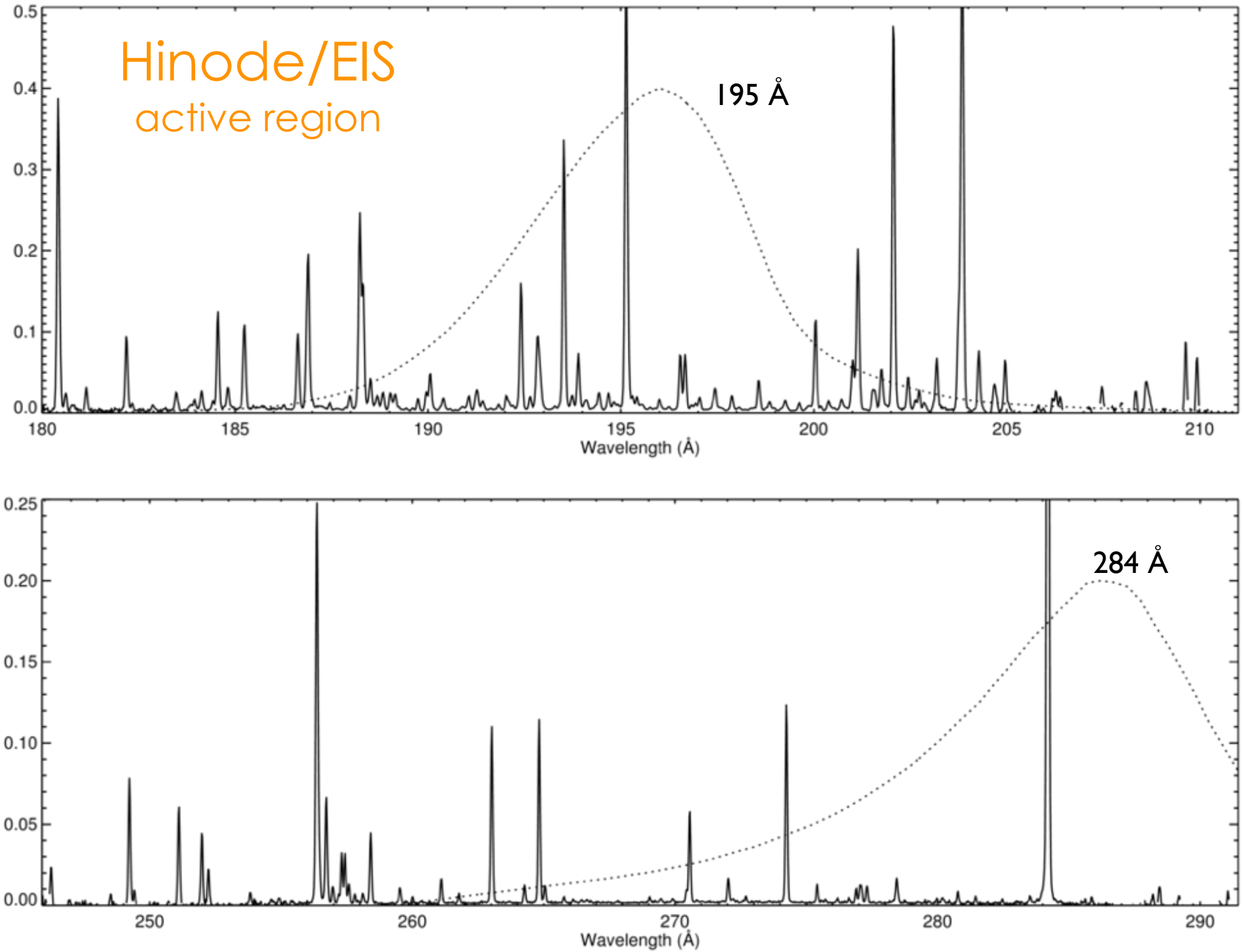
Problem 1: Properties of the atomic systems producing emission in the solar atmosphere are uncertain, but the systems are constrained

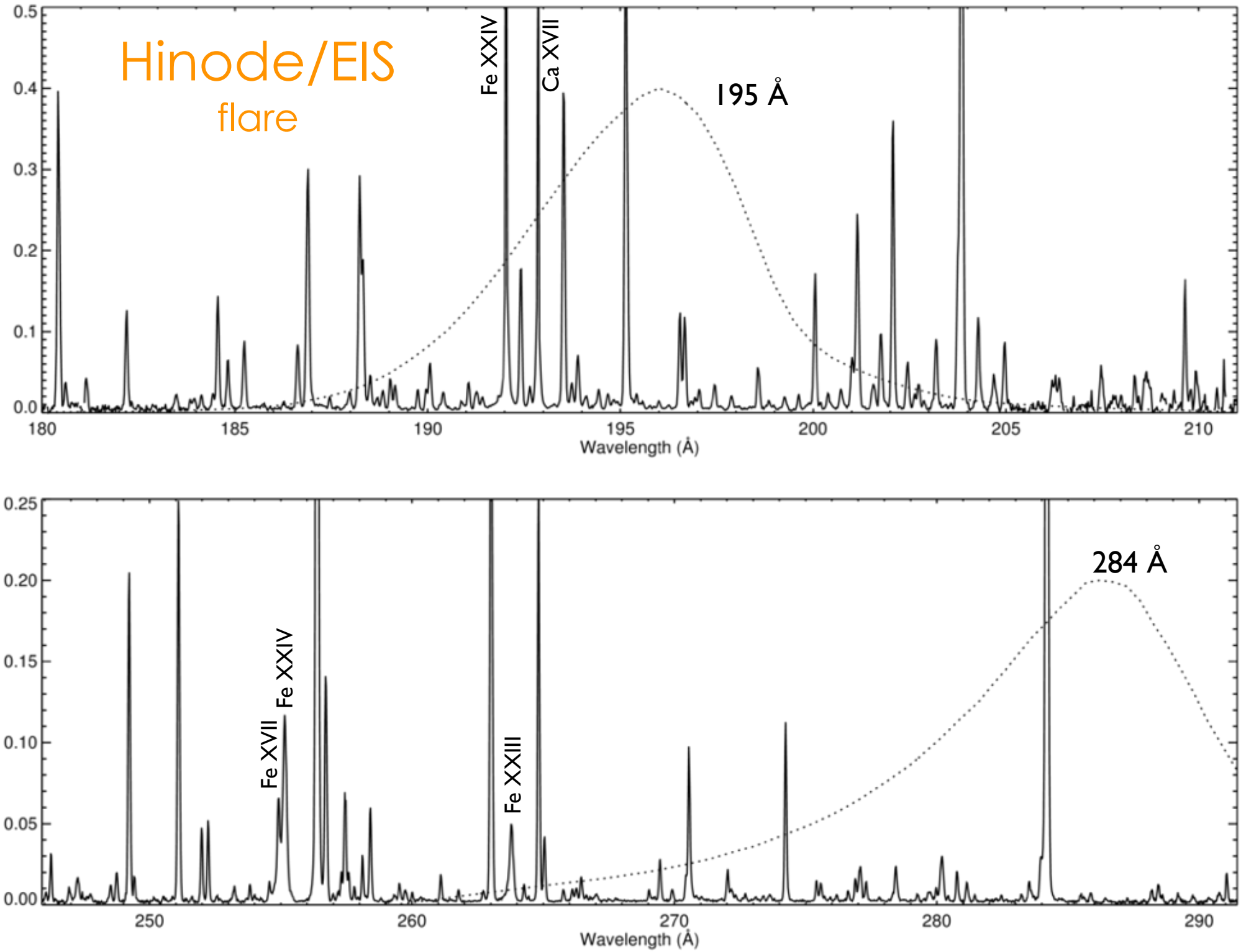
Problem 2: Properties of the instrumentation are uncertain and can change with time

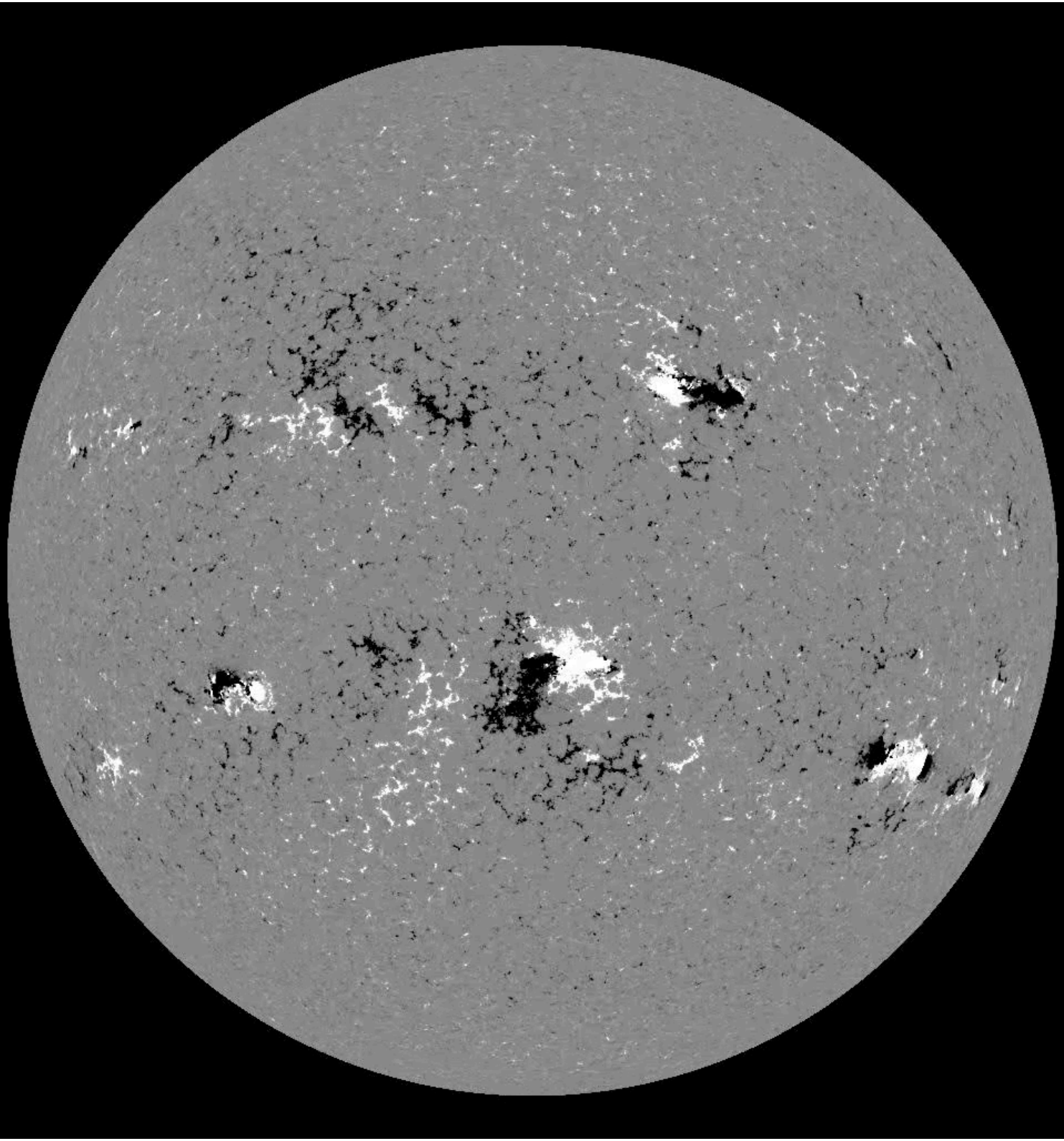


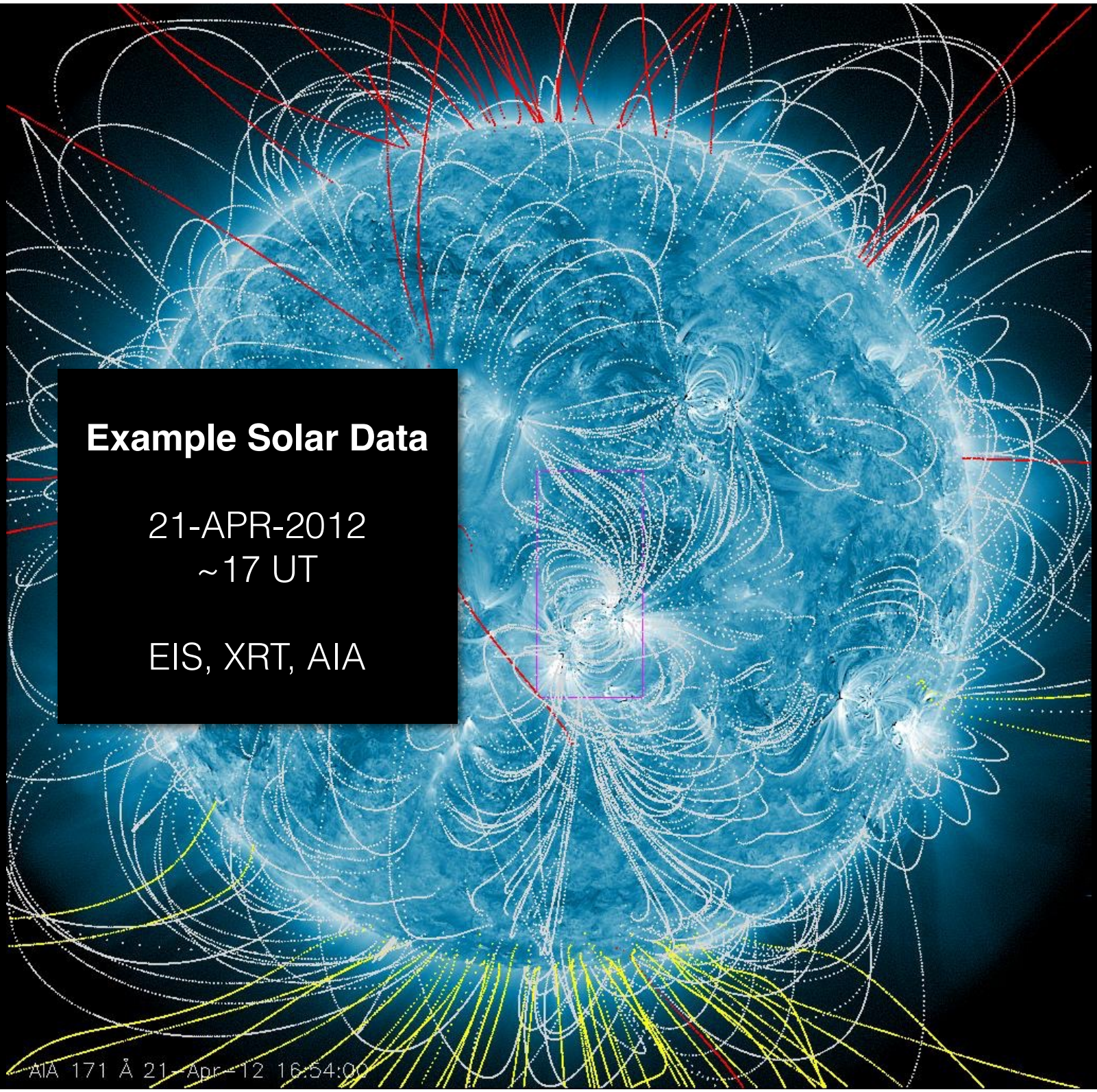


What inferences can we make about the properties of solar and stellar atmospheres in the presence of these uncertainties?

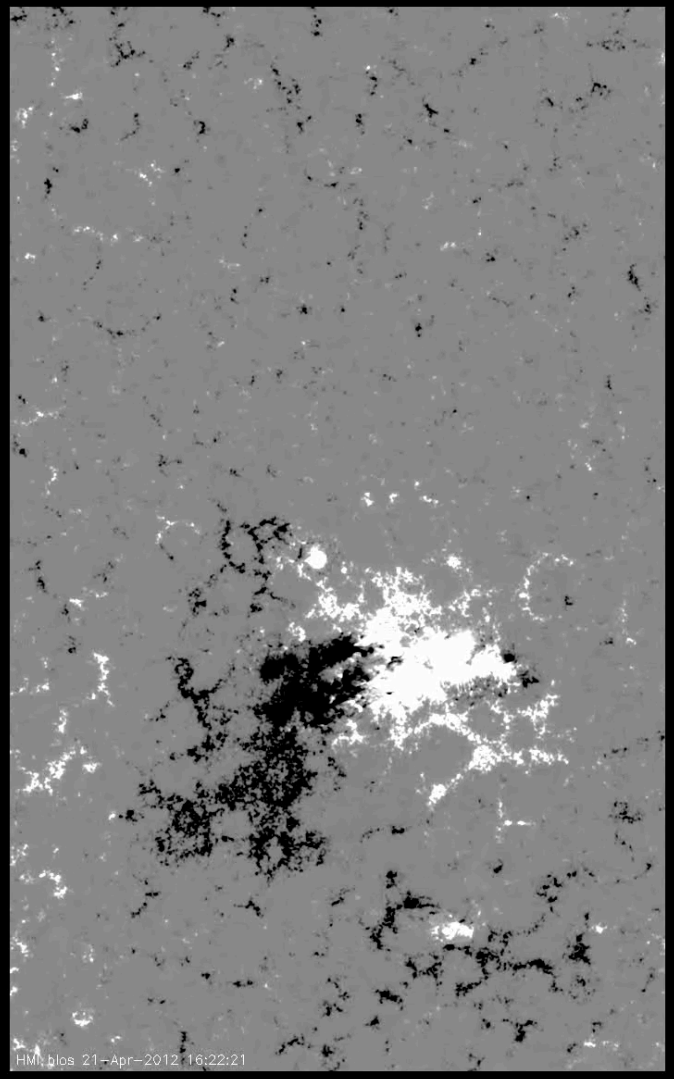

Hinode/EIS
active region
195 Å
0.5
0.4
0.3
0.2
0.1
0.0
180
185
190
195
200
205
210
Wavelength (Å)
284 Å
0.25
0.20
0.15
0.10
0.05
0.00
250
260
270
280
290
Wavelength (Å)


Hinode/EIS
flare
Fe XXIV
Ca XVII
195 Å
Wavelength (Å)
Fe XVII
Fe XXIV
Fe XXIII
284 Å
Wavelength (Å)

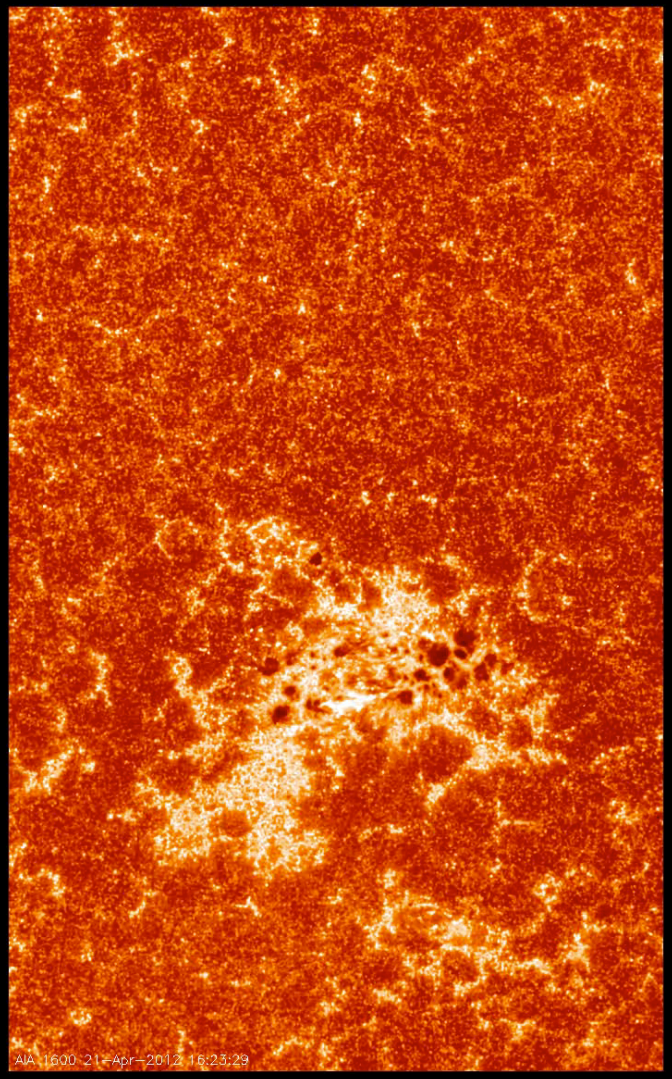



Example Solar Data
21-APR-2012
~17 UT
EIS, XRT, AIA
AIA 171 Å 21-Apr-12 16:54:00

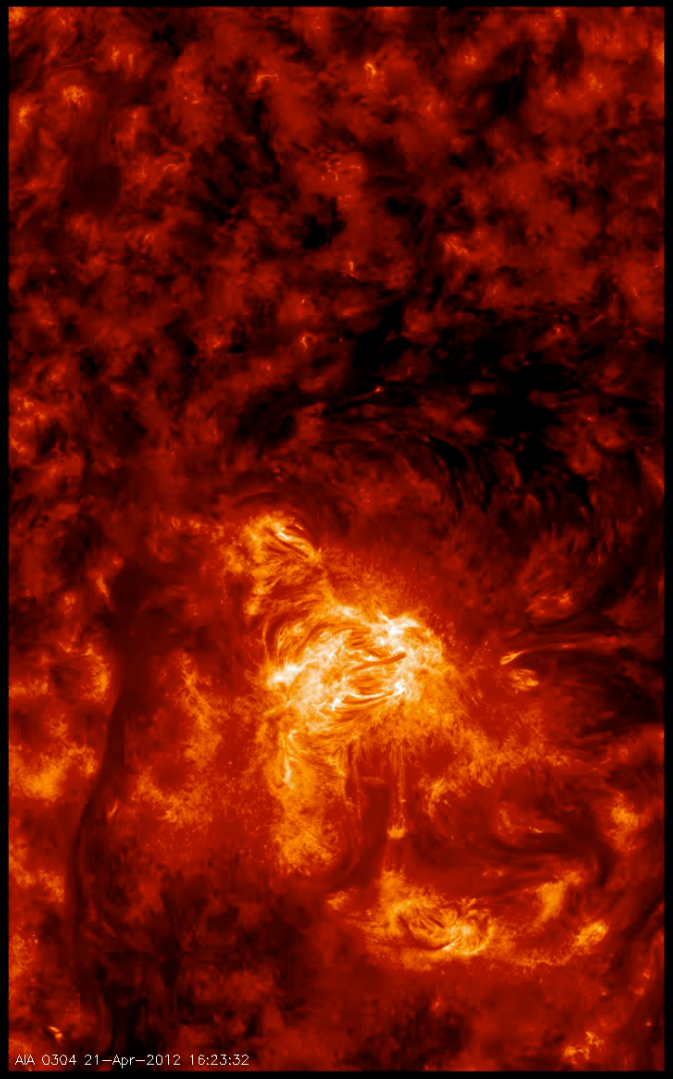
Solar Dynamics Observatory



photosphere
magnetic field

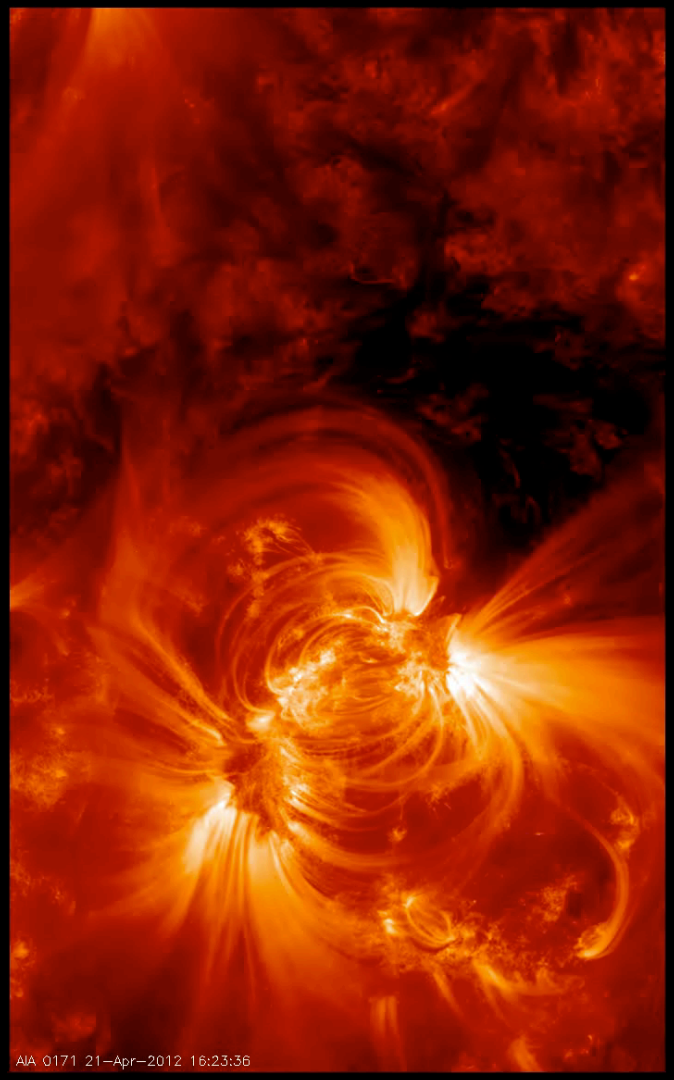


chromosphere

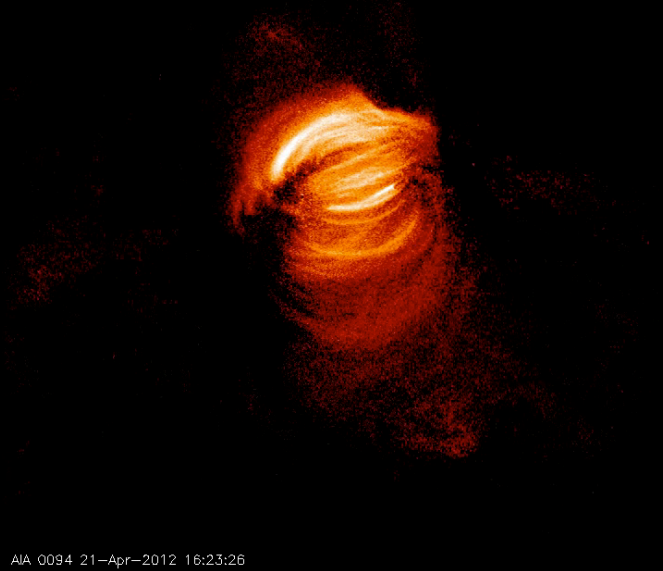


transition region

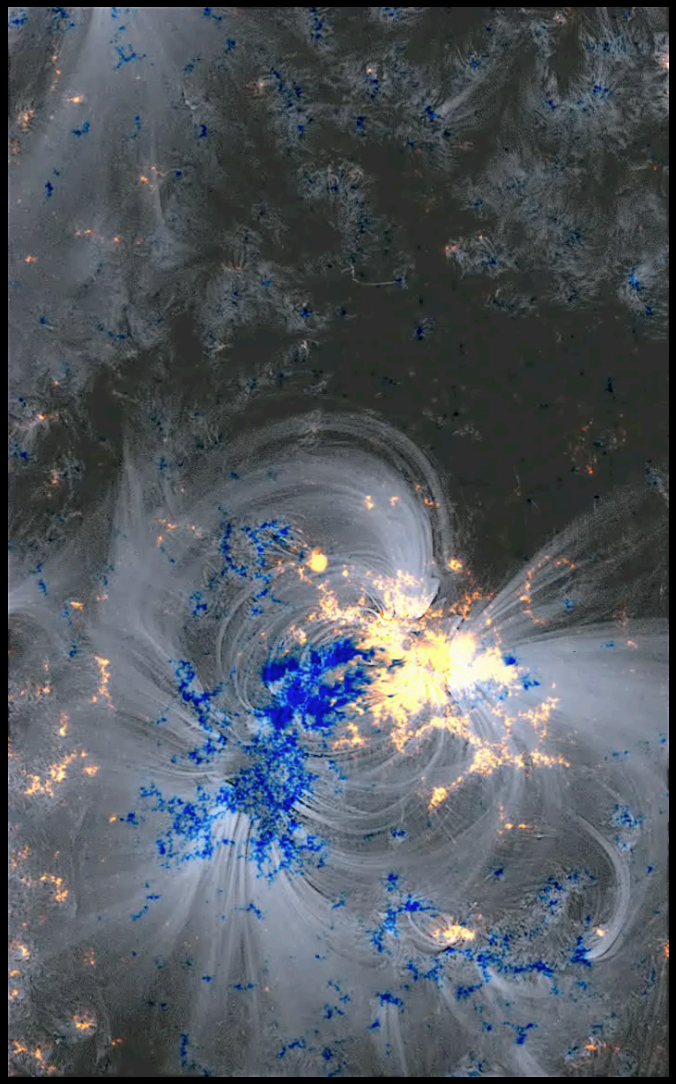
Solar Dynamics Observatory



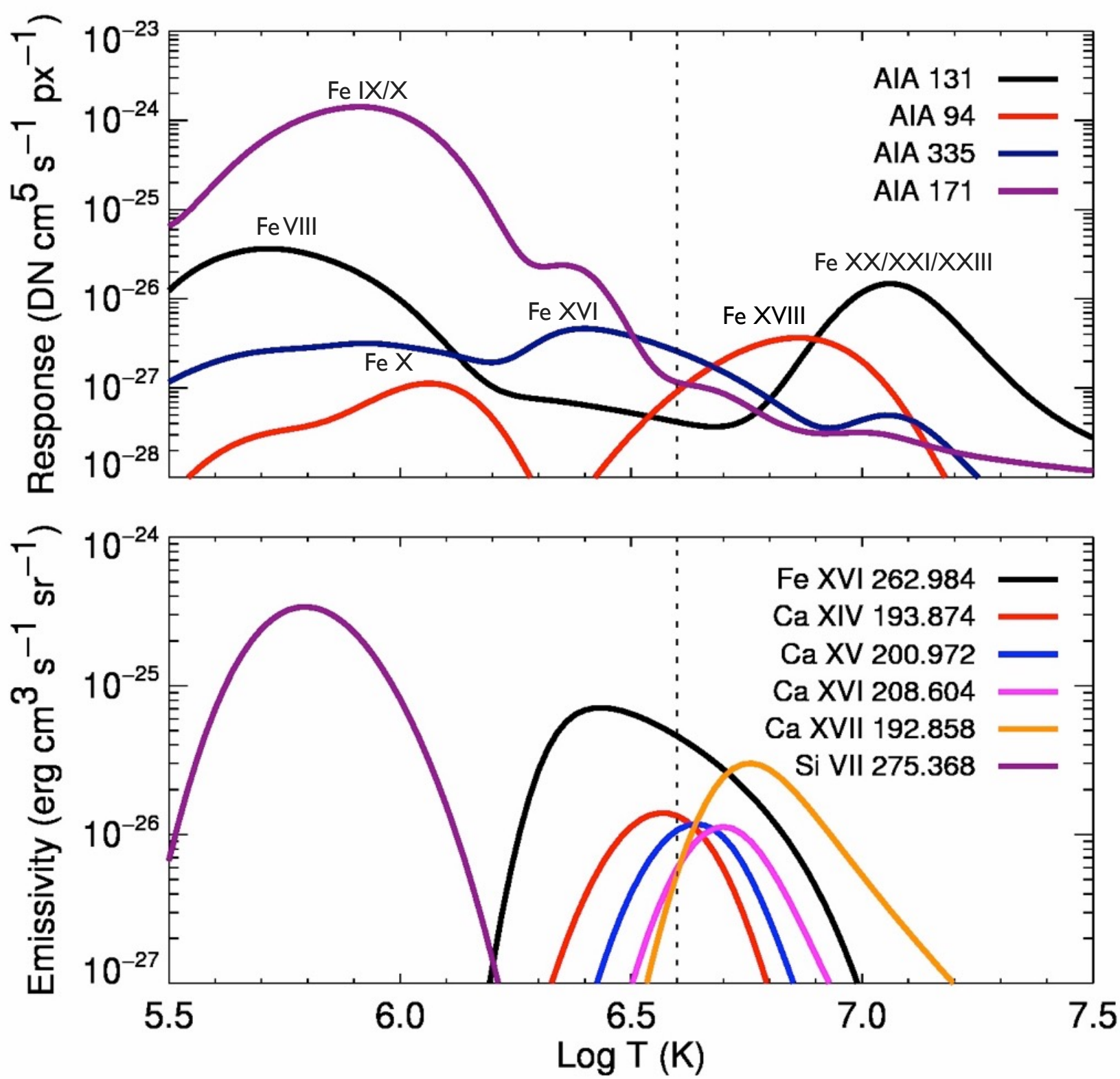
"1 MK" Corona



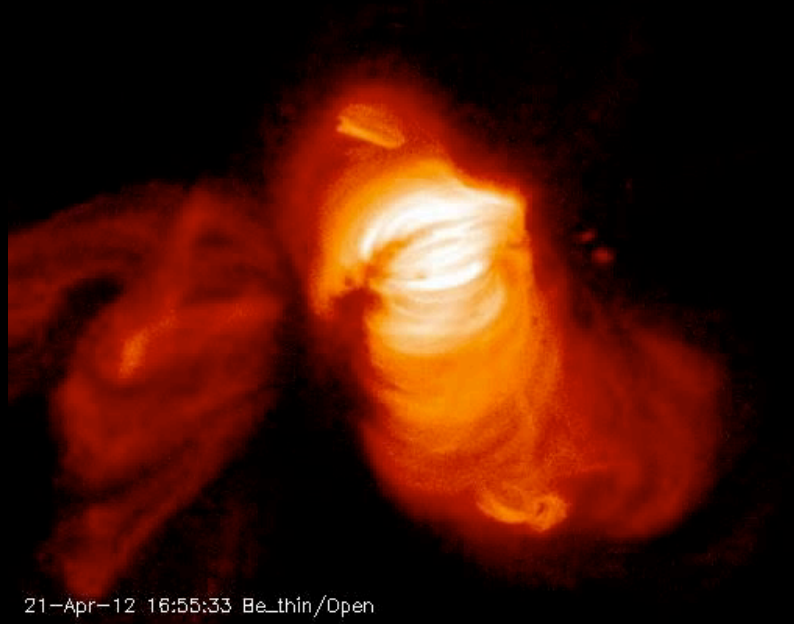
"4 MK" Corona

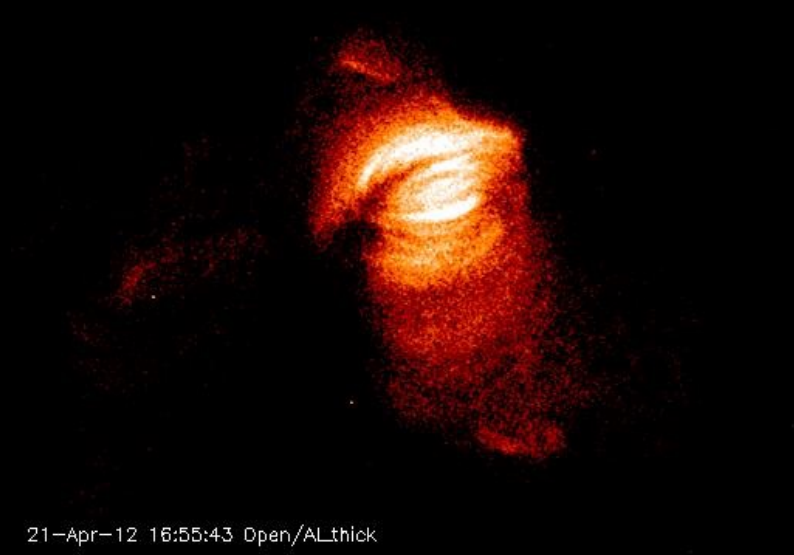


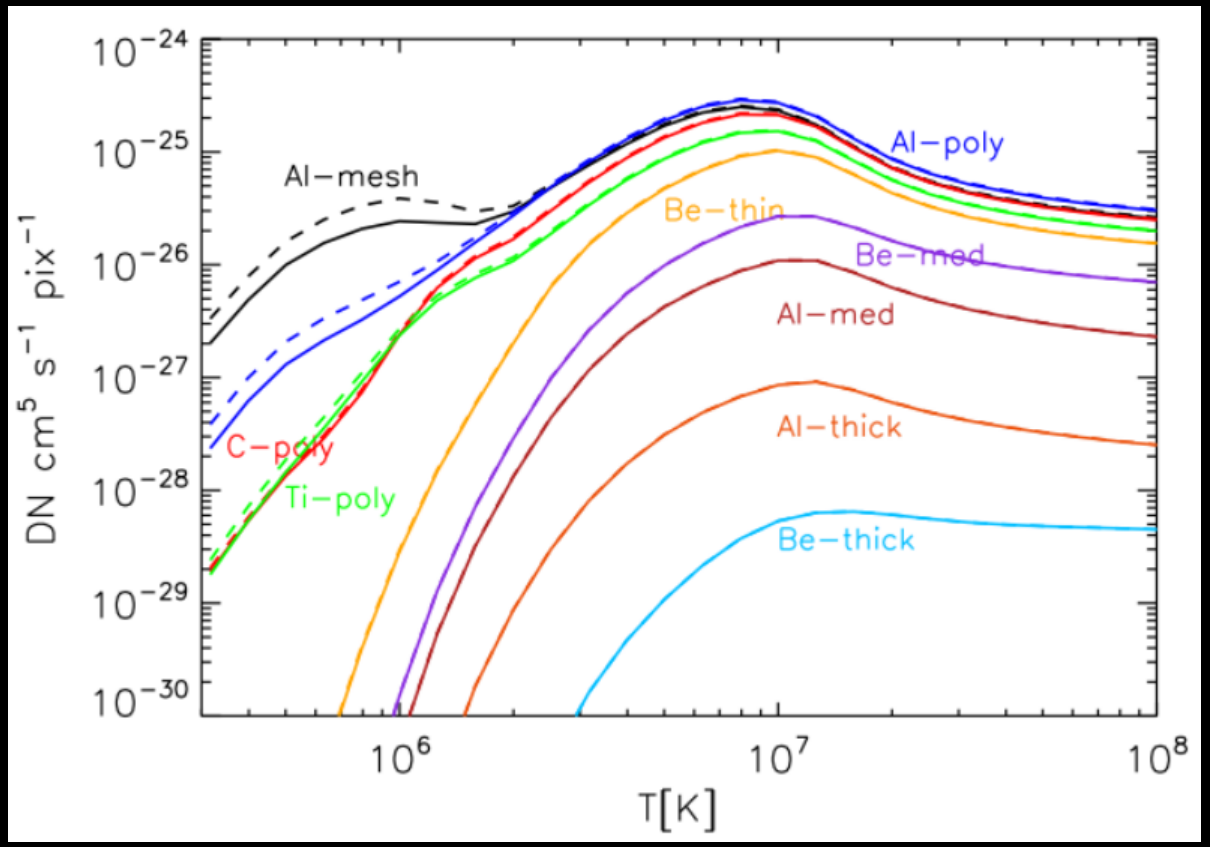
"1 MK" Corona magnetic field


Response (DN cm^5 s^{-1} px^{-1})
10^{-23}
10^{-24}
10^{-25}
10^{-26}
10^{-27}
10^{-28}
Fe IX/X
Fe VIII
Fe X
Fe XVI
Fe XVIII
Fe XX/XXI/XXIII
AIA 131
AIA 94
AIA 335
AIA 171
Emissivity (erg cm^3 s^{-1} sr^{-1})
10^{-24}
10^{-25}
10^{-26}
10^{-27}
Fe XVI 262.984
Ca XIV 193.874
Ca XV 200.972
Ca XVI 208.604
Ca XVII 192.858
Si VII 275.368
5.5
6.0
6.5
7.0
7.5
Log T (K)

XRT/Hinode Temperature Responses







Computing Line Intensities

$$I_\lambda = n_u A_{ul} V$$

$$I_\lambda = \frac{n_u}{n_{ion}} \frac{n_{ion}}{n_{el}} \frac{n_{el}}{n_H} \frac{n_H}{n_e} n_e A_{ul} V$$

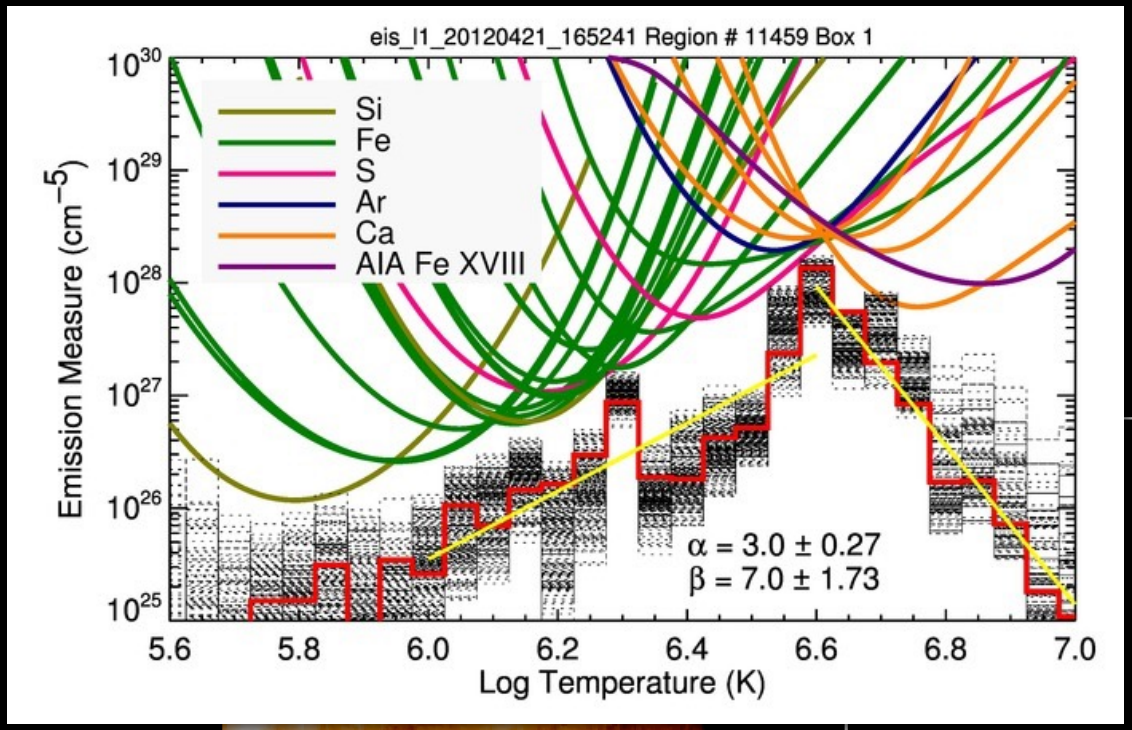
$$I_\lambda = \epsilon_\lambda(T_e) n_e^2 V$$

$$I_\lambda = \int_{T_e} \epsilon_\lambda(T_e) n_e^2 \frac{dV}{dT_e} dT_e$$

$$I_\lambda = \int_{T_e} \epsilon_\lambda(T_e) \xi(T_e) dT_e$$

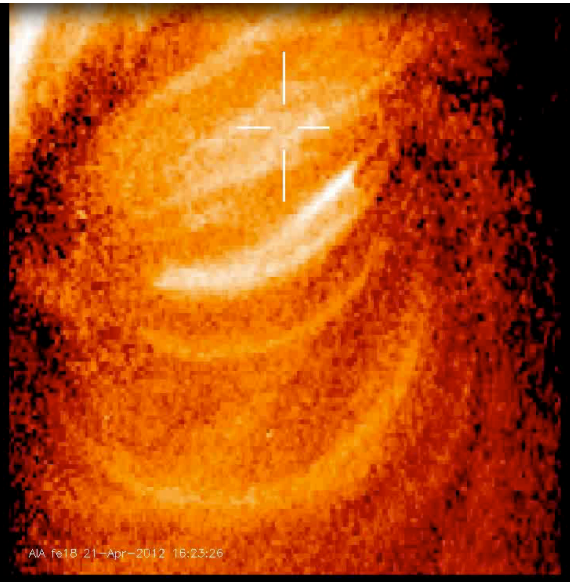
inversion is noisy ⇒ regularize or smooth

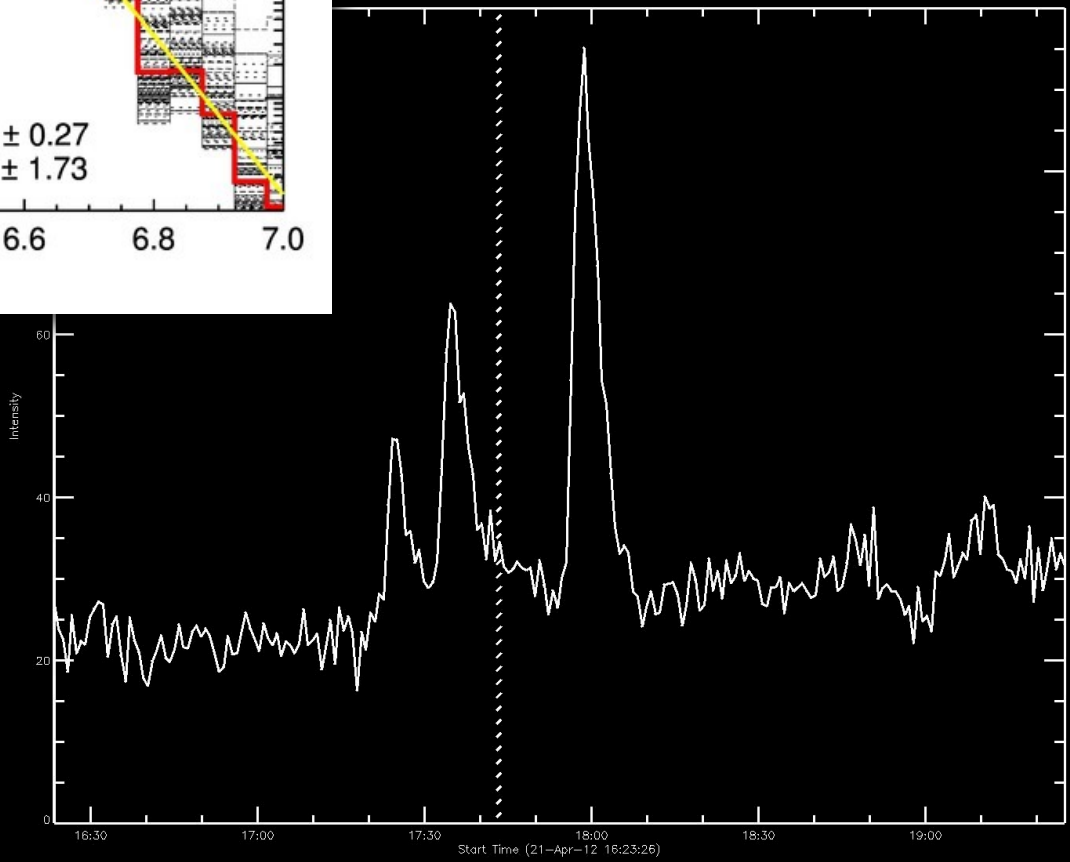
Example DEM Calculation



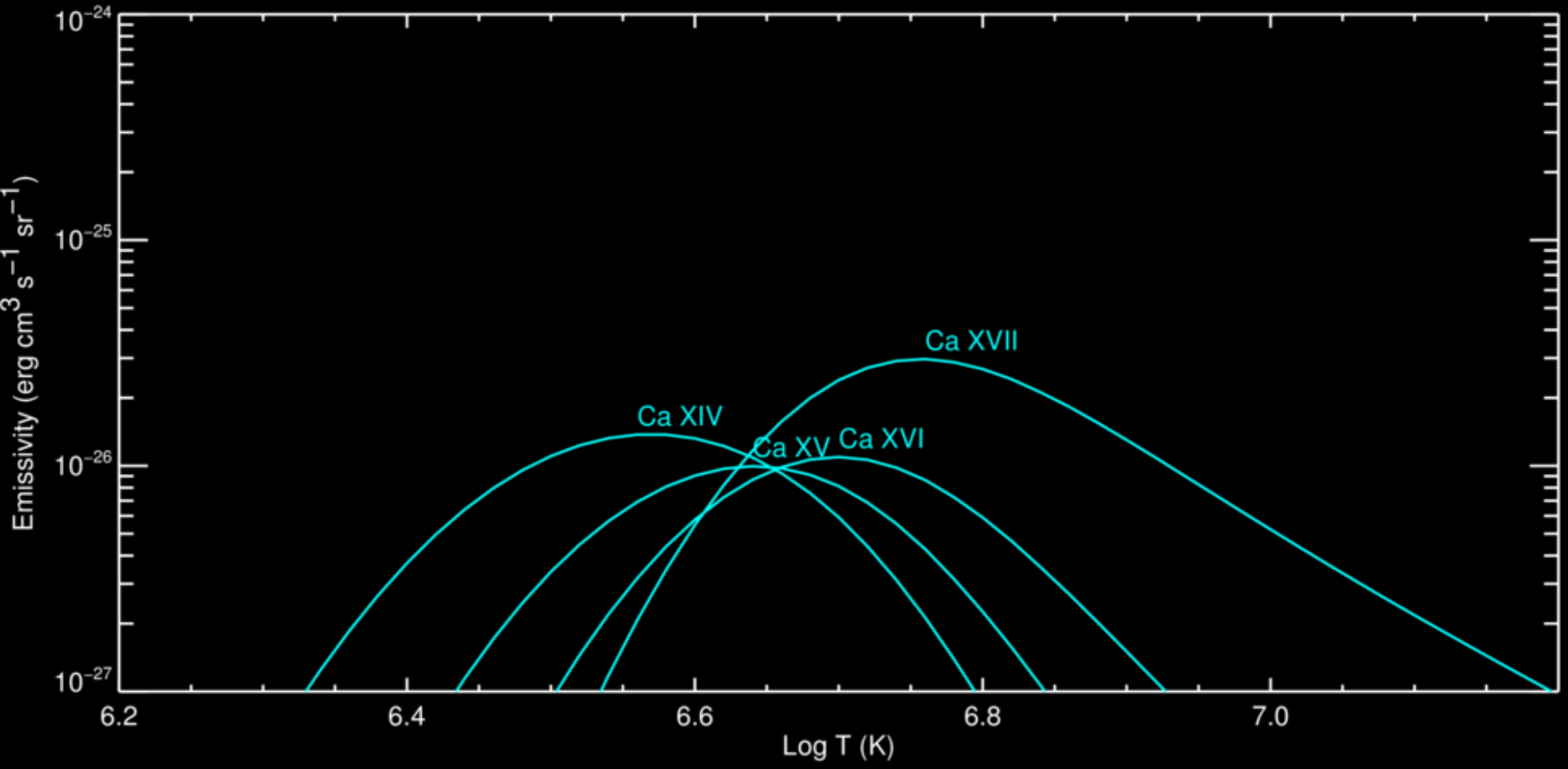
$$I_\lambda = \epsilon_\lambda(T_e) n_e^2 V$$

AIA Fe XVIII

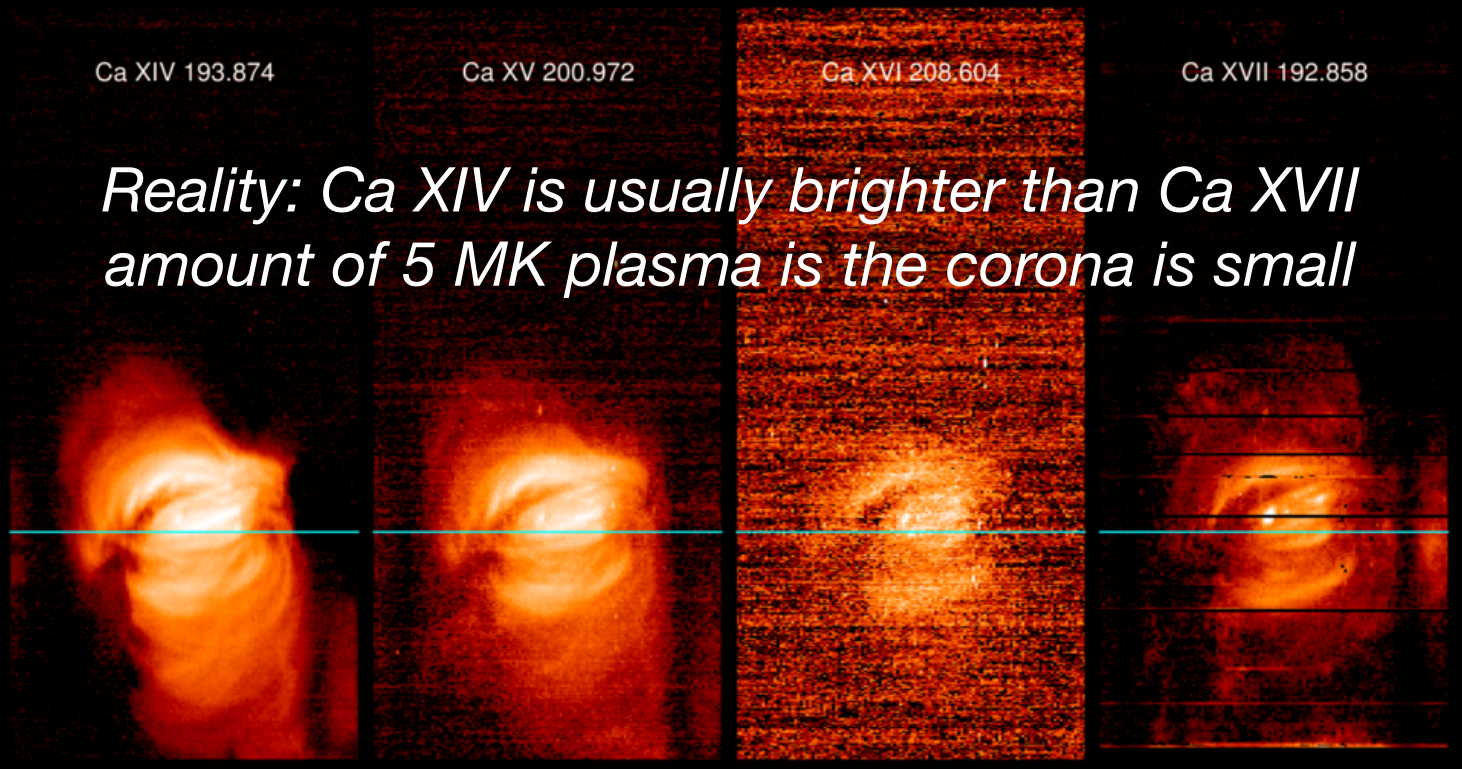




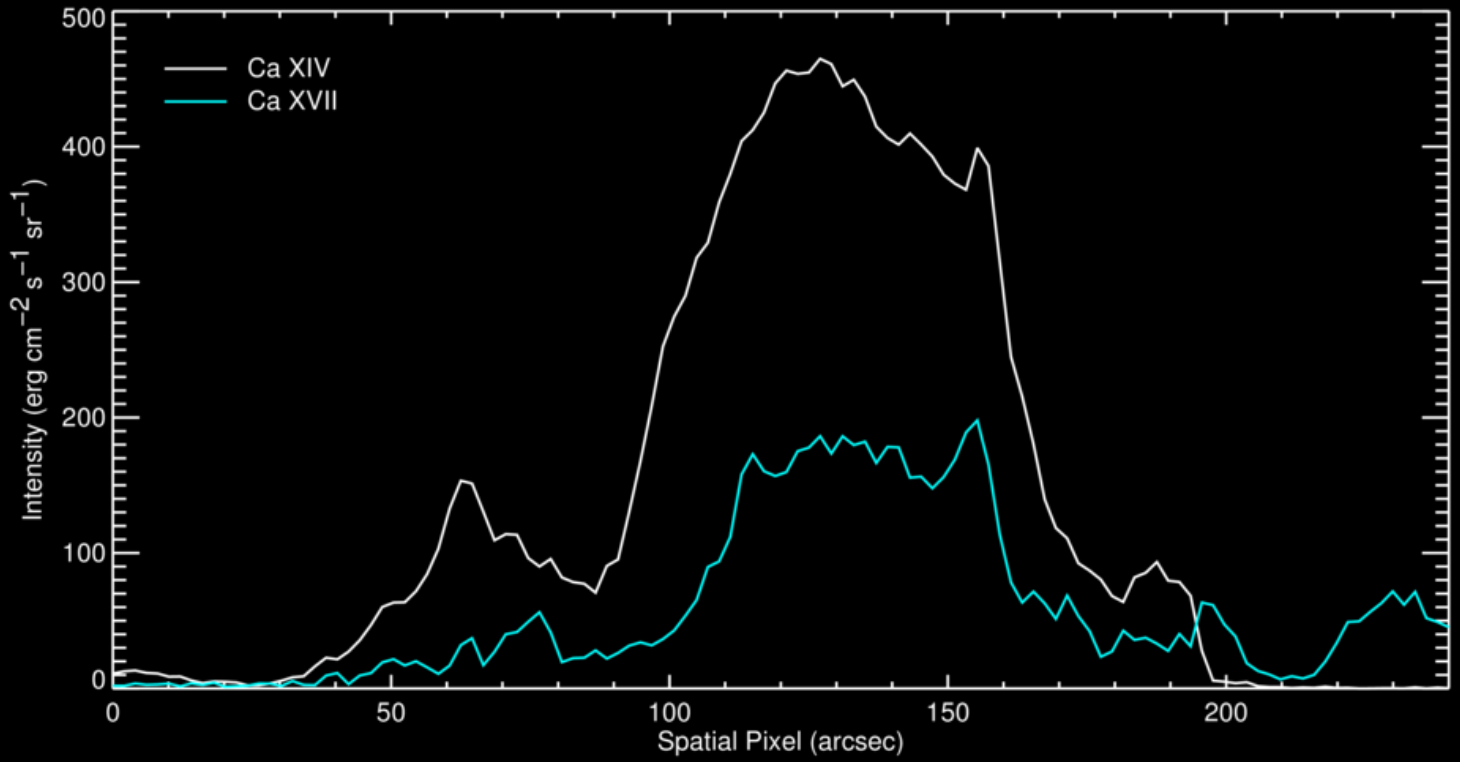
A Simpler Argument



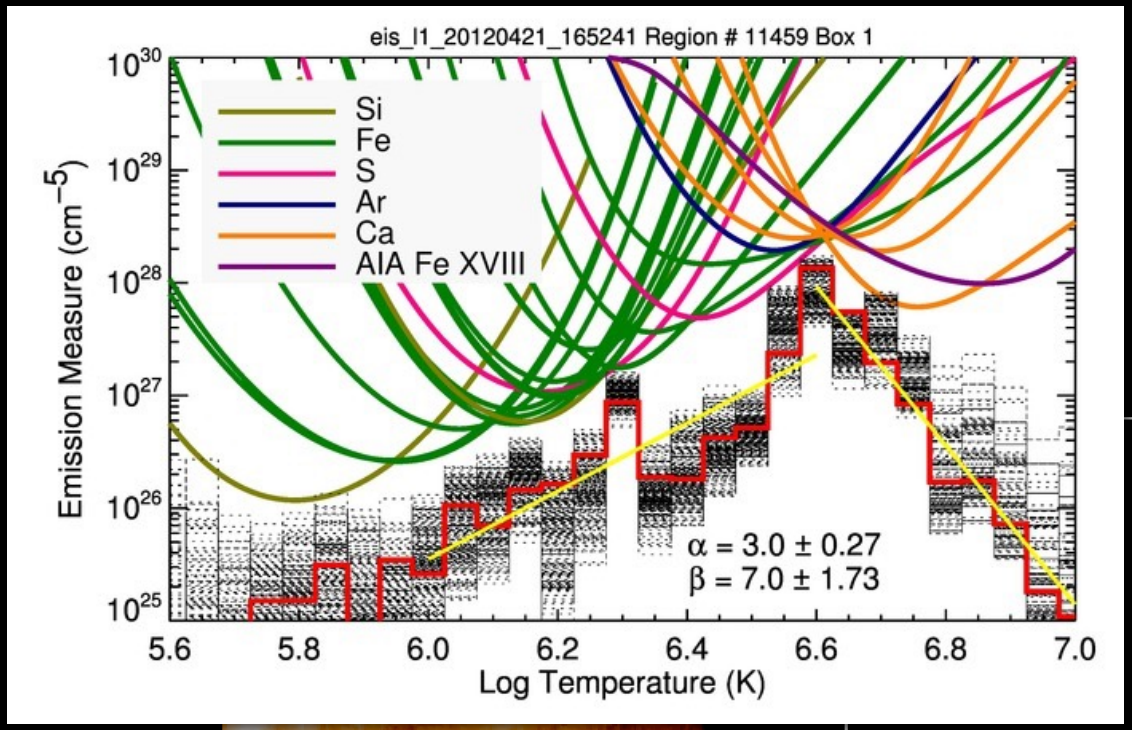
For cooling loops Ca XVII should be brighter than Ca XIV



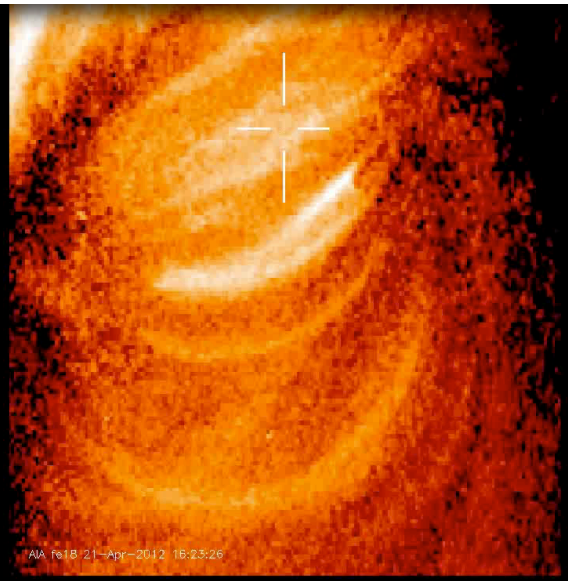
Reality: Ca XIV is usually brighter than Ca XVII
amount of 5 MK plasma is the corona is small

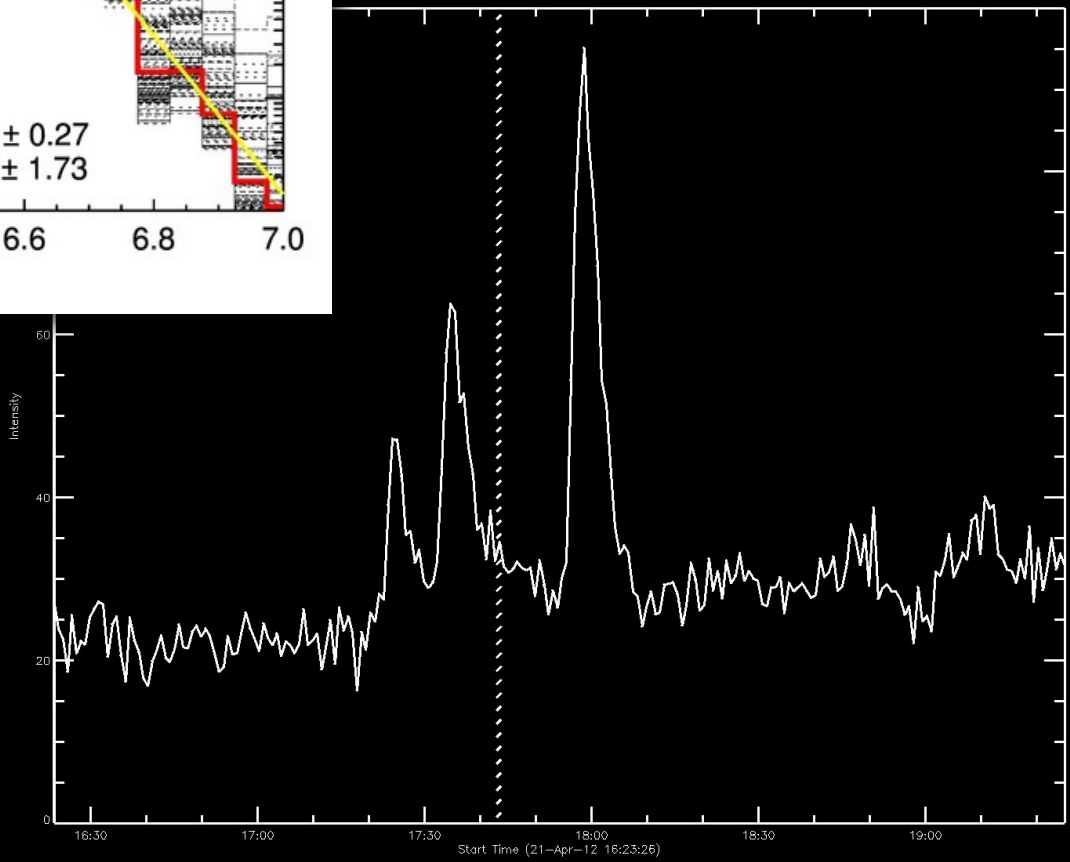


Example DEM Calculation

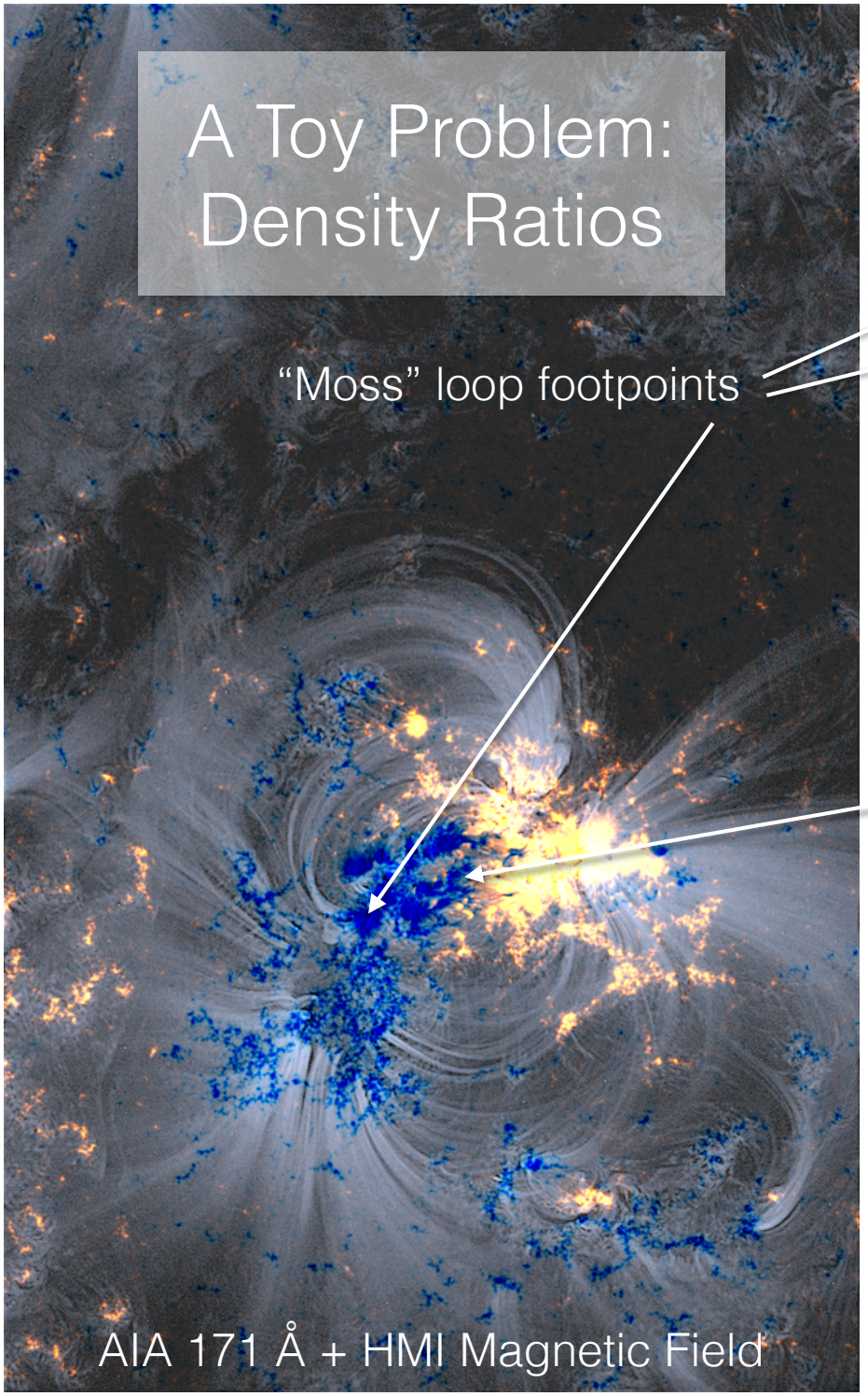


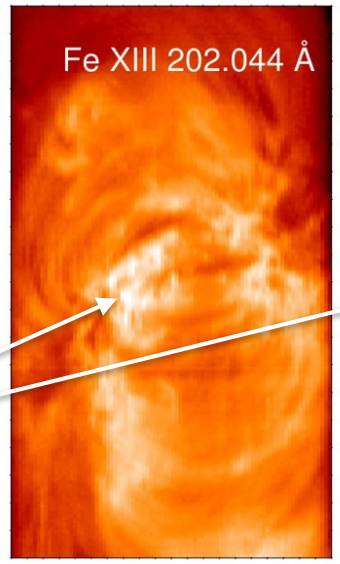
AIA Fe XVIII

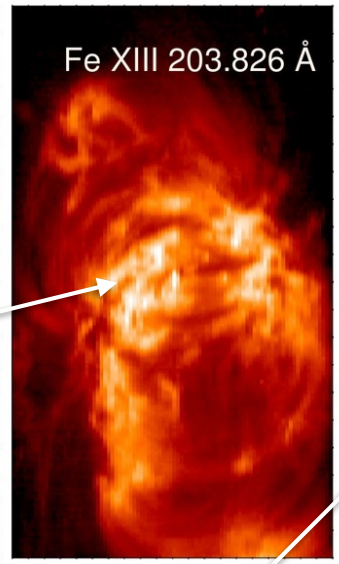


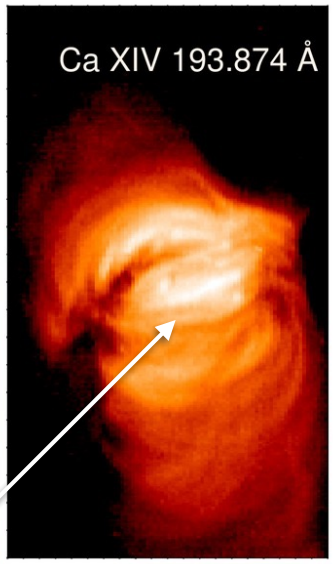


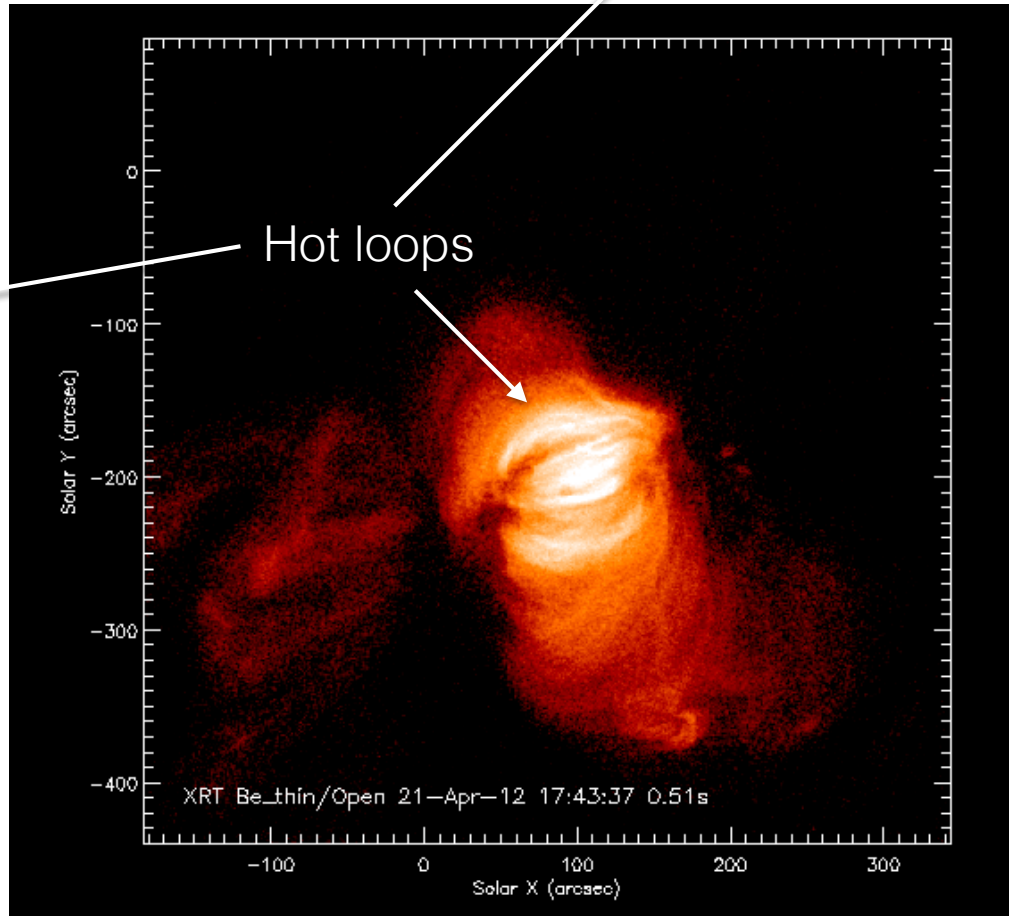
A Toy Problem: Density Ratios



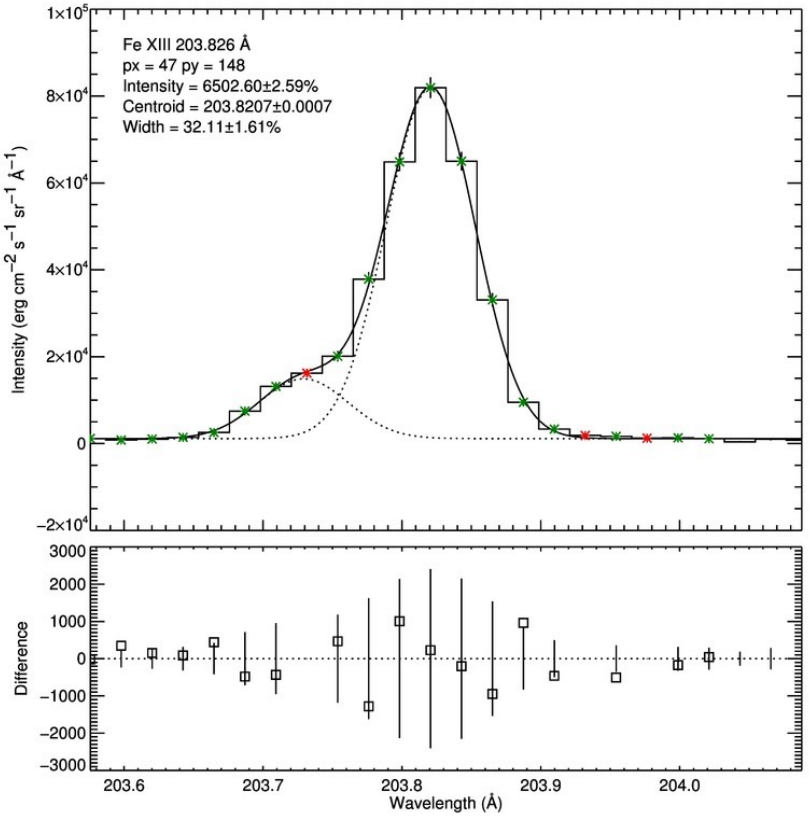


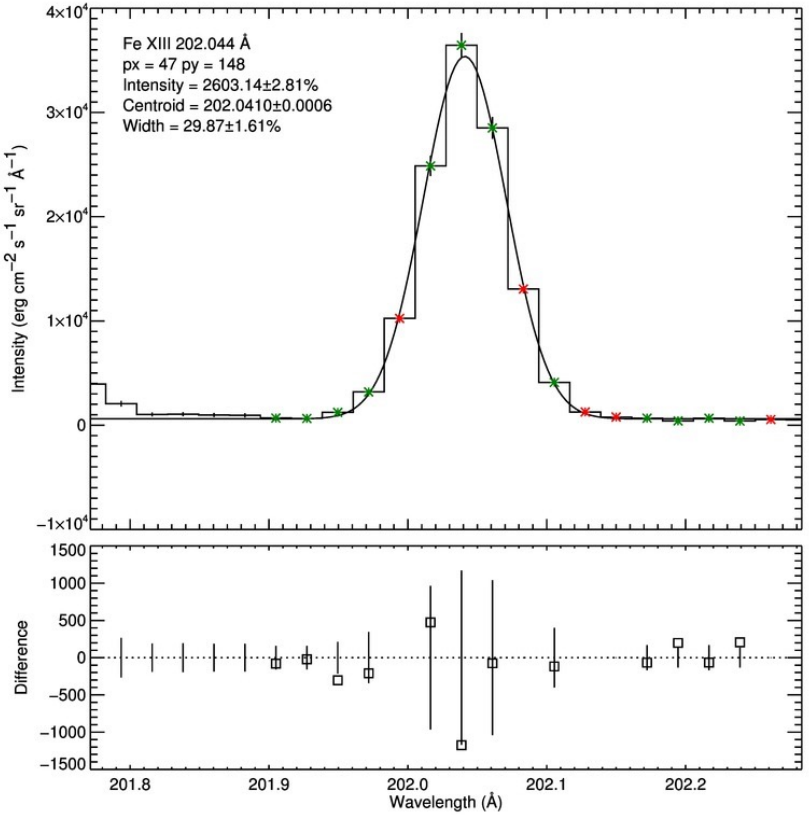




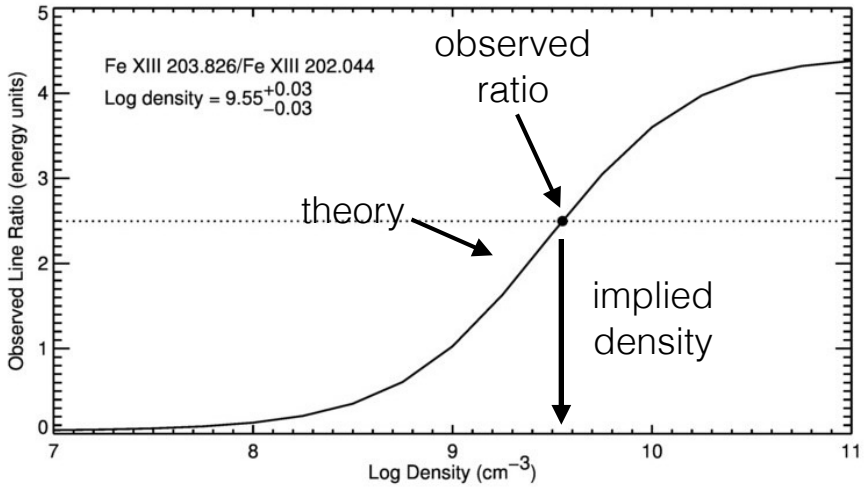


Example Line Ratio

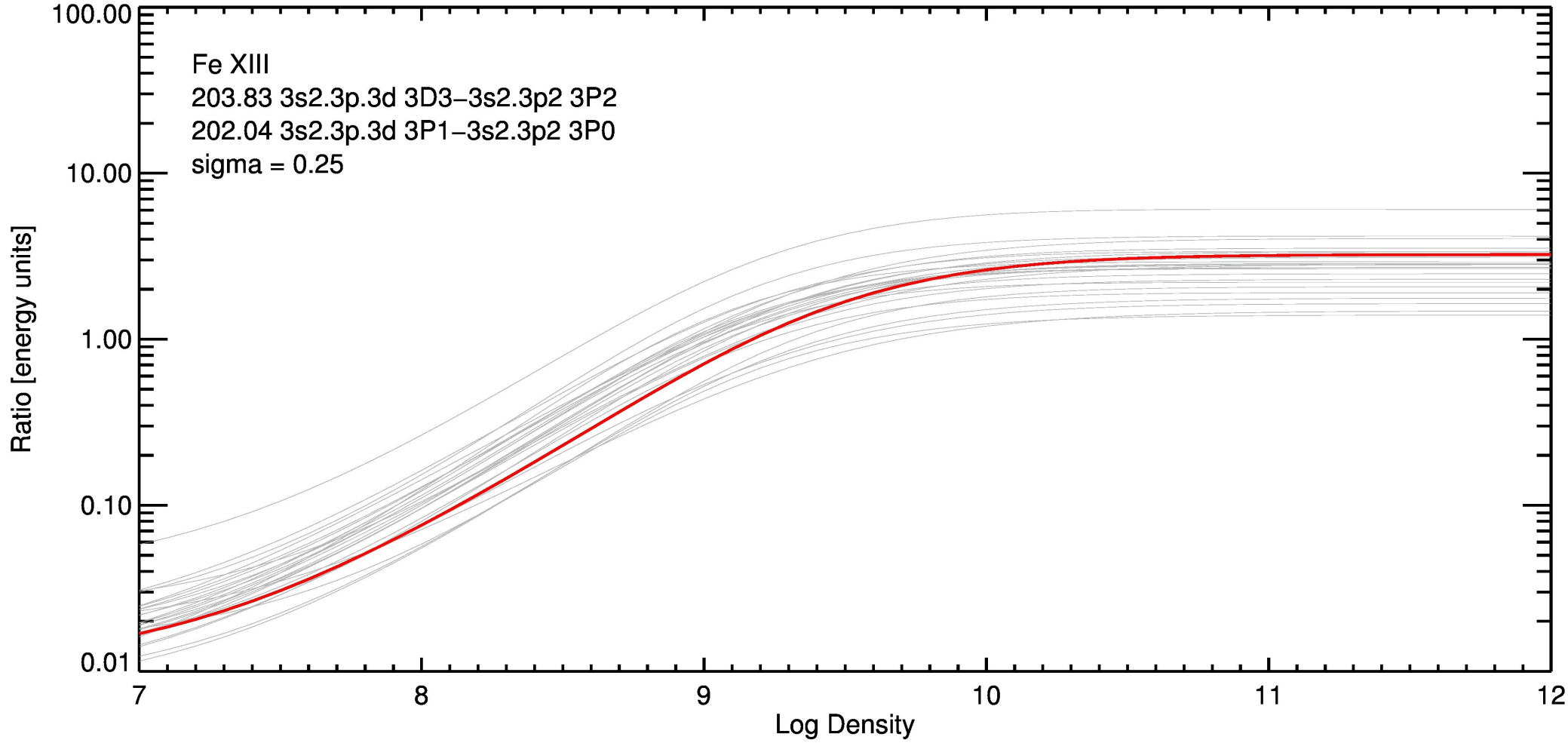




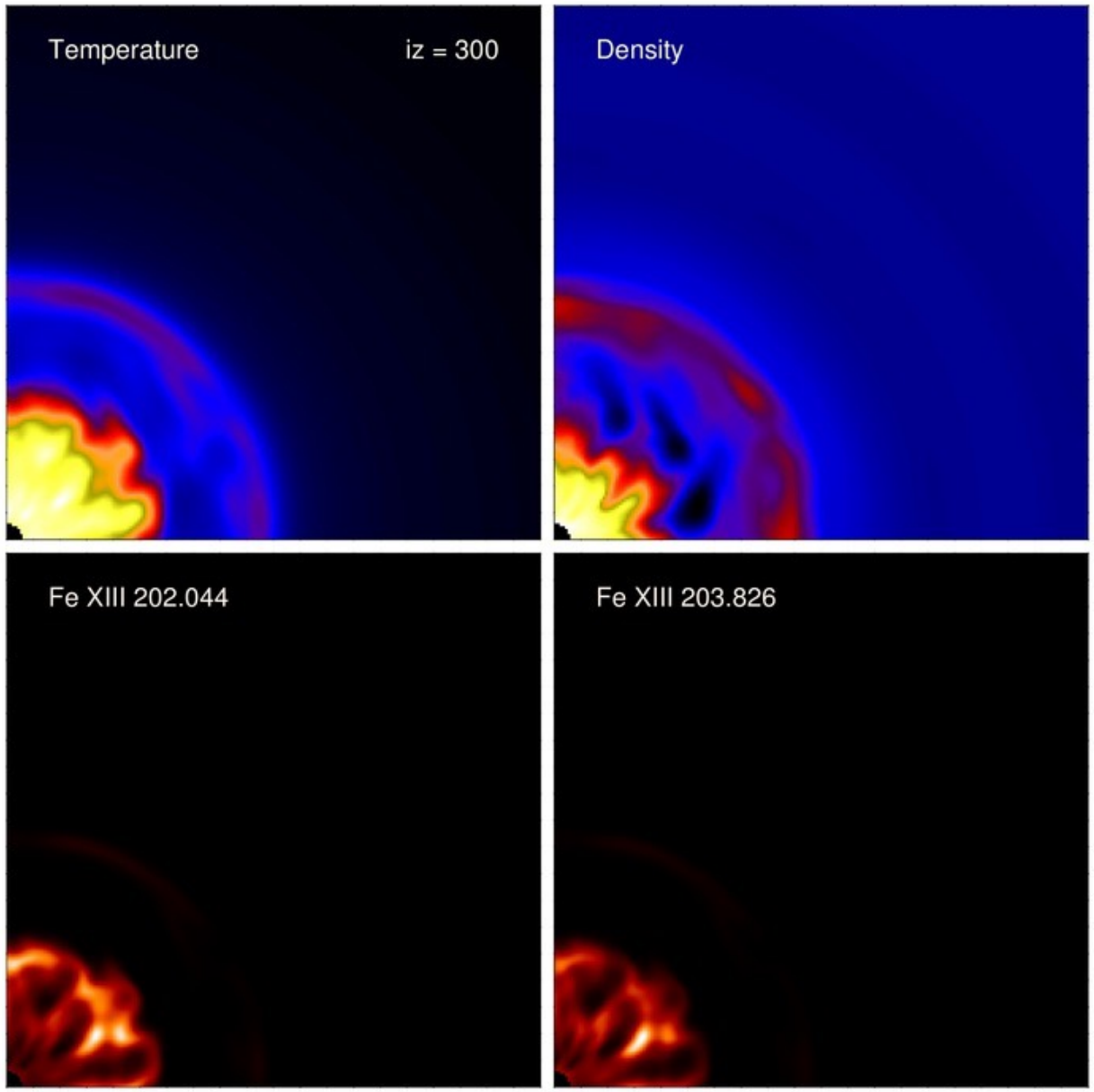
Some atomic levels are metastable and sensitive to collisional de-excitation. Taking the ratio of an emission line from such a level to another emission line from the same ionization stage isolates the density dependance. The ratio of 203.826/203.044 is an example of such a ratio. By comparing the observed line ratio with a theoretical calculation the density at the loop footpoint can be inferred.



Example Perturbed CHIANTI Atomic Data



Numerical Simulation



Simulations can be used to test inference methods

Meeting Goals

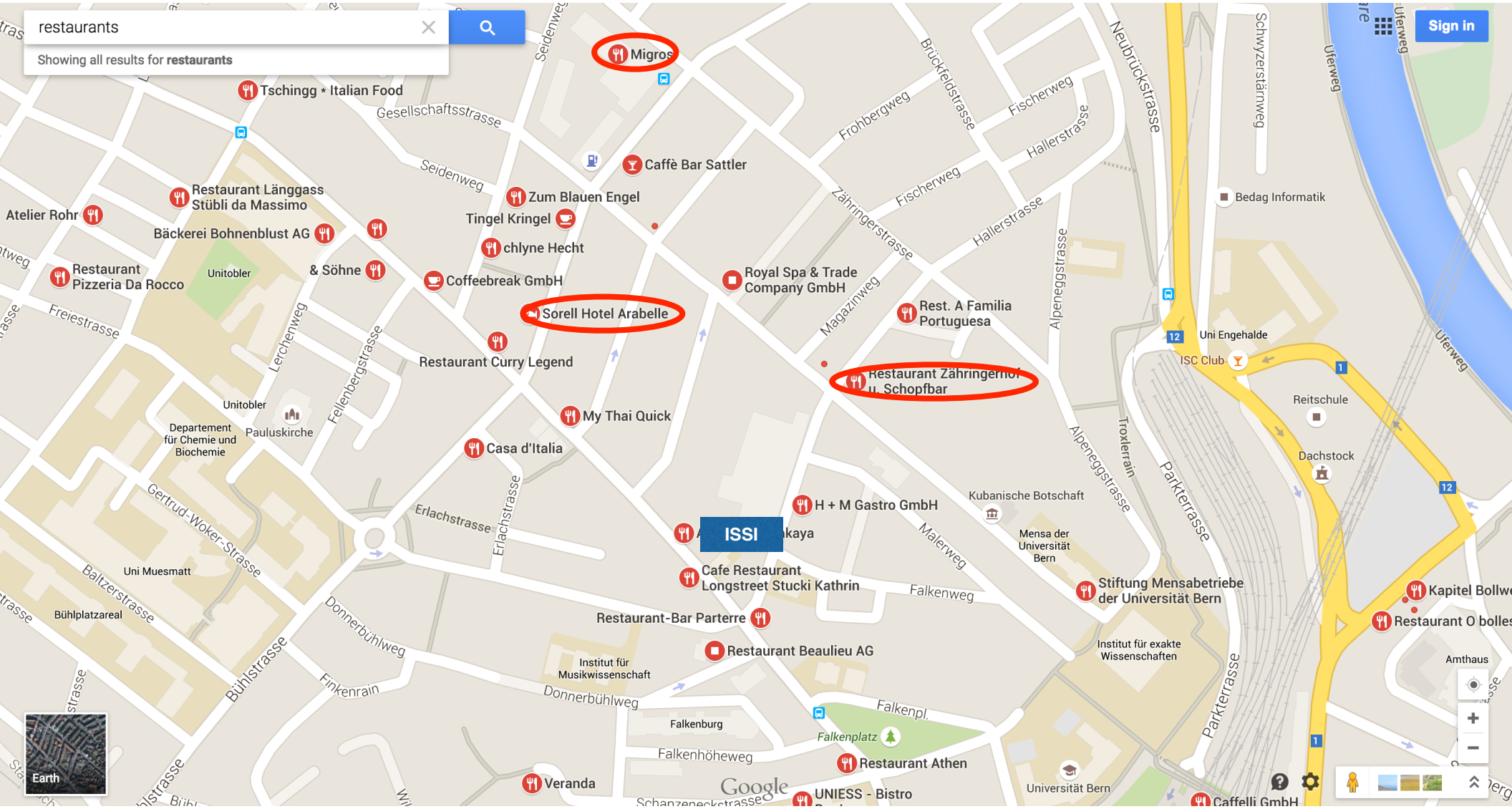
Top Level Goal

- Estimates of uncertainties
  - atomic data
  - instrumental calibration
- Algorithm for computing the limits to inference

Meta Goal

- Modernizing statistical inference in solar physics

"The problem with the astrophysical literature is that most of it is wrong."
- Steven Weinberg


restaurants
Showing all results for restaurants
Sign in
Migros
Tschingg • Italian Food
Caffè Bar Sattler
Restaurant Länggass Stübli da Massimo
Zum Blauen Engel
Atelier Rohr
Tingel Kringel
Bäckerei Bohnenblust AG
chlyne Hecht
Restaurant Pizzeria Da Rocco
& Söhne
Coffeebreak GmbH
Royal Spa & Trade Company GmbH
Sorell Hotel Arabelle
Rest. A Familia Portuguesa
Restaurant Curry Legend
Restaurant Zähringerhof u. Schopfbar
My Thai Quick
Casa d'Italia
H + M Gastro GmbH
ISSI
Cafe Restaurant Longstreet Stucki Kathrin
Restaurant-Bar Parterre
Restaurant Beaulieu AG
Stiftung Mensabetriebe der Universität Bern
Bedag Informatik
Uni Engehalde
ISC Club
Reitschule
Dachstock
Kubanische Botschaft
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Institut für exakte Wissenschaften
Institut für Musikwissenschaft
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Falkenburg
Restaurant Athen
Veranda
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Restaurant O bolles
Unitobler
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Uni Muesmatt
Bühlplatzareal
Gesellschaftsstrasse
Seidenweg
Freiestrasse
Lerchenweg
Fellenbergstrasse
Gertrud-Woker-Strasse
Baltzerstrasse
Bühlstrasse
Donnerbühlweg
Finkenrain
Erlachstrasse
Malerweg
Falkenweg
Falkenpl.
Falkenhöheweg
Parkterrasse
Troxlerrain
Alpeneggstrasse
Magazinweg
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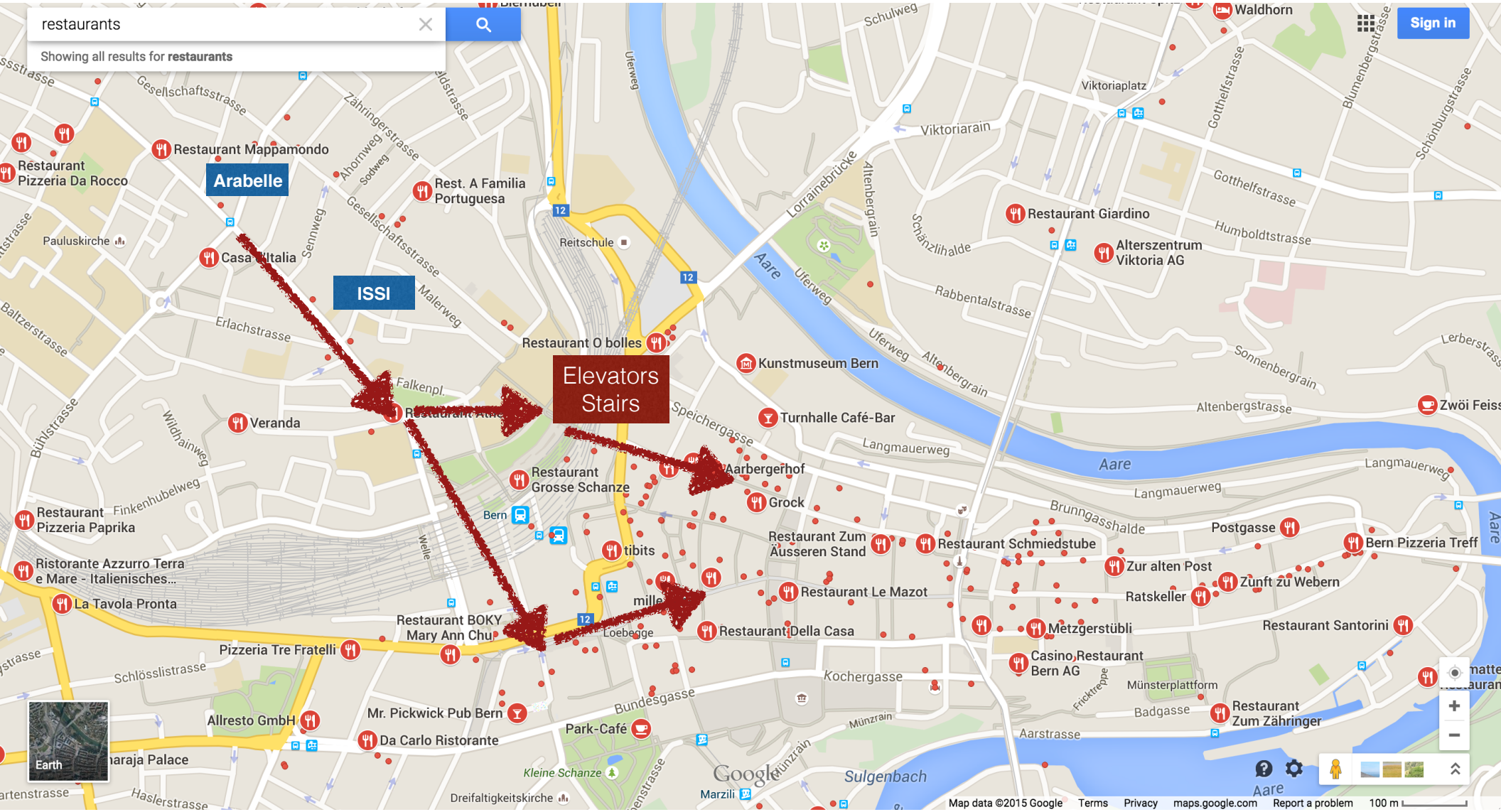
Schwyzerstärnweg
Uferweg
Earth
Google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Restaurant Pizzeria Da Rocco
Rest. A Familia Portuguesa
Casa d'Italia
Pauluskirche
Reitschule
Restaurant O bolles
Kunstmuseum Bern
Veranda
Turnhalle Café-Bar
Restaurant Grosse Schanze
Aarbergerhof
Grock
Restaurant Pizzeria Paprika
Restaurant Zum Äusseren Stand
Restaurant Schmiedstube
Postgasse
Bern Pizzeria Treff
Zur alten Post
Zunft zu Webern
Ratskeller
Restaurant Le Mazot
tibits
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La Tavola Pronta
Restaurant BOKY Mary Ann Chu
Restaurant Della Casa
Metzgerstübli
Restaurant Santorini
Casino Restaurant Bern AG
Pizzeria Tre Fratelli
Allresto GmbH
Mr. Pickwick Pub Bern
Da Carlo Ristorante
Park-Café
Restaurant Zum Zähringer
Restaurant Giardino
Alterszentrum Viktoria AG
Waldhorn
Viktoriaplatz
Viktoriarain
Schulweg
Gesellschaftsstrasse
Zähringerstrasse
Ahornweg
Sodweg
Sennweg
Malerweg
Erlachstrasse
Baltzerstrasse
Bühlstrasse
Wildhainweg
Finkenhubelweg
Falkenpl.
Speichergasse
Langmauerweg
Brunngasshalde
Aare
Uferweg
Lorrainebrücke
Altenbergrain
Schanzlihalde
Rabbentalstrasse
Sonnenbergrain
Altenbergstrasse
Gotthelfstrasse
Humboldtstrasse
Schönburgstrasse
Blumenbergstrasse
Lerberstrasse
Bern
Loebegge
Kochergasse
Bundesgasse
Münzrain
Münsterplattform
Fricktreppe
Badgasse
Aarstrasse
Schlössli strasse
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