Elemental abundance variations across coronal hole boundaries

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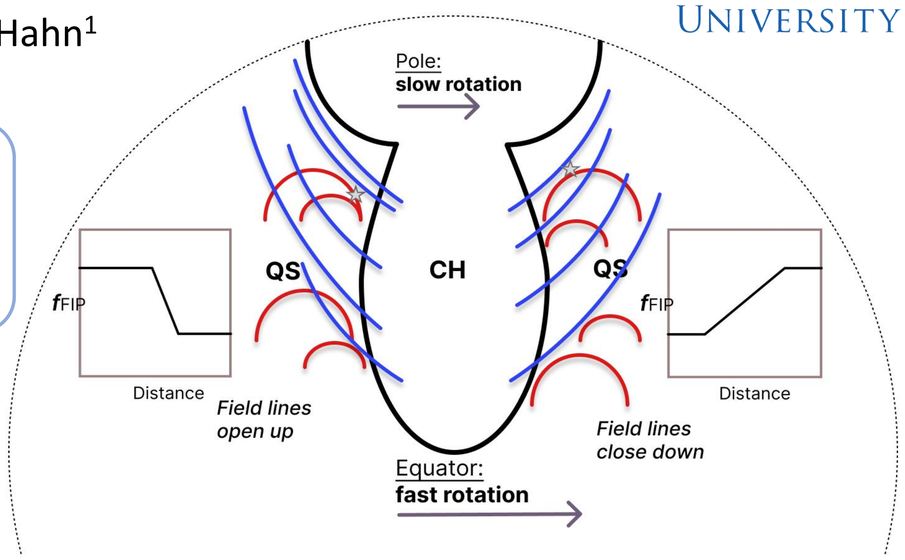
1) Goals

a) Quantify the relative abundances of different elements at the boundaries of coronal holes (CHs). Reconnection is expected to modulate these abundances through the First Ionization Potential (FIP) effect

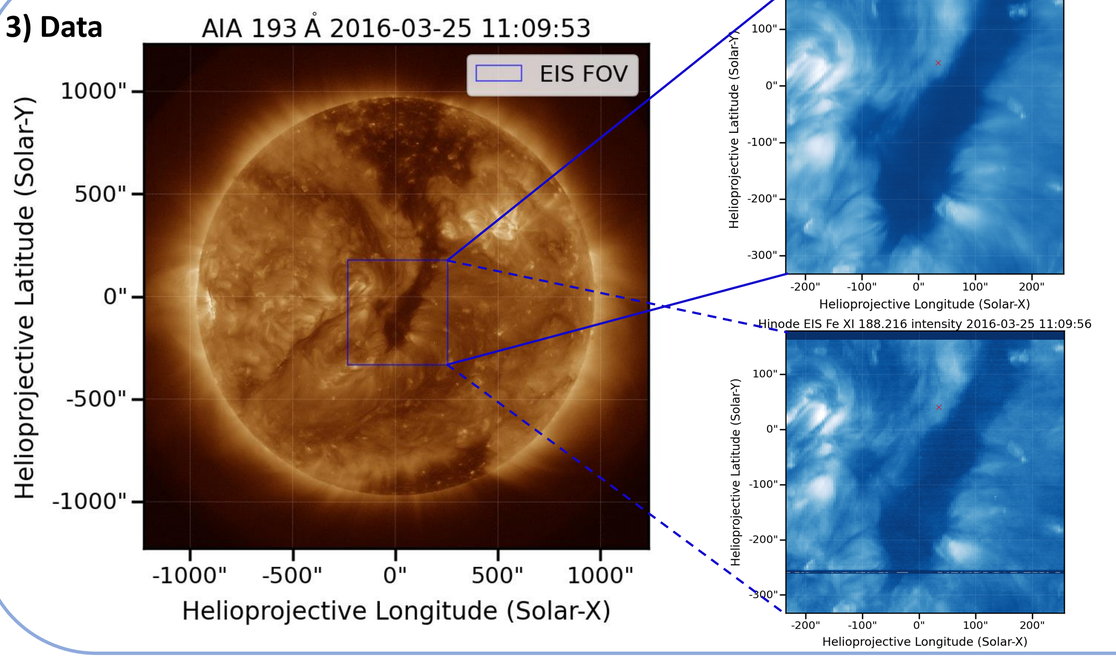
b) Measure the FIP effect across coronal hole boundaries as a function of latitude on the leading and trailing edges of coronal holes and quantify any differences

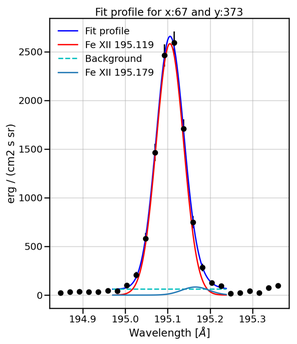


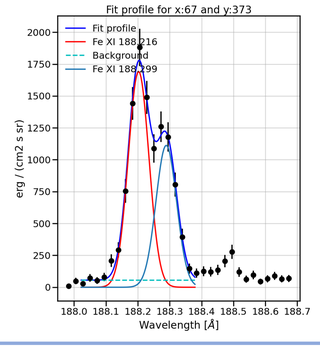
2) Methodology

- Fit the observed EIS lines and derive their intensities
- Use the Fe lines (+ Si) to calculate the Deferential Emission Measure (DEM)
- Identify the lines of high-FIP elements (e.g., Sulphur)
- Compute the modeled intensity of the high-FIP elements using the DEM
- Analyze the behavior of the FIP-bias ratio at the boundaries between the quite sun and the coronal hole

3) Data







4) DEM

Low-FIP lines: (log(T[K]))

- Fe X 184.536 - (6.05)
- Fe VIII 185.213 - (5.80)
- Fe XI 188.216 - (6.10)
- Fe XII 195.119 - (6.20)
- Fe IX 188.497 - (5.75)
- Fe XIII 202.044 - (6.25)
- Fe XV 284.160 - (6.35)
- Si X 258.375 - (6.15)

High-FIP line:

- S X 264.233

FIP-bias: $f_X = \frac{A_X^c}{A_X^p}$

A_X = abundance of element X

CHIANTI* DEM

$$I_{ji} = \frac{1}{4\pi}\int G_{ji}(T_e, n_e)\,\varphi(T_e)\,dT_e$$

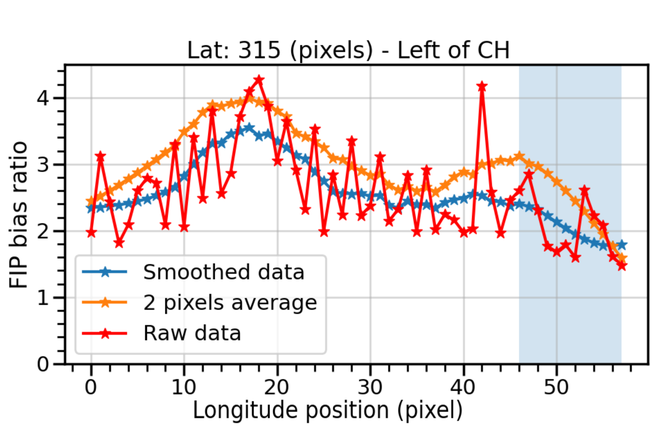
Inversion
(Hannah and Kontar 2013)

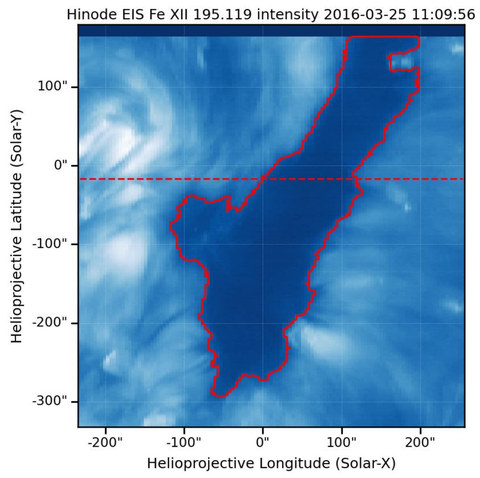
$$\frac{I^S_{pred}}{I^S_{obs}} = \frac{f_{(Fe+Si)}}{f_S} \equiv \textbf{FIP bias ratio}$$

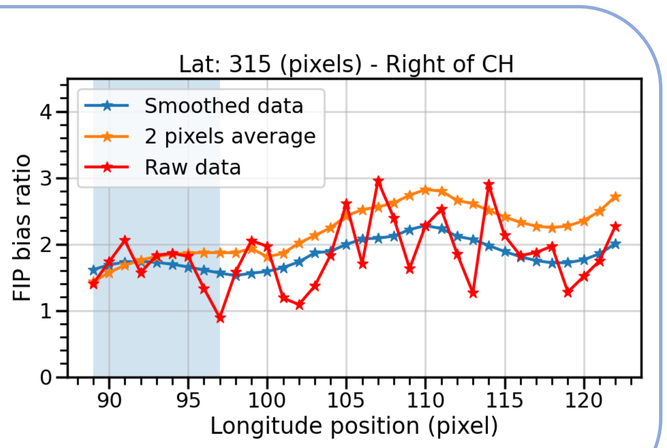
* The CHIANTI 10.0.2 database was used, and the electron density was derived from density diagnostics (line ratios)

5) Analysis

- Take longitudinal cuts of the FIP-bias ratio
- Identify the CH boundary using the triangle thresholding method
- Smooth the FIP bias ratio data using the Savitzky-Golay filter
- By examining the derivative of the FIP bias ratio identify the boundary region from the CH edge, where the behavior of the FIP bias ratio changes significantly
- Calculate the width of this region (CHB-width) and the gradient

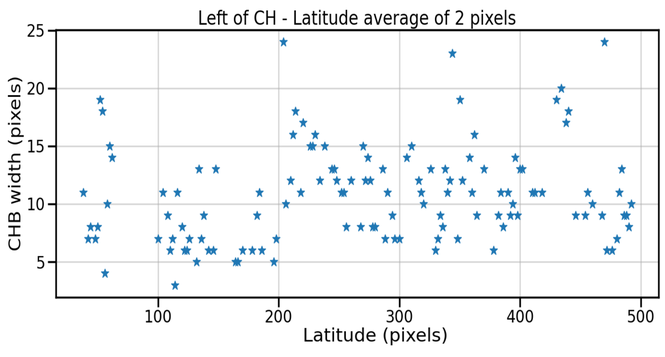


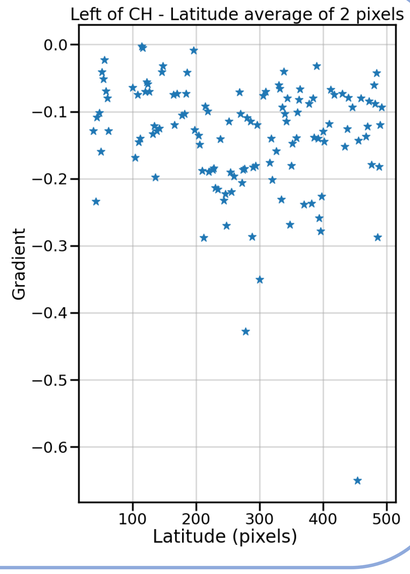




6) Preliminary results

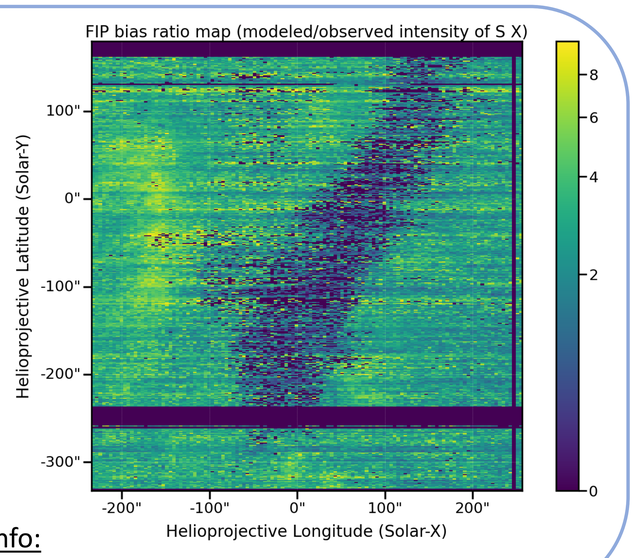
- For every longitudinal cut examine the CHB-width and the gradient as a function of latitude





7) Conclusions

- The width of the CH boundary and the gradient of the FIP bias ratio there show no significant variation with latitude
- There is an indication for a difference between the leading and the trailing edge of the CH
- FFT also revealed persistent spatial periodicities in the FIP bias ratio signal
- But several uncertainties in the processing of the data should be considered before further analysis
- Any comments or suggestions are welcomed!



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