SDO/AIA response to coronal hole, quiet Sun, active region and flare plasma

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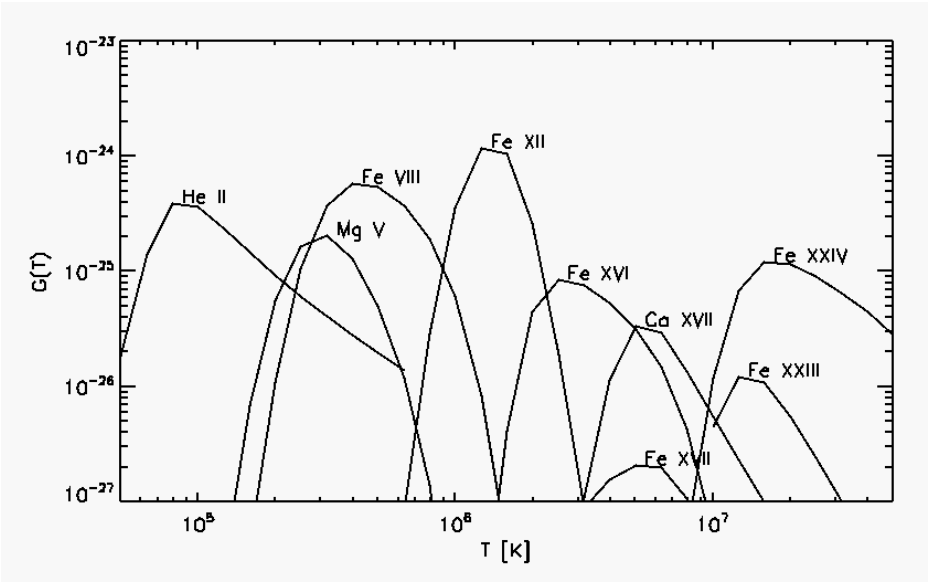
Solar Dynamics Observatory Atmospheric Imaging Assembly

- The Atmospheric Imaging Assembly (AIA) is one of three instruments on-board the recently launched Solar Dynamics Observatory.
- AIA is a set of normal-incidence imaging telescopes designed to acquire images of the solar atmosphere in a variety of extreme ultraviolet (EUV), ultraviolet and visible-light wavelength bands.
- The instrument observes solar plasma from photospheric to coronal temperatures, taking full-disk images, with high spatial resolution (~0.6 arcsec pixels) and with a cadence of 10 seconds or better.

AIA wavelength bands

Channel	Primary ion(s)	Region of atmosphere	log (T)
94 Å	Fe XVIII	flaring regions	6.8
131 Å	Fe VIII, Fe XXI	transition region, flare plasma	5.6, 7.1
171 Å	Fe IX	quiet corona	5.8
193 Å	Fe XII, Fe XXIV	corona and hot flare plasma	6.1, 7.3
211 Å	Fe XIV	active-region corona	6.3
304 Å	He II	chromosphere	4.7
335 Å	Fe XVI	active-region corona	6.4

Optically Thin Emission Lines

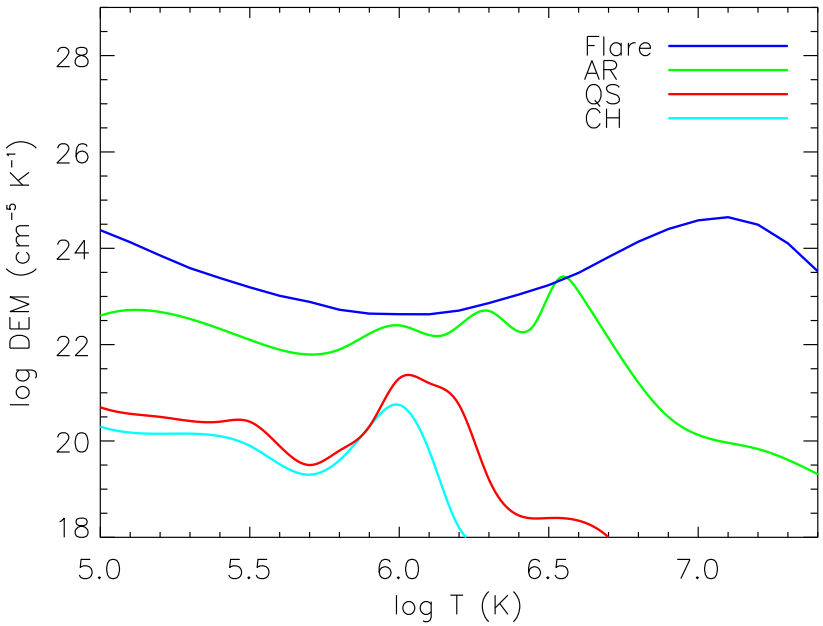


Under the assumption that a plasma is optically thin and in ionization equilibrium the observed intensity of a spectral emission line can be expressed as

$$\mathbf{I_{ob}} = \mathbf{A}(\mathbf{z}) \int_{\mathbf{T_e}} \mathbf{G}(\mathbf{T_e}, \mathbf{N_e}) \varphi(\mathbf{T_e}) \mathbf{dT_e}$$

where the contribution function, $\mathbf{G}(\mathbf{T_e}, \mathbf{N_e})$, contains the relevant atomic parameters for each line.

Optically Thin Emission Lines

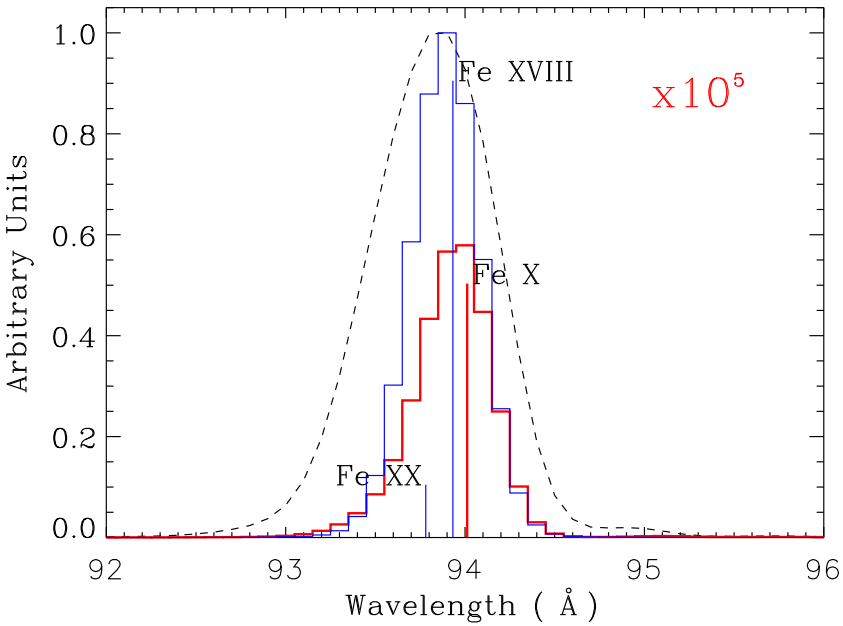


The quantity $\varphi(\mathbf{T_e})$ is known as the differential emission measure (DEM) which is defined as

$$\varphi(\mathbf{T_e}) = \mathbf{N_e}^2 \frac{\mathbf{dh}}{\mathbf{dT_e}}$$

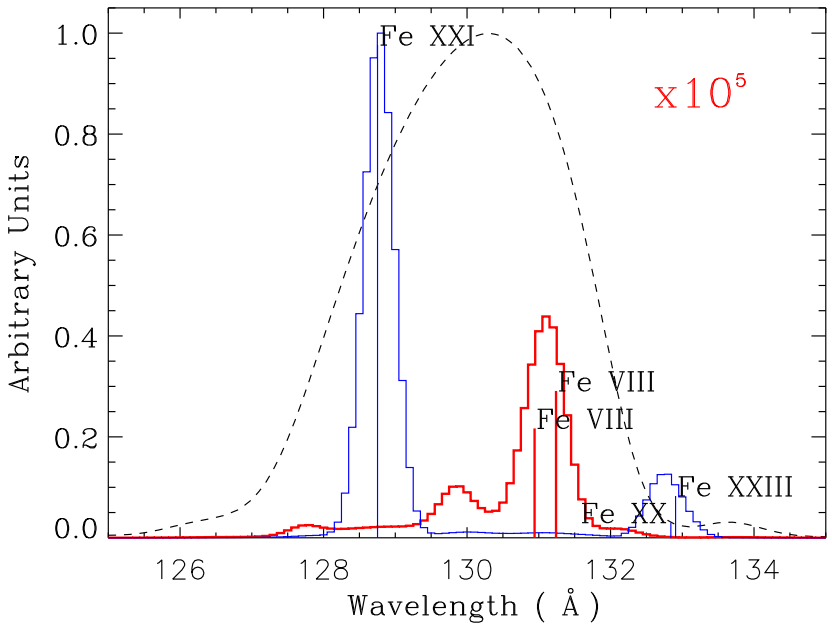
where h is the line-of-sight coordinate.

94 Å Channel



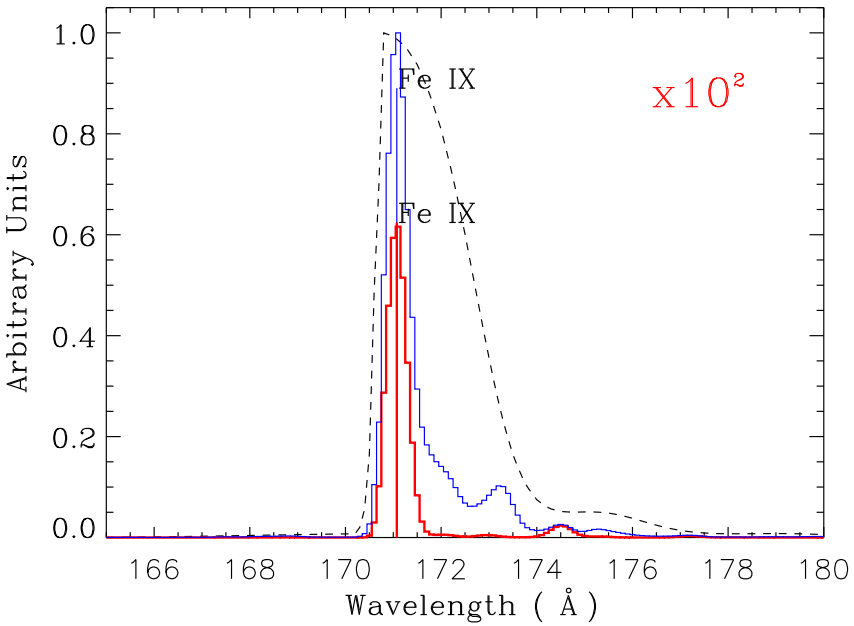
- For the flare spectrum the dominant contribution comes from the Fe XVIII 93.93 Å line.
- The dominant contribution to the 94 Å channel for quiet Sun plasma is predicted to come from the Fe X 94.01 Å line.

131 Å Channel



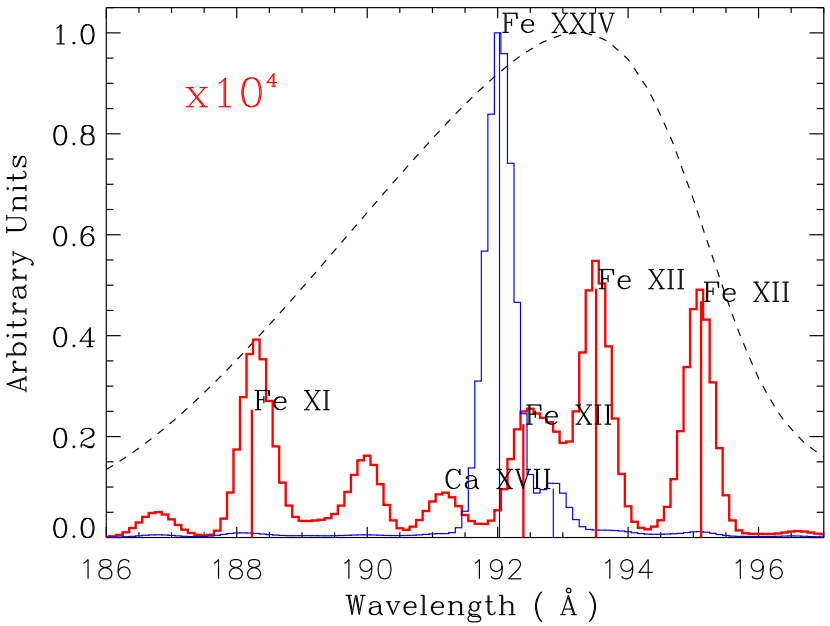
- For our flare spectrum the dominant contribution does not come from the Fe XX 132.84 Å or Fe XXIII 132.91 Å lines, but instead from the Fe XXI 128.75 Å line.
- The dominant contribution to the 131 Å channel for coronal hole plasma comes from Fe VIII lines.
- The contribution of continuum emission to the 131 Å channel in active regions is significant.

171 Å Channel



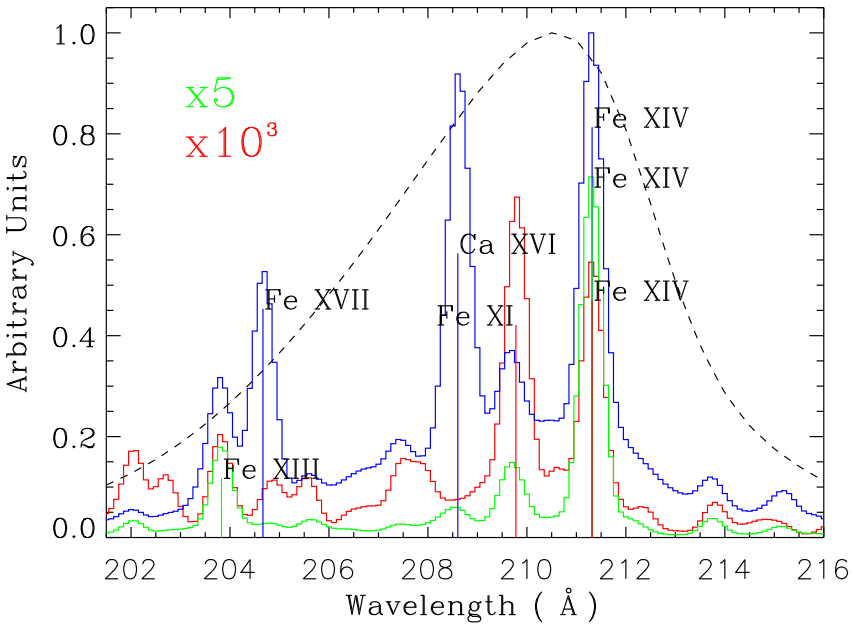
- For CH, QS and AR plasma the dominant contribution comes from the Fe IX 171.07 Å line.
- The 171 Å channel has a response to flarelike temperatures due to contributions from Fe XX lines, as well as continuum emission.

193 Å Channel



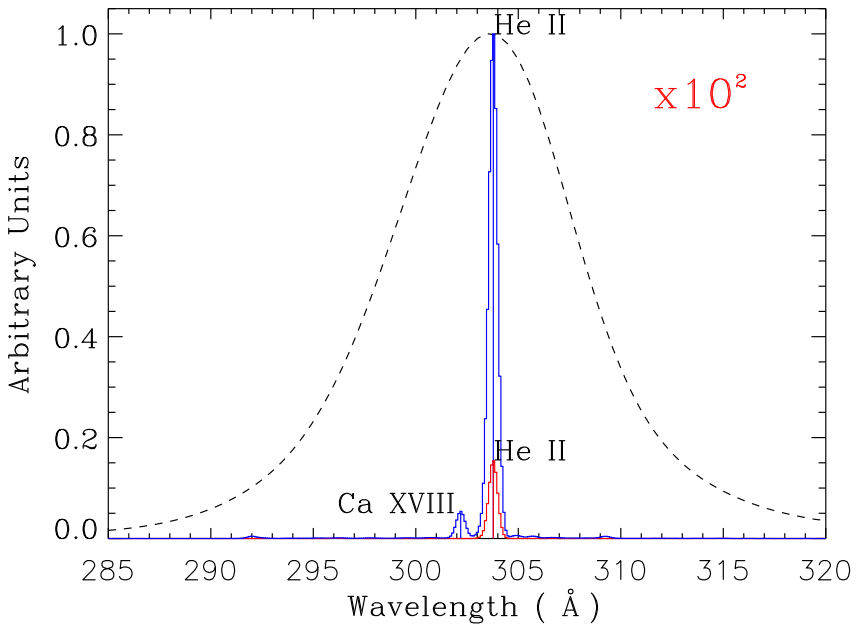
- For the QS and AR spectra the dominant contribution comes from Fe XII lines.
- In flaring regions the 193 Å channel is dominated by the Fe XXIV 192.03 Å line.
- For the CH spectrum there are significant contributions from Fe IX, Fe XI and Fe XII lines.

211 Å Channel



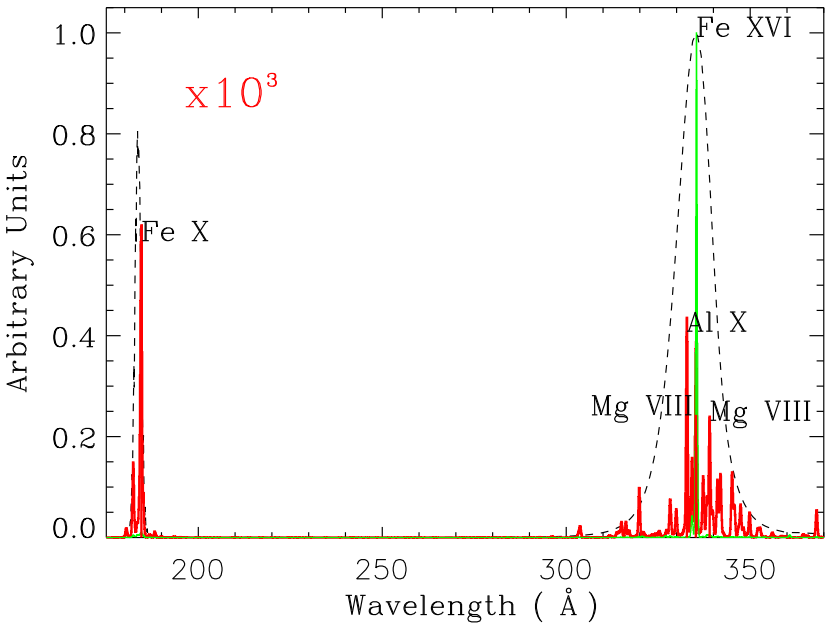
- For AR plasma the dominant contribution comes from the Fe XIV 211.32 Å line, as well as a significant contribution from Fe XIII lines.
- For the flare spectrum the most significant contribution comes from continuum emission.

304 Å Channel



- The 304 Å channel is dominated by the two He II 303.8 Å lines for CH, QS, AR and flare plasma.
- However, in QS off-limb the contribution of the Si XI 303.33 Å line is significant.
- The 304 Å channel has a small response to flarelike temperatures due to a contribution from the Ca XVIII 302.19 Å line.

335 Å Channel



- For AR and flare plasma the dominant contribution comes from the Fe XVI 335.41 Å line.
- For the CH and QS spectra the most significant contributions come from Mg VIII, Al X and Fe X lines.

Summary

- With the 131 Å channel for a flare spectrum the dominant contribution does not come from the Fe XX 132.84 Å or Fe XXIII 132.91 Å lines, but instead from the Fe XXI 128.75 Å line.
- The dominant contribution to the 94 Å channel for quiet Sun plasma is predicted to come from the Fe X 94.01 Å line.
- The contribution of continuum emission to the 211 Å channel in flaring regions is significant.