Active Region Spectrum From EVE Lunar Transit

Caleb Kline  8/3/11
LASP REU Program
Mentors: Frank Eparvier, Rachel Hock, Andrew Jones
• EUV Variability Experiment (EVE)
• Instrument aboard Solar Dynamics Observatory (SDO)

• Measures extreme ultraviolet radiation from the Sun.
  ▪ EUV varies with solar activity
• Takes a measurement of the irradiance from the full disc of the sun every ten seconds.

• Spectra from Multiple EUV Grating Spectrograph (MEGS)
  ◦ MEGS_a1 (7-17nm)
  ◦ MEGS_a2 (17-38nm) with 0.1nm resolution.
Transits

2010 280 = 10/07/10
2010 310 = 11/06/10
2010 340 = 12/06/10
2011 063 = 3/4/11

*Not to scale
Subtracting Spectra

A (Red): Average,  B (Blue): During transit,  C (Green): Difference
Movie
Spectrum at 6:59 = $S_1$

Spectrum at 6:44 = $S_2$

Area of quiet sun surrounding active region ($A_1$)

Area of quiet sun covered at 6:44 ($A_2$)

Scale Factor ($F$) = $A_1 / A_2$

Corrected Spectrum = $S_1 - (S_2 \times F)$

**Quiet Sun Correction**
- Database of atomic information with a package of programs written in IDL to analyze the spectra from astrophysical plasmas.
- Can create synthetic spectra.
- Contains a representative spectrum for an active region with high resolution.
- Convolved this spectrum with a .1 nm Gaussian curve to make it comparable to the EVE spectrum.
16 emission lines were extracted from the EVE and CHIANTI spectra.

<table>
<thead>
<tr>
<th>Ion</th>
<th>Log T (K)</th>
<th>Ion</th>
<th>Log T (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si VII 27.53nm</td>
<td>5.91</td>
<td>Fe XIV 27.420nm</td>
<td>6.30</td>
</tr>
<tr>
<td>Fe IX 17.107nm</td>
<td>5.99</td>
<td>Fe XIV 21.132nm</td>
<td>6.31</td>
</tr>
<tr>
<td>O VI 15.01nm</td>
<td>6.12</td>
<td>Fe XIV 26.479nm</td>
<td>6.32</td>
</tr>
<tr>
<td>Al X 33.27nm</td>
<td>6.16</td>
<td>Fe XV 28.416nm</td>
<td>6.39</td>
</tr>
<tr>
<td>Si X 27.20nm</td>
<td>6.17</td>
<td>Fe XVI 33.541nm</td>
<td>6.48</td>
</tr>
<tr>
<td>Fe XII 19.512nm</td>
<td>6.21</td>
<td>Fe XVI 36.07nm</td>
<td>6.50</td>
</tr>
<tr>
<td>Ni XII 15.41nm</td>
<td>6.26</td>
<td>Fe XVI 26.2984nm</td>
<td>6.50</td>
</tr>
<tr>
<td>Fe XIV 27.052nm</td>
<td>6.28</td>
<td>Fe XVIII 9.393nm</td>
<td>6.69</td>
</tr>
</tbody>
</table>
Ratio of Emission Lines for EVE and CHIANTI for Active Region

- Fe XVIII 9.393nm: EVE 6.9, CHIANTI 6.9
- Fe XVI 36.07nm: EVE 6.8, CHIANTI 6.8
- Fe XVI 33.541nm: EVE 6.8, CHIANTI 6.8
- Fe XVI 26.294nm: EVE 6.8, CHIANTI 6.8
- Fe XV 28.416nm: EVE 6.4, CHIANTI 6.4
- Fe XIV 27.420nm: EVE 6.3, CHIANTI 6.3
- Fe XIV 27.052nm: EVE 6.3, CHIANTI 6.3
- Fe XIV 26.479nm: EVE 6.3, CHIANTI 6.3
- Fe XIV 21.132nm: EVE 6.3, CHIANTI 6.3
- Fe XII 19.512nm: EVE 6.2, CHIANTI 6.2
- Fe IX 17.107nm: EVE 5.9, CHIANTI 5.9
A Differential Emission Measure (DEM) describes the amount of plasma as a function of temperature along a line of sight.

- Describes density and temperature of solar atmosphere.

- Represents a possible solution, not a unique one.

DEM Results

- DEM plot is a good fit.
- Bottom plot peaks at 5.9
  - More plasma at cooler temperatures in CHIANTI AR.
- EVE DEM peaks at 6.25.
- CHIANTI DEM peaks at 6.20
- EVE AR is hotter than CHIANTI AR
- Not all active regions are the same or error in CHIANTI.
Questions?