Poster on solar observations of the FeXIV/FeX line ratio

During the <u>13th European Solar Physics Meeting</u> (held in Rhodes, Greece, September 12-16, 2011), we had the opportunity to present our work on spectroscopic observations of the Sun.

Observations of FeXIV/FeX line ratio during the extended Solar minimum (2006-2010) total Solar eclipses

Strikis Iakovos-Marios, Kouloumvakos Athanasios, Patsourakos Spiros

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During the last four eclipses we were able to image the spectrum of the Solar Chromosphere and the Solar Corona. We report the drop of the FEXIV line intensity and the rise of the FeX line until the eclipse of 2009 and the rise of the FeXIV and from of FeX line during the total solar eclipse of 2010 from the Island of Mangaia (Cook Islands). As a result of our observations we will present that the Temperature of the Solar Corona is following the Solar Cycle and the Sunspot Cycle. In the end we attribute that the rise of the FeXIV line indicates that the new Solar Cycle has already started between the end of 2009 and beginning of 2010.



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HELIOS

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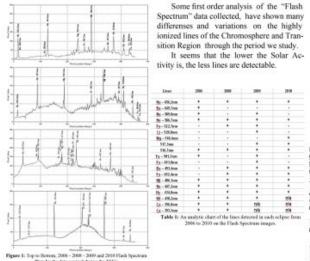
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Typical "Flash Spectrum" image: 2009 TSE Russia

Observations and Data analysis.

Coronal temperature is measured by several means of direct or indirect observations (G. Noci,2003; Habbal,1993) such observations in the visible, radio observation, observations on the disk in the UV spectral region and dielectronic recombination. At this point we will give more attention to the visible observations and determination of the coronal temperature from line ratios as require the analysis and the purpose of this poster. The estimation of the coronal temperature from line intensity ratios primary depends on the assumption that the density and temperature along a given line of sight where the emission of the spectral line is observed is constant. To determine the temperature from spectral line ratios we compare the line ratio deduced from the observation with those derived from theoretically from the emissivity (R. Esser,1995; Guhathakurta, 1992).

We present the spectral and temperature analysis derived from the measurements during the total solar eclipses of 2006 (Greece), of 2008 (Russia), 2009 (China) and 2010 (Cook Islands). To estimate the coronal temperature we used the FeXIV and FeX line ratio. The reason that we used this specific line ratio is the strong coronal emission of this lines providing us an easy way of analysis and identification of this iron lines. In addition these coronal lines have been used several times in the past for temperature diagnostics and they are among the lines used by SOHO instruments.



Fe X & Fe XIV Observations.

After the Data-Reduction and the Calibration of the images, measurements of the Relative Intensities have been made using the following equation:

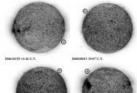
$$RI(true)Fe = \frac{Iobs - Ibac}{Ibac}$$

where "RI(true)Fe" is the true relative intensity of the multiple ionized Iron line "I Obs" is the intensity of the line with a correction factor added to correct the non linear effect of the grating from the spectrograph. "I background" is the intensity of the continuum background (noise), All the measurements have been made at Heliographic Latitudes between 300 and -300 in places that have been selected, not to be near active regions or coronal holes so that our measurements would not have been affected from these areas of high or low density respectively. Then our measurements have been averaged to give us the final results. Using the above equation to our measurements we construct the table with the results [Table 2].

1	Relative intensity				
	2006 Greece	2008 Russia	2009 China	2010 Mangaia	
FeX (6374A)	0.02	0.0734	0.1031	0.0738	
FeXIV (5303A)	0.12	0.0531	0.0045	0.1329	
FeXIV/FeX	6	0.7234	0.0436	1,8008	
log(FeXIV/FeX)	0.7781	-0.1406	.1 3605	0.2554	

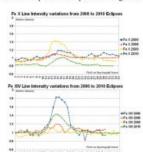
Table 2: Relative intensities of the FeX & FeXIV ionized lines.

Acknowledgements: Special thanks to: Avgouli Orsoula, Emmanouilides Kostas Miloslav Druckmuller, Moussas Xenofon, Preka Panagiota. For their support and contribution all these years.



powers status.

Figure 2: So.H.O. EIT 304 images marked with the points of



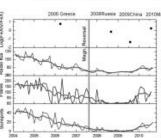


Figure 3: Correlation of the Fe Measurements with other

The line ratio from 2006 (Greece) decreases until 2009 (China) as it is expected from the extended minimum of the 23rd solar cycle. Between 2006 and 2008 the drop of the disceeding phase. At 2009 the drop seems to be steeper than 2006-2008 and the extended minimum of 2009 with 279 spotless days seems to contribute further to the drop of FeXIV intensity and the rise of FeX. At our last observation of 2010 (Mangaia) we see a significant rise. This rise comes together with the beginning of the new Sunspot Cycle which started, according to sunspot number, at the first months of 2010.

Coronal Temperature Estimation.

For the purposes of our analysis we use the CHIANTI atomic database for spectroscopic diagnostics of astrophysical plasmas. We compute the intensity per emission measure for each iron line between the limits of 5.8-6.5 in units of log[T] and density fixed at log[Ne]-7.0. The ionization database we used is the chianti provided database and as for the abundance database we selected the coronal database provided by chianti as well. The line ratio from the above data is plotted at figure 4. From the results of our observations and the theoretical line ratio produced, we estimated the temperature of solar corona for every eclipse observations. The results are summarized in table 3.

The temperature starts to drop, from its higher value of 2006 eclipse, until 2009 and then rise again at 2010 as the new solar cycle starts again. The drop of the temperature between 2006 and 2008 was 440.000K indicating the deep solar minimum of these years. While the new solar cycle starts at 2010, the expected rise of the temperature between 2009-2010 was 312.000K.

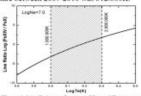


Figure 4: Line Ratio as a function of Coronal Temperature as calculated by Chianti code.

	Temperatur-Estaution				
	20% Owner	206 Roois	309 Sax	200 Magai	
lgR07(R0)	07%	4106	-1305	0.594	
Tesperton(kgT)	6229	61691	69/94	6.9977	
Tesperitor(C)	1,00,00	1475.000	129(00)	1362000	

Table 3: Corona Temperature Estimations as a function of Fe Line Ratio as observed in TSE's

References:

(1) Esser, R., et al. 1995, igg, 1001, 19829 (2) Koutchmy, S. 2004, 223, 509 (3) Gaharbakarta, M., 1992, 27, 305 (4) J.D. Smikis et al., Amature Astr., Conf., Patras 2010 (5) J.D. Smikis et al., Amature Astr., Conf., Patras 200

Imaging dense globular clusters like M3 and M15

During the Society for Astronomical Sciences 29th Annual Symposium on Telescope Science (held May 11-13, 2010 at Big Bear Lake, CA) the following work was published:

Imaging dense globular clusters like M3 and M15

Rodney Howe, Iakovos-Marios Strikis, Ido Bareket, Dimitrios Stouraitis

Abstract

The objective for this study will be to explore new photometric methods for amateur telescope observations of 'cluster variables' and globular clusters using CCD photometry. Amateur telescope photometric observations of 'cluster variables' in globular clusters are limited because of dense, crowded star fields. However, with improvements in CCD photometric methods, there are opportunities to observe cluster variables, such as RR Lyrae and SX Phoenicis type stars, through time series analysis of multiple exposures of whole cluster images. Traditional methods for determining light curves in 'field' RR Lyrae and SX Phoenicis type stars require selection of comparison and perhaps check stars to perform differential photometry; i.e. subtraction of flux density measures between a non-variable (comparison star) and the variable star as they change in magnitudes over time. We explore the possibility of measuring the variable star's periodicity in areas, or sections of a globular cluster, to sort different stellar type 'cluster variables' within each section of the cluster. There are areas or regions of a globular cluster which 'pulsate' at a variable rate which is representative of 'cluster variables' that make up that region. For example: we have detected different variability periods within the 'core' of a cluster compared to the outer circumference areas of the cluster.

A link to the work can be found to NASA/ADS: 2010SASS...29..129H