ON THE BEST WAVELENGTH RANGE(S) FOR THE EUV SPECTROMETER

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INTRODUCTION

- **SOLARORBITER** will provide the **unprecedented opportunity to observe the Sun from 1/5 of astronomical unit** and will allow to study the structures of the outer atmosphere of the sun with a degree of **spatial details never attained before.**

- A **lot of physical properties** of fine scale structures in the corona may be obtained if the **great advantage offered by the proximity is complemented by monochromatic images supplied by spectrographic instrumentation.**

- The **EUV spectral region is extremely rich of lines emitted by ions formed in a very broad range of temperature and density regimes;**

- the EUV region of the spectrum **(40 - 900 Å)** is investigated in order to **identify proper spectral ranges** useful to get

  1. **temperature diagnostics from the very low transition region to high temperature flares**
  2. **density diagnostics from** $10^{8-9} cm^{-3}$ **of coronal holes to some** 10^9 **of the quiet loops to** 10^{11-12}**of flares**

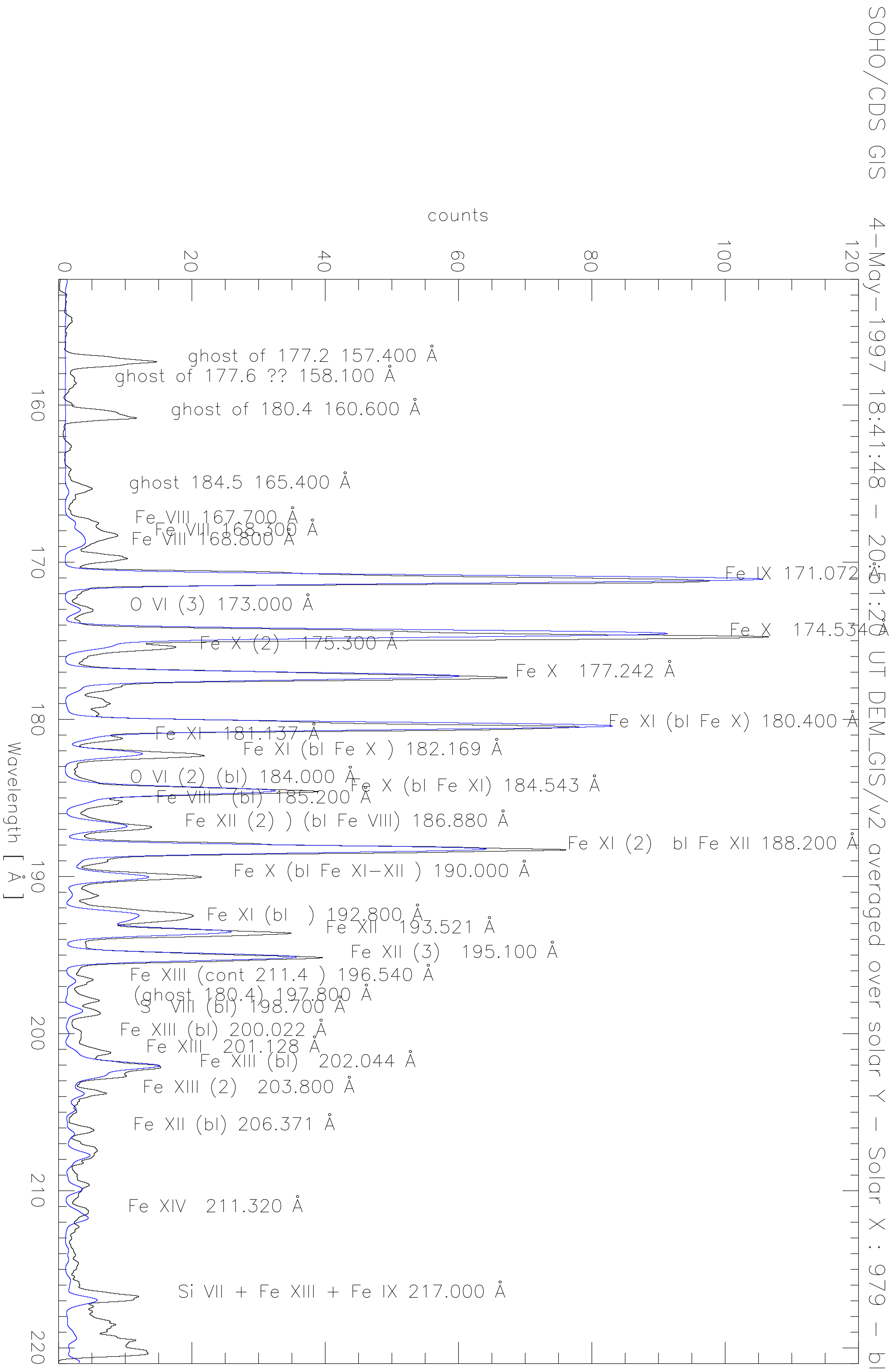

Figure 1: Observed (black) and synthetic (blue) spectrum of GIS1 on SOHO

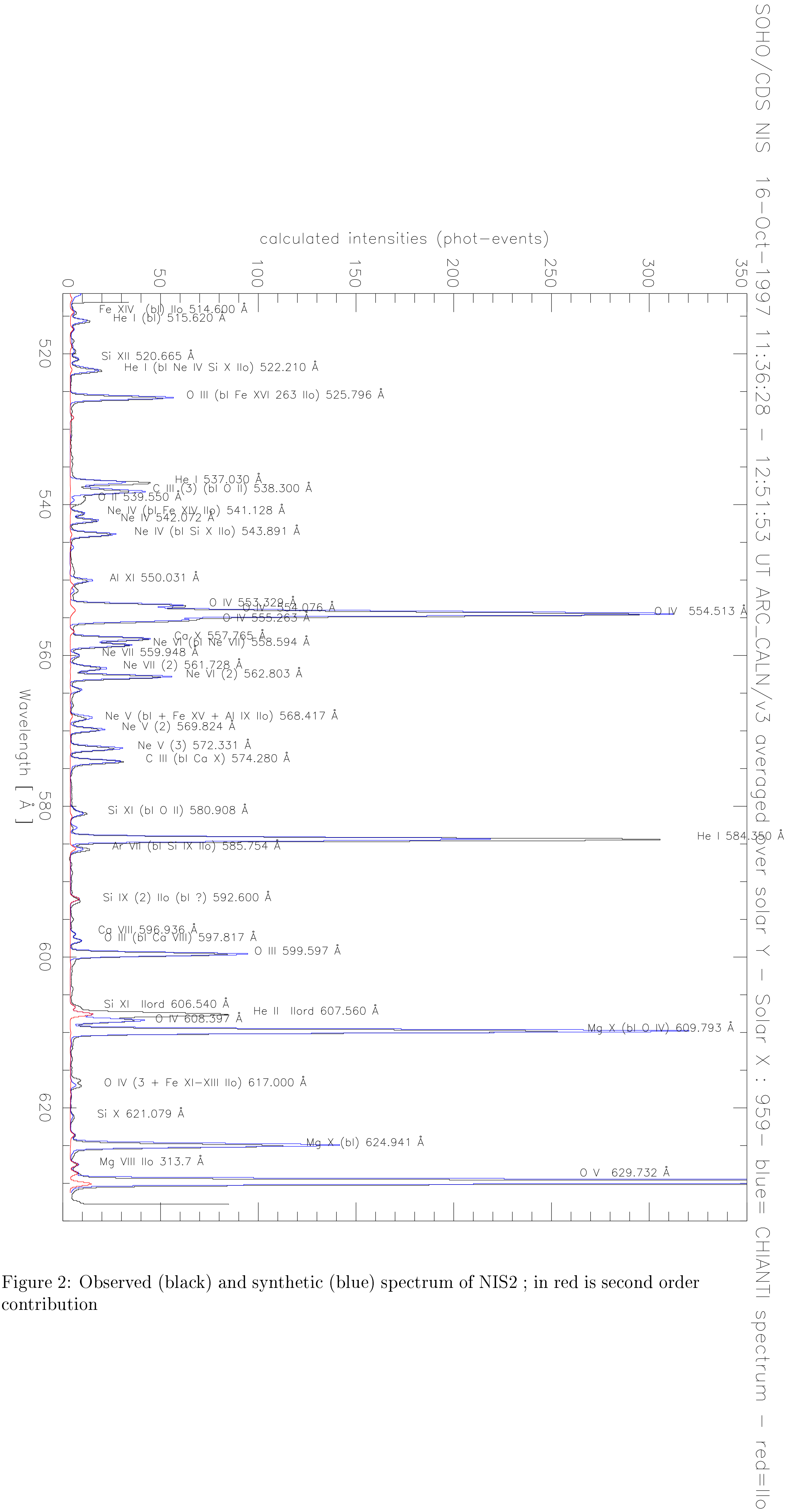

Figure 2: Observed (black) and synthetic (blue) spectrum of NIS2 ; in red is second order contribution

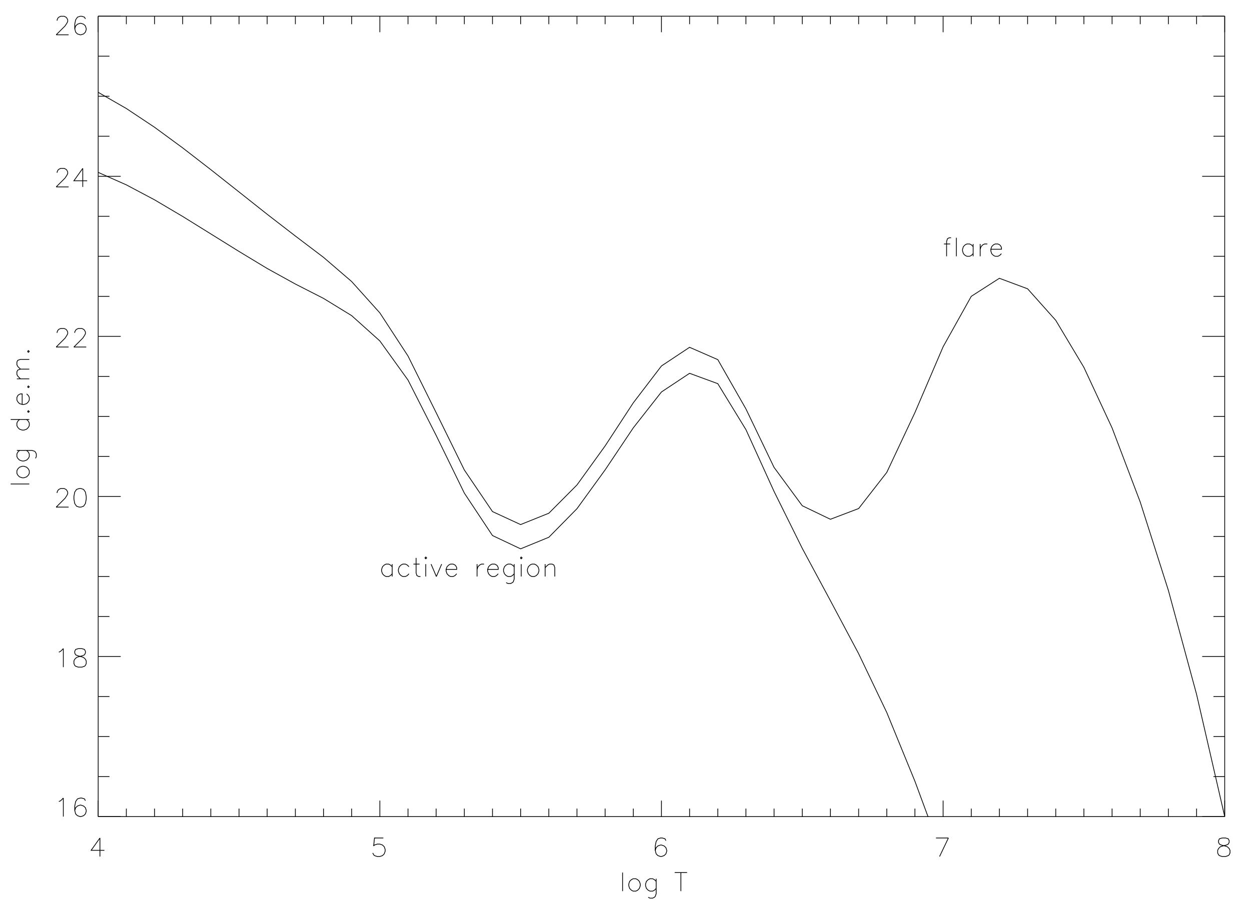

Figure 3: Differential Emission Measure distribution for active region and flare

Lines intensity computation

CDS observations and atomic data from **CHIANTI database** has been used to evaluate the linear differential emission measure

$$N_e^2 \ \frac{dh}{dT} = \phi(T) \ \ cm^{-5}K^{-1}$$

The total number of photons along the line of sight h originating from a surface element dS produces at distance d the flux F_{ji}

$$F_{ji} = \frac{A_{ji}}{4\pi d^2} \ dS \int N_j dh \ phot \ cm^{-2} \ s^{-1}$$

By

$$G_{ji}(T, N_e) = A_{ji} \frac{N_j}{N_{E,Z}} \frac{N_{E,Z}}{N_E} \frac{N_E}{N_H} \frac{N_H}{N_e} \frac{1}{N_e}$$

Where

$\frac{N_j}{N_{E,Z}}$ is the level j relative population

$\frac{N_{E,Z}}{N_E}$ is the abundance of ion Z of element E

$\frac{N_E}{N_H}$ is the abundance of element E to hydrogen

and N_e is the electron density

the line intensity is

$$I_{ji}(T, N_e) = \frac{1}{4\pi} \int G_{ji}(T, N_e) \ \phi(T) \ dT \ phot \ cm^{-2} s^{-1} sterad^{-1}$$

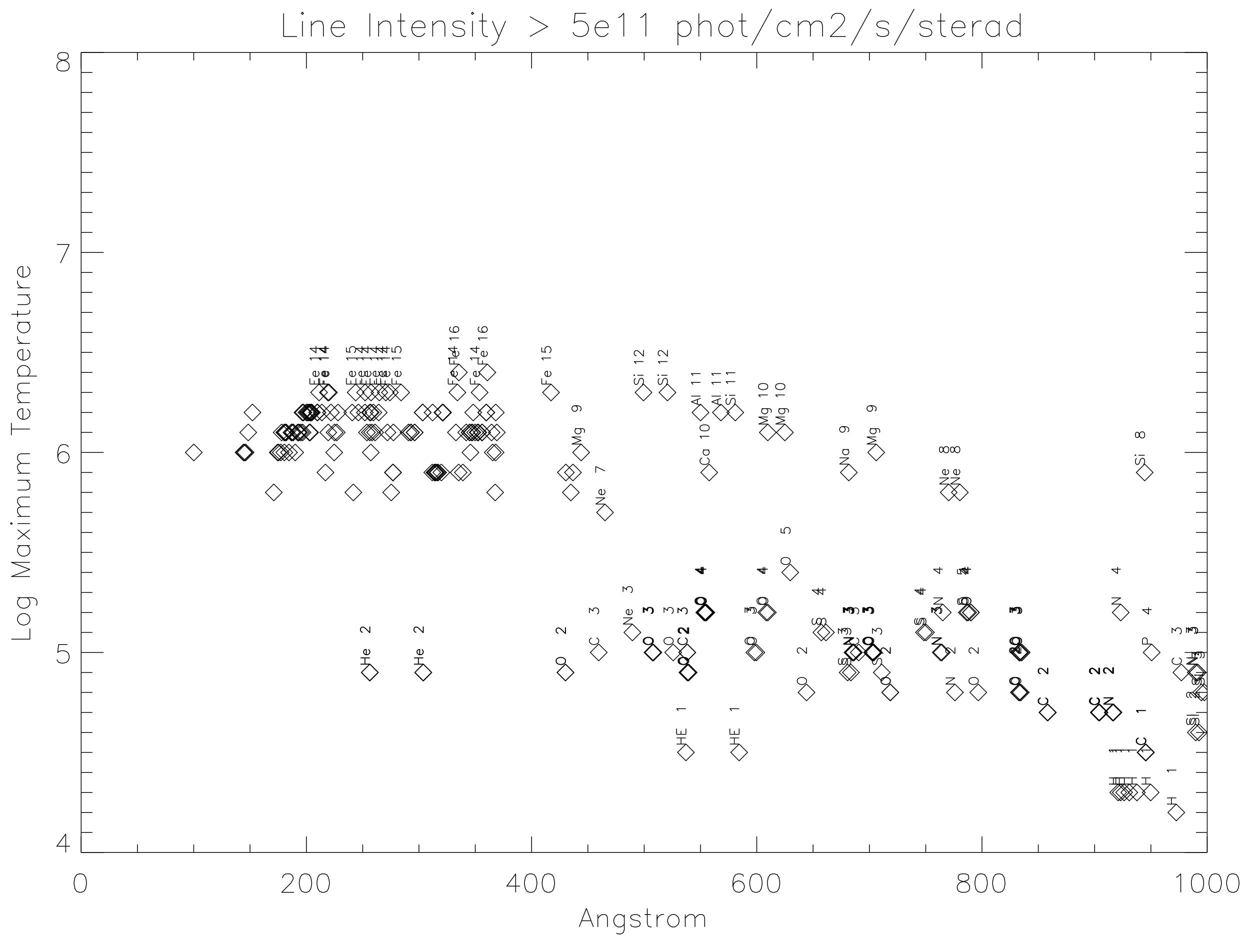

Figure 4: For each line the temperature of strongest emission is plotted versus its wavelength; active region dem is used

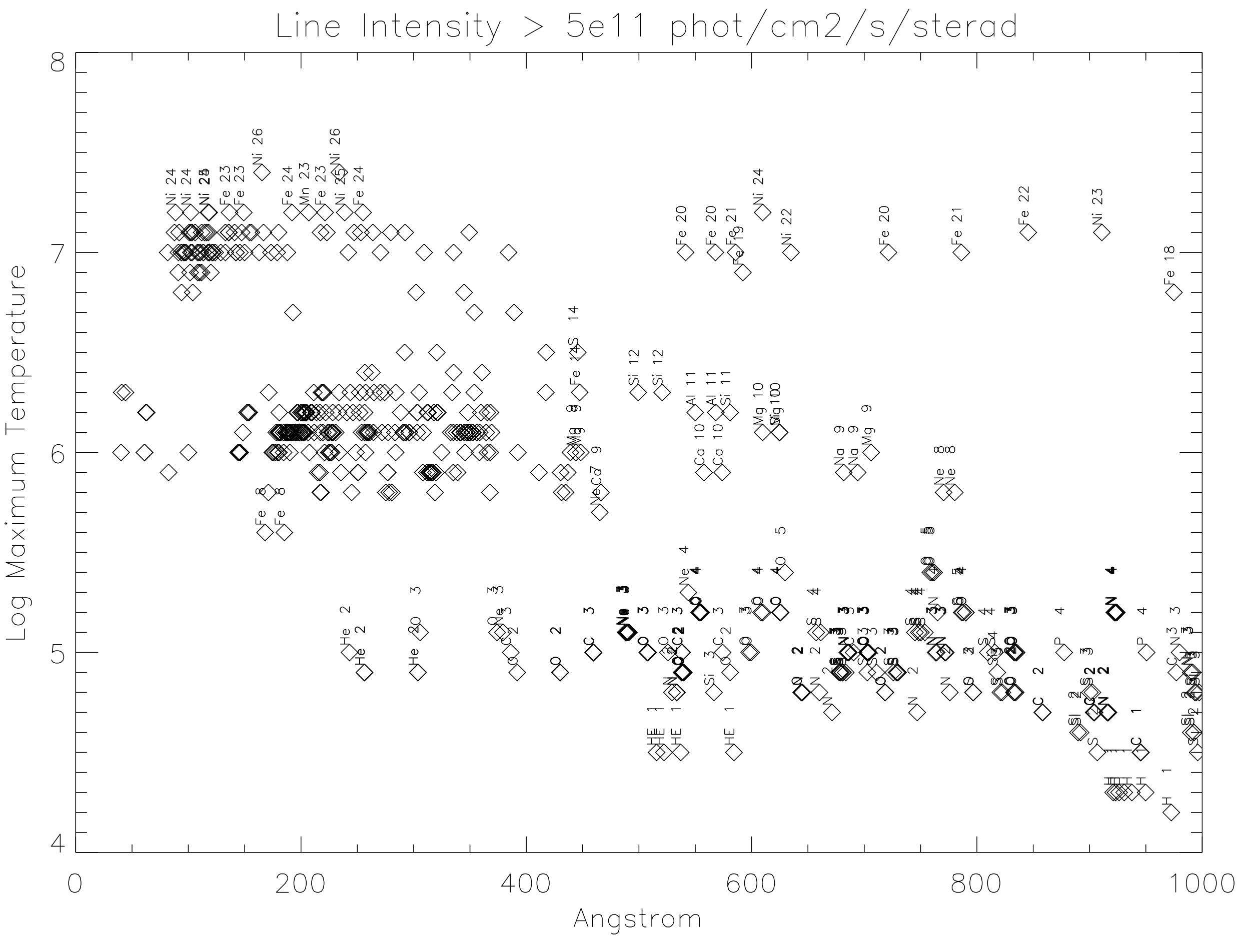

Figure 5: For each line the temperature of strongest emission is plotted versus its wavelength; flare dem is used

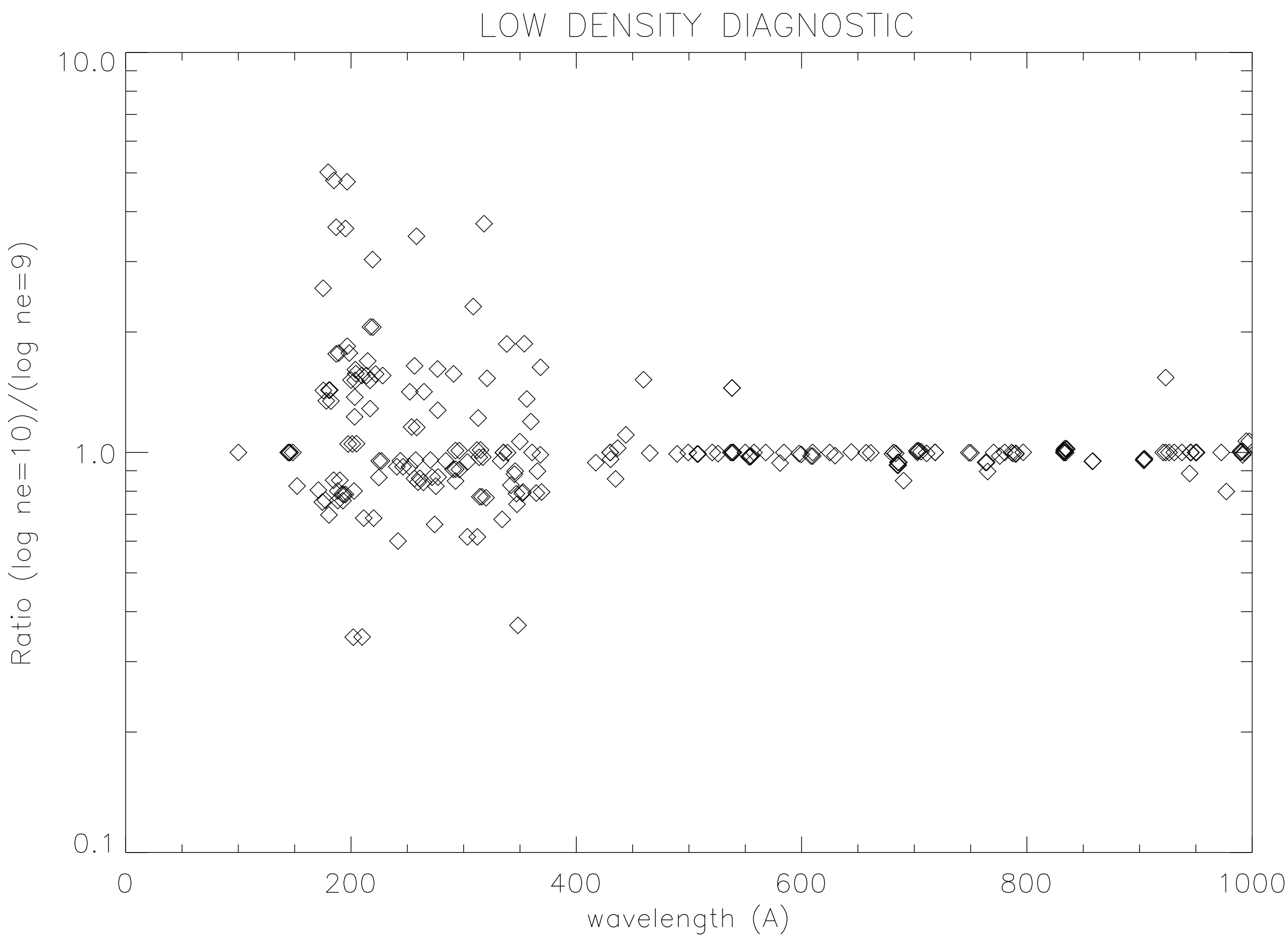

Figure 6: Low density sensitive lines; ratio of intensities computed assuming electron density 10^{10} or 10^9 and active region dem is shown

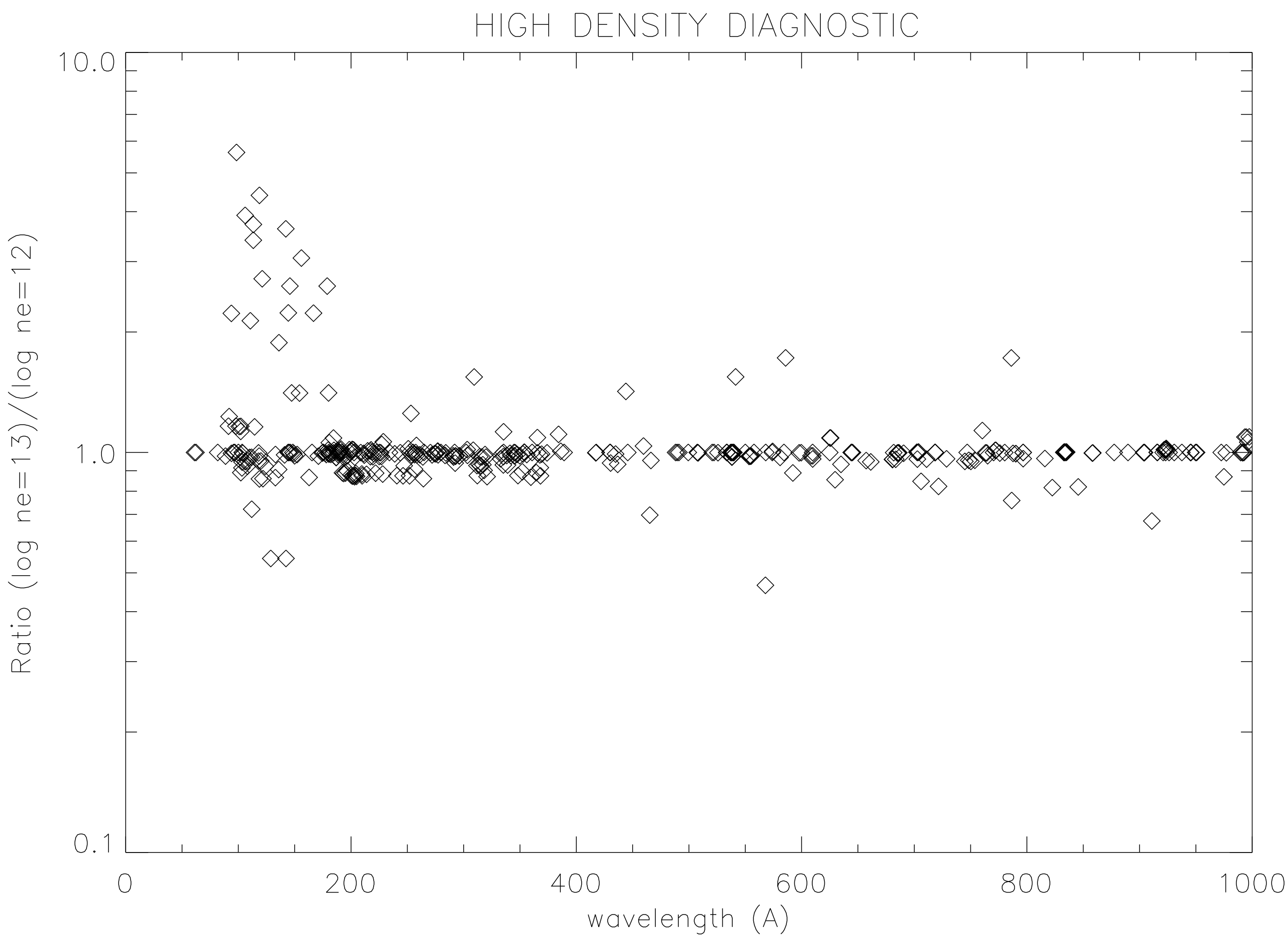

Figure 7: High density sensitive lines; ratio of intensities evaluated assuming electron density 10^{13} or 10^{12} and flare dem is shown

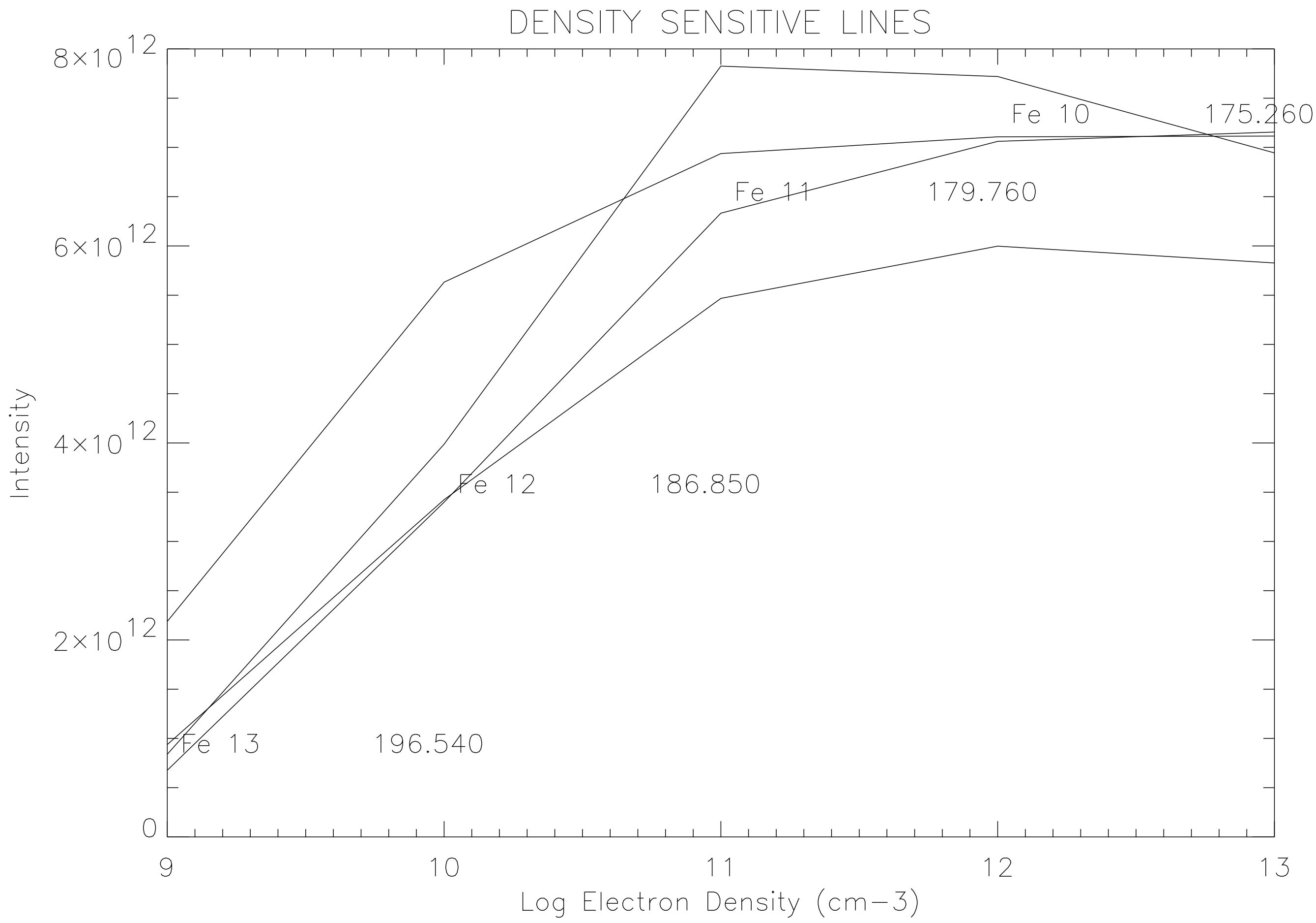

Figure 8: Some low density sensitive lines

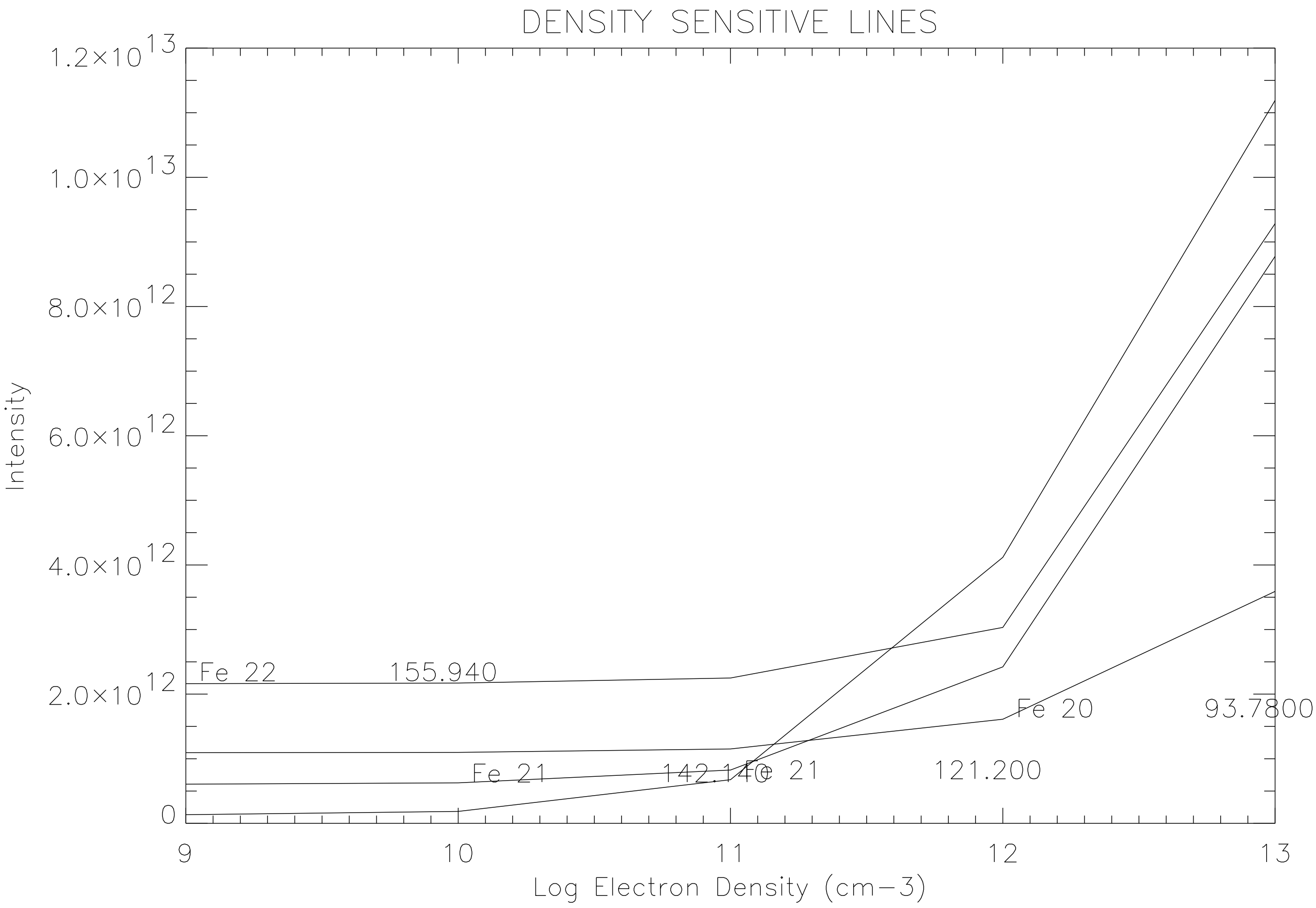

Figure 9: Some high density sensitive lines

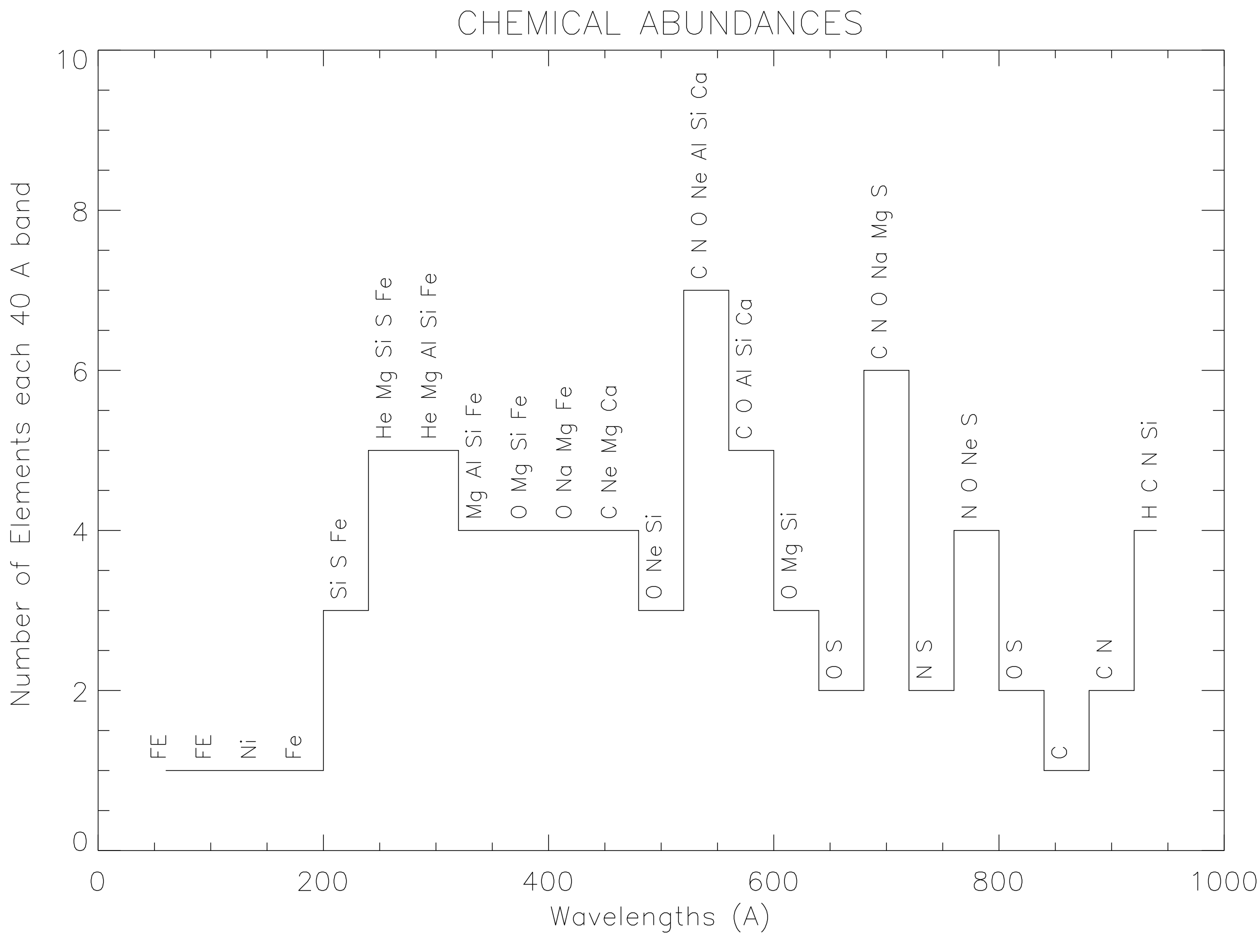

Figure 10: Number of different elements whose abundance can be monitored in each 40 Åband

CONCLUSIONS

- The spectral range between **150 and 260 Å** is **very rich of density sensitive lines in the density regime** $\underline{10^9 - 10^{10}\ cm^{-3}}$;

  also the density regime $\underline{10^{11} - 10^{13}\ cm^{-3}}$ may be monitored in the same spectral range using **lines of FeXXII and XXIII** ;

  in the **second order 80-130 Å** range several other **lines of FeXX and FeXXI** are available.

- **Table I** lists the most important density sensitive lines for the **low density regime**

  Table II lists the most important density sensitive lines for the **high density regime**.

  Each line will be complemented with proper density insensitive lines of the same ion, usually available, in order to evaluate lines ratios and avoid absolute calibration problems.

- The **160-260 Å** allows to cover **temperature regimes between million degrees to several ten millions degrees** but is **very poor** in the temperature regime of the **transition region**. Most lines belongs to iron with a few silicon and magnesium contribution and one helium line.

- To complete the **temperature monitoring between** 10^5 **and** 10^6 it is necessary to select a second spectral range ;

  in the spectral region **550- 650 Å** lines of neutral He , OIII,OIV and OV, CIII and IV, Mg X, SiX and SiXI allow to monitor the **low temperature** regime with some overlapping with the million degrees region.

Table 1: Low density sensitive lines; for each line the ratio of the intensity using electron density $10^{10} cm^{-3}$ and $10^{9} cm^{-3}$, is shown

Wavelength (A)	Ion	Ratio(10/9)	Max Temp	Ref. Line (A)
175.260	Fe 10	2.57396	6.00000	174.53
179.760	Fe 11	5.02166	6.10000	181.14;182.16
184.800	Fe 11	4.78664	6.10000	181.14;182.16
186.850	Fe 12	3.65612	6.10000	193.52
191.050	Fe 12	3.13224	6.10000	193.52
196.540	Fe 13	4.75120	6.20000	200.02
202.040	Fe 13	0.345303	6.20000	200.02
209.910	Fe 13	0.345766	6.20000	200.02
217.270	Fe 12	2.06007	6.10000	193.52
219.430	Fe 12	2.05798	6.10000	193.52
227.360	Si 9	3.89688	6.10000	277.00
257.230	Fe 10	0.314847	6.00000	257.28
258.080	Si 9	3.47178	6.10000	277.00
308.540	Fe 11	2.31615	6.10000	352.66
319.010	Mg 7	2.19015	5.80000	277.00;278.40
335.330	Fe 12	3.79718	6.10000	346.85
348.180	Fe 13	0.369637	6.20000	359.64
772.390	N 3	4.09859	5.00000	

Table 2: High density sensitive lines; for each line the ratio of the intensity using electron density $10^{13} cm^{-3}$ and $10^{12} cm^{-3}$, is shown

Wavelength (A)	Ion	Ratio(13/12)	Max Temp	Ref. line (A)
93.7800	Fe 20	2.22727	7.00000	132.84
98.3600	Fe 21	5.62394	7.00000	128.75
110.620	Fe 20	2.13393	7.00000	132.84
113.340	Fe 20	3.71551	7.00000	132.84
121.200	Fe 21	2.71822	7.00000	128.75
142.140	Fe 21	3.62308	7.00000	128.75
144.380	Fe 23	2.23277	7.10000	132.90
145.730	Fe 21	2.60538	7.00000	128.75
155.940	Fe 22	3.06140	7.10000	117.17;135.75
166.680	Fe 23	2.23040	7.10000	132.90