§21. LHD Simulated Experiment for Solar Non-Equilibrium Plasmas and Development of Its Spectroscopic Diagnostic Tools

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Solar-B will be launched in summer 2006. EUV Imaging Spectrometer (EIS, 1) on board Solar-B

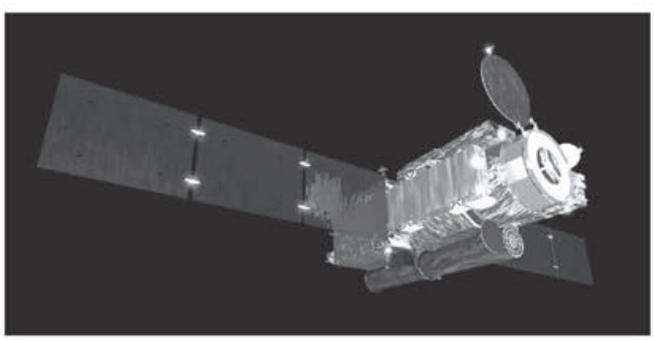

Fig. 1 Solar-B Spacecraft in orbit

accommodates the system of multilayer coated optics and back-illuminated CCD, and will be able to observe, for the first time in EUV observations, spectra and monochromatic images of non-ionization-equilibrium plasmas in the solar chromosphere, transition-region, and corona at two-wavelength bands of 170 – 210 Å and 250 - 290Å, with typical time-resolutions of 1 – 10 seconds.

Time-dependent collisonal-radiative model will be developed to analyse the data taken by this EIS instrument, and to diagnose temperatures and densities of those plasmas in the outer atmospheres of the Sun. No systematic models yet exist for iron ions of L- and M-shells, which are very important for coronal plasma diagnostics. Atomic data 2) for iron ions of Fe^{9+} to Fe^{14+} are surveyed and evaluated, and most recommended data are determined. Parameters for analytical fitting functions are obtained and provided.

Possibility of getting the experimental data of ionization and recombination cross sections for iron ions with an instrument called NICE (Naked Ion Collision Experiment) is in consideration. EUV spectra in the wavelengths of 170 – 190 Å are taken by LHD, injecting iron TESPEL (tracer-encapsulated solid pellet). Data taken by this experiment has been analysed now. Temperatures at the center of LHD plasma reached almost 2keV, similar to those of solar flares, and they are higher than those of coronal plasmas. Therefore, cooler surrounding plasmas in LHD should be observed more precisely at the next round.

Solar-B is currently scheduled to be launched on 23-Sep-06, and it will be put into a final sun-synchronous orbit in three week time after the launch. Scientific operation will start soon after the instrument commissioning phase. Prioritized "Initial Three Month Operation Plan" will be conducted, and the standard modes of scientific observations will be established. 3)

"Solar-B Science Center" was founded at NAOJ in 2005 to promote Solar-B sciences, constructing so called the "Level 2" database, that is a science-value added database. Solar-B Science Center will be able to provide three-dimensional photospheric magnetic field structures and movies of co-aligned images in X-ray, EUV, and optical wavelengths. Newly developed time-dependent collisional-radiative models in this study will be also included in the data-analysis software system in Solar-B Science Centre, and available for use of world-wide researchers, both of solar physics and plasma physics among others.

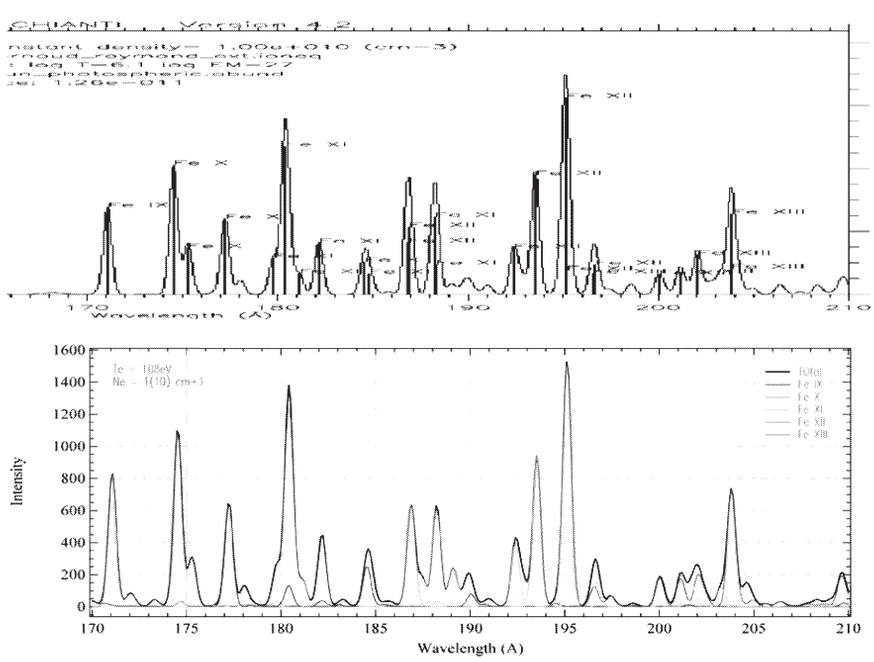

Fig. 2 Comparison of theoretical iron line spectra generated by an ionization-equilibrium model (CHIANTI 4); upper panel) and by currently developed time-dependent code at t = ∞ (equilibrium state).

References

1) Culhane, J. L. et al.: 2005, Ad. Sp. Res., 36, 1491.

2) NIFS-DATA95, 2006

3) Watanabe, T. and the Solar-B Team: 2005, Ad. Sp. Res., 36, 1478.

4) Landini, E. et al.: 2006, Astrophys. J., Suppl., 162, 261.