New Atomic Data for Doubly Ionized 3d Transition Group Elements by High Resolution Fourier Transform Spectroscopy

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Improvements in the quality of astrophysical spectra obtained using high resolution spectrographs on ground and satellite telescopes have highlighted the inadequacies of the existing laboratory atomic spectral data base needed to interpret these observations, especially in the vacuum ultraviolet (VUV) wavelength region, *i.e.*, below 200 nm, where the majority of absorption lines from hot stars are found. In these spectra, lines from doubly and singly ionised species predominate. The existing spectra of doubly ionised iron-group elements were recorded as much as 50 years ago using spectrographs of modest dispersion, photographic plates, and eye estimates of intensities. The accuracy of the old wavelength data is about 10 mÅ whereas wavelengths are now needed to an accuracy of 1 part in 10^7, or 0.2 mÅ at 2000 Å.

Fourier transform (FT) spectroscopy is ideal for making large scale improvements to the atomic data base since its high resolution is combined with broad spectral range, source-limited resolution, high absolute wavelength accuracy, and good optical throughput [1].The FT spectroscopy group at Imperial College, London, and collaborators at the Harvard College Observatory and Lund University, Sweden, have used a unique VUV FT spectrometer, whose MgF_2 beamsplitter allows study of high resolution spectra down to a world record short wavelength of 135 nm, in a program focussed on improving knowledge of spectra of many neutral and singly and doubly ionised, astrophysically important, iron group elements. Spectra of Fe II and Fe III have been recorded at UV and VUV wavelengths with signal-to-noise ratios of several hundred for the stronger lines. Intensity calibration of the spectra with accurate radiometric standards produces branching ratios that yield f-values when combined with level lifetimes. f-values for Fe II have been published [2].Wavelengths and energy levels for Fe III are an order of magnitude more accurate than previous work [3]; analysis is close to completion. Initial work on Ni III and Mn III has begun.

References:

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