Spectral Catalogue of Intermediate Charge States of High-Z Ions for Astrophysical Diagnostics in the EUV and Soft X-Ray

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The soft x-ray and EUV region, 20 - 140 Å, provides useful diagnostic tools in astronomy. This region contains a great number of emission lines that can be used to determine plasma properties and elemental abundances over a wide temperature range. However, this region has been poorly studied and remains relatively unknown territory to astrophysicists. We have shown earlier, for example, that the currently available line lists for the intermediate charge states of iron are highly incomplete in this region [1,2].

Observations by the *Chandra* and *XMM-Newton* X-Ray Observatories show a wealth of lines in the x-ray and EUV wavelength band, albeit weak in most cases. Most of these lines remain unidentified as the observations have outpaced the available experimental databases. The reason is that the accuracy of wavelength calculations is generally insufficient for line identification in the absence of careful laboratory measurements. Candidate ions responsible for these lines include iron, nickel, neon, argon, sulfur, silicon, and magnesium.

In order to establish a complete catalogue of the relevant emission lines we are using the Lawrence Livermore electron beam ion trap EBIT-I for systematic measurements of the spectra of astrophysically important ions in the EUV. EBIT-I is well suited for this endeavour because it is capable of producing the low ionization energies (100 – 1000 eV) needed to produce and excite the relevant charge states.

Measurements of the spectra of intermediate ionization stages of argon (Ar IX - Ar XVI) and sulfur (S VII - S XIV) have been completed, and measurements of silicon (Si V - Si XII) are in progress. The measurements include line assignments, wavelengths, and relative strengths. Our spectra are compared with calculations from the Hebrew University – Lawrence Livermore Atomic Code (HULLAC). EBIT-I data agree broadly with HULLAC calculations. However, typically the wavelengths agree only within ±0.3 Å.

References:

[1] Beiersdorfer, P., *et al.*, 1999, *ApJ (Letters)*, **519**, L185.
[2] Lepson, J. K., *et al.*, 2000, *Rev. Mex. Astron. Astrofisica,* **9**, *137.*

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