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New laboratory atomic data for neutral, singly, and doubly ionised iron group elements for astrophysics applications

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Abstract. We report new measurements of atomic data for the neutral, singly and doubly ionised iron group element spectra for modern astrophysics applications.

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We report new laboratory spectroscopic measurements to produce atomic data for astrophysically important species: neutral, singly and doubly ionised iron group elements. We use high resolution Fourier Transform Spectrometry (FTS), with resolving power up to 2 x 10^6 at 200 nm, to measure atomic spectra, giving accurate line wavelengths (to a few parts in 10^8), atomic energy levels, hyperfine structure splitting, and log gfs (accurate to a few %, see Pickering & Ruffoni 2015). These data are vital for astrophysical spectral analyses, namely line identification, spectrum synthesis, elemental abundance determinations (e.g. Bergemann, *et al.* 2010), and disentangling of blends etc, and cannot be theoretically calculated to the accuracy needed for many astrophysics applications.

At Imperial College we have a unique visible-VUV FT spectrometer with short wavelength cut-off of 135 nm. We supplement FTS data at shorter wavelengths with spectra recorded on the NIST 10.7 m grating spectrograph and at longer wavelengths in the IR we use the NIST IR FT spectrometer. An elemental spectrum may contain thousands of spectral lines from the IR to VUV. We use these wavelengths to correct known atomic energy levels and search for new atomic levels. The result is a classified linelist and accurate atomic energy levels. Examples of recent progress on iron group element atomic energy levels and wavelengths are our studies of V I and V II (Thorne, *et al.* 2011, Thorne, *et al.* 2013), Cr II (Sansonetti & Nave 2014), Co III (Smillie, *et al.*, in press), with work ongoing for Cr I, Mn I and Mn II, and Ni II. Order-of-magnitude improvements in accuracy of wavelengths and atomic energy levels have been possible. This work is supported by STFC(UK), The Leverhulme Trust, The Royal Society, and NASA.

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