Spectral Catalogue of Multiply and Highly Charged Ions for Astrophysical Diagnostics in the Extreme Ultraviolet

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With the launch of the *Extreme Ultraviolet Explorer* (EUVE) in 1992, the extreme ultraviolet spectral region from 70 to 400 Å has been opened to stellar astrophysicists for high-resolution exploration. It was immediately apparent that EUVE could provide superb spectra of stellar coronae for deriving densities, abundances, and, very importantly, the coronal temperature structure not provided by any other means (Dupree et al. 1993, Brown 1994, Vedder et al. 1994, Mewe et al. 1995). The diagnostic opportunities are the result of the wealth of emission lines that mark the extreme ultraviolet spectral region. In particular, the region contains rich line emission from virtually all charge states of iron, i.e., transitions of the type 3ℓ-$n\ell'$ of the ionization states Fe IX–Fe XVII and transitions of the type $2s$-$2p$, of the ionization states Fe XVIII-Fe XXIV. These provide line diagnostics for the transition region ($T \leq 5 \times 10^5$ K), the "quiet" corona ($T \approx$ 1-2 $\times 10^6$K; e.g. Fe IX-Fe XII), active regions ($T \approx$ 2-5 $\times 10^6$ K; e.g. Fe XIV-Fe XX), and flares ($T \geq 10^7$ K; e.g. Fe XXI-Fe XXIV). The analysis of EUVE spectra is, however, not without problems. In fact, the spectra, especially those in the short wavelength band 70-180 Å, cannot be properly fitted without making controversial assumptions about the completeness of the available line lists covering the intermediate charge state iron ions. We are addressing this controversy by establishing a definitive spectral catalogue of the intermeditate ionization states of iron in the extreme ultraviolet based on measurements carried out under precisely controlled laboratory conditions using the LLNL Electron Beam Ion Trap facility. The measurements are providing a complete line list, wavelength assignments, line intensities, and branching ratios, including the contributions from weak, unresolved lines to the overall flux level. These measurements support the development of reliable modeling codes for the analysis of data from present and future space astrophysics missions sensitive to extreme ultraviolet radiation.

References:

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