ISM abundances from accurate *f*-values for the VUV resonance lines of FeII, CoII, and NiII

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A High Sensitivity Absorption Experiment which measures absolute UV and VUV oscillator strengths has been developed at the University of Wisconsin-Madison. This experiment uses a hollow cathode discharge as an absorbing sample, the Aladdin storage ring at the Synchrotron Radiation Center as a continuum source, and a 3m focal length vacuum echelle spectrometer equipped with a CCD detector array. The experiment achieves spectral resolving powers of 350,000 and sensitivities to fractional absorptions much smaller than 1% at deep UV and VUV wavelengths. Column densities of sputtered metal atoms and ions as small as 3.0×10^8 cm^{-2} can be detected. The absorption experiment measures relative oscillator strengths for lines from a common lower level, usually a VUV transition relative to a well known UV transition. An accurate absolute scale for all of these measurements is established using radiative lifetimes from laser induced fluorescence measurements on atomic/ionic beams. This experiment is applicable to essentially every element in the periodic table, both neutral atoms and atomic ions. The experiment is used to measure oscillator strengths for the most important UV and VUV resonance lines of Fe^+, Co^+, and Ni^+ [1-3]. These resonance lines are prominent in absorption spectra on the Interstellar Medium (ISM) recorded using the Hubble Space Telescope. The Fe measurements include a number lines with widely varying *f*-values. Cardelli and Savage [4] used these *f*-values to establish accurate absolute column densities along a variety of sight lines through the ISM. They were then able to perform "self-consistent analysis of ISM FeII over a large dynamic range (e.g. between different sight lines sampling a large range of column densities and in single sight lines with multiple and widely varying component structure)." Recent work with Zsargo and Federman [3] established that gas phase cobalt is significantly less depleted onto dust grains in the ISM than determined previously. The depletion of nickel may be one of the best probes for grain evolution in galaxies [5]. Our work in progress will establish an accurate absolute scale for the relative NiII *f*-values reported by Zargo and Federman from ISM observations [5].

References:

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