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Improved wavelengths of Fe V and Ni V for analysis of spectra of white dwarf stars

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Abstract. We summarize measurements of improved wavelengths of Fe V and Ni V in the vacuum ultraviolet.

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A recent paper by Berengut *et al.* (2013) tests for a potential variation in the fine-structure constant, α, in the presence of a high gravitational field through spectral analysis of white-dwarf stars. The spectrum of G191-B2B has prominent Fe V and Ni V lines in the vacuum ultraviolet (VUV) region that were used to determine any variation in α via observed shifts in their wavelengths. Although no strong evidence for a variation was found, the authors did find a difference between values obtained for Fe V and Ni V that were indicative of a problem with the laboratory wavelengths. The laboratory wavelengths dominate the uncertainty in the measured variation, so improved values would tighten the constraints on the variation in α.

We have re-measured the spectra of Fe V and Ni V spectra in the VUV in order to reduce the wavelength uncertainties and put the two spectra on a consistent wavelength scale. The spectra were produced by a sliding spark light source with electrodes made of invar, an iron nickel alloy. Spectra of Fe V and Ni V were obtained using peak currents of 750-2000 A. The spectra were recorded using the NIST Normal Incidence Vacuum Spectrograph with phosphor image plates and photographic plates as detectors. Wavelengths from 1100 Å to 1800 Å were covered in a single exposure. A spectrum of a Pt/Ne hollow cathode lamp was also recorded for wavelength calibration.

The spectra recorded on photographic plates are better resolved than the phosphor image plate spectra and are being measured in two ways. The first measures the positions of the spectral lines on a comparator, traditionally used to measure many archival spectra at NIST. The second uses a commercial image scanner to obtain a digital image of the plate that can be analyzed using line fitting software. Analysis of these spectra indicates that previously-measured values of the Fe V and Ni V wavelengths are on different scales and differ from our new measurements by up to 0.02 Å in some wavelength regions.

Reference

Berengut, J. C., Flambaum, V. V., Ong, A., Webb, J. K., Barrow, J. D., Barstow, M. A., Preval, S. P., & Holberg, J. B. 2013, *Phys. Rev. Lett.* 111, 010801

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