INVESTIGATION OF THE ZEEMAN EFFECT IN THE $e\,^6\Pi - a\,^6\Delta$ SYSTEM OF FeH: APPLICATION TO STELLAR SPECTROSCOPY

AMANDA J. ROSS, PATRICK CROZET, *Inst. Lumière Matière, Univ Lyon 1 & CNRS, Université de Lyon, Villeurbanne, France*; ALLAN G. ADAM, *Department of Chemistry, University of New Brunswick, Fredericton, NB, Canada*; TIMOTHY E BLACKMORE, DENNIS W. TOKARYK, *Department of Physics, University of New Brunswick, Fredericton, NB, Canada*.

We investigate the Zeeman effect in the $e\,^6\Pi - a\,^6\Delta$ system of FeH. The molecule has been produced by reaction of $Fe(CO)_5$ with H atoms, and examined by laser excitation with selective detection and by Fourier transform resolved fluorescence. The field-free spectrum of the $e\,^6\Pi - a\,^6\Delta$ system was extensively studied by the J.M. Brown group and collaborators in the 1990's [a]. Their analysis located the low-lying excited $a\,^6\Delta$ state 1890 cm^{-1} above the $X\,^4\Delta$ electronic ground state.

One of the infrared systems of FeH already recognised[b] in the spectra of cool stars around 1.6 μm, $E\,^4\Pi - A\,^4\Pi$, originates in an excited state lying only 920 cm^{-1} lower in energy in energy than $a\,^6\Delta$, so it seemed not unreasonable to expect signatures from the known sextet systems $e-a$ and $g-a$ to appear in the spectra of cool stars as well. We found that the $e-a$ system can indeed be used as a diagnostic for FeH. Cross-correlation functions between a mask of laboratory-measured $e-a$ transitions and spectra from four M- dwarf stars taken on spectropolarimetric instruments ESPaDOnS (on Maunakea) and Narval (in the French Pyrenees), show that reliable radial-velocity information can be extracted for these objects. Our new Zeeman measurements are intended to improve reference data for cross-correlation calculations for M-type stars, whose magnetic fields are typically $0-5000$ Gauss.

---

[a] Goodridge *et al* J . Chem. Phys. 106 (12), 4823 (1997); Wilson *et al* J. Chem. Phys. 115 (13), 5943 (2001)

[b] Wallace & Hinkle, ApJ, 559, 424 (2001)