LABORATORY MEASUREMENTS OF THE ZEEMAN EFFECT IN THE F–X SYSTEM OF IRON MONOHYDRIDE

PATRICK CROZET, GUILLAUME TOURASSE, AMANDA J. ROSS, *LASIM, Université Lyon 1 & CNRS, 43 Bd du 11 novembre 1918, F-69622 Villeurbanne, France*; D. W. TOKARYK, *Department of Physics and Center for Laser, Atomic, and Molecular Sciences, University of New Brunswick, Fredericton, Canada E3B 5A3*; FRÉDÉRIC PALETOU, *Observatoire Midi-Pyrenées (CNRS) 14 Av Edouard Belin, 31400 Toulouse, France*; ARTURO LÓPEZ ARISTE, *THEMIS Telescope, CNRS UPS 853, C/Via Lactea s/n, 38200 La Laguna, Tenerife, Spain*.

We have used a hollow cathode sputtering source, flowing a mixture of 10 % H_2 in Ar $\sim$ 45 standard cm^3/minute to form FeH radicals. Sputtering from iron required currents $\geq$ 250 mA. A permanent magnet was placed 2–3 cm below the cathode, generating magnetic fields 3000–4500 Gauss. Output from a Sirah Matisse Ti:sapphire laser was focused to a beamwaist $<$ 1mm to probe a reasonably homogeneous region of the magnetic field, with the laser operating around 1 μm for the 0-0 band and 890 nm for the 1-0 band of the $F\,^4\Delta \leftarrow X\,^4\Delta$ system in FeH. The magnetic field is calibrated to 0.5 % accuracy from the Zeeman response of the Ar I line at 10958.339 cm^{-1}. Several spectra have been taken for lines of the R branches of the $F\,^4\Delta_{7/2} \leftarrow X\,^4\Delta_{7/2}$ and $F\,^4\Delta_{5/2} \leftarrow X\,^4\Delta_{5/2}$ sub-bands, showing resolved structures at Doppler resolutions. Unresolved structures are seen for the Q and P transitions. Landé factors have been determined for the upper state (relying on ground state data from LMR work[a]) either from fits to peak positions, or by simulating observed profiles when this was impossible. The Landé factors have been used to deduce a magnetic field of 2200 Gauss in sunspots from lines near 1 μm observed at the solar telescope THEMIS (Tenerife) in July 2011. Stokes V profiles were recorded at the telescope, for optimum sensitivity. The magnetic field deduced from atomic lines (Ti,Fe) is around 10 % higher than that found from FeH, compatible with molecules forming at higher altitudes in the solar atmosphere.

---

[a] J.M. Brown, H. Korsgen, S.P. Beaton, & K.M. Evenson, J. Chem. Phys. 124 234309 (2006)

We gratefully acknowledge financial support from the French agency ANR, and from the CNRS (PNPS programme) for this work.