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Contribution ID: **3830** Type: **Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)**

(G*) Laser Based Studies of Iron Monohydride (FeH): New Electronic States and Zeeman Spectroscopy in Support of Exoplanet Research

Monday 19 June 2023 16:45 (15 minutes)

We will report on the development of efforts to create new spectroscopic reference data to help astronomers to find exoplanets. Astronomers routinely observe spectra of the molecule iron hydride (FeH) in the atmosphere of M-class stars. By measuring the Doppler shifts of transitions in FeH, they can determine a star's radial velocity. If a star has an exoplanet, the star and the exoplanet will orbit their common center of mass inducing a periodic frequency wobble in the star's FeH spectrum. However, M-class stars often have strong magnetic fields that modify its FeH spectrum through Zeeman splitting. While the infrared transition of interest ($E^4\Pi$-$A^4\Pi$, ˜ 1600 nm) has been studied in detail, its response under magnetic field has not been studied in the lab, although it has been observed in sunspots (A. Asensio Ramos et al., 2004). Hence astronomers require an FeH spectrum to interpret their stellar observations when there is non-negligible magnetic field.
We are creating FeH in the lab to study the response of the $E^4\Pi$ and $A^4\Pi$ states to controlled magnetic fields. Transitions involving $E^4\Pi$ and $A^4\Pi$ are accessed through new higher-lying states that we have recently discovered. One of the new states is accessible from the ground state, $X^4\Delta$, via laser excitation spectroscopy in the green region (˜ 510 nm) and fluoresces to both the $E^4\Pi$ and $A^4\Pi$ states. Thus, we can obtain information about the infrared transition indirectly through Zeeman spectroscopy of the visible transitions. The second new higher-lying state is assigned as the $(2)^4\Phi$ state. This state is also accessed from the ground state (˜ 515 nm) and fluoresces very strongly in the red (˜ 625 nm) to the previously observed $C^4\Phi$ state.

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Keyword-2

Molecular physics

Keyword-3

Exoplanets

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