A study of magnetic fields in Intermediate Mass T-Tauri Stars

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Introduction

Stellar magnetic fields play a critical role throughout stellar formation and evolution. We observe two topologies of magnetic fields: (a) dynamo-generated fields in cool stars such as the Sun, which are weak, complex, and rapidy evolving. (b) "fossil" fields found in hot stars, which are strong, stable, and organised.

Around 10% of A/B type stars, and their pre-main sequence precursors Herbig Ae/Be stars present such fossil fields, of comparable strength and nature, indicating that their magnetic field is inherited from an earlier stage of evolution (Alecian 2013).

Intermediate mass T-Tauri stars are pre-main sequence stars with masses around 2 $M_{\odot}$, and are the likely precursors of Herbig Ae/Be and ultimately A/B type stars. The study of magnetic fields inside these stars is a step towards a better understanding of the origin of fossil magnetic fields.

Data

We use high resolution infrared spectra acquired in the H and K bands (respectively *fig. 1* and *fig. 2*) at the Very Large Telescope using the CRIRES infrared spectrograph. We have observations for a sample of Intermediate Mass T-Tauri stars with effective temperatures ranging from roughly 4000 K to 6000 K.

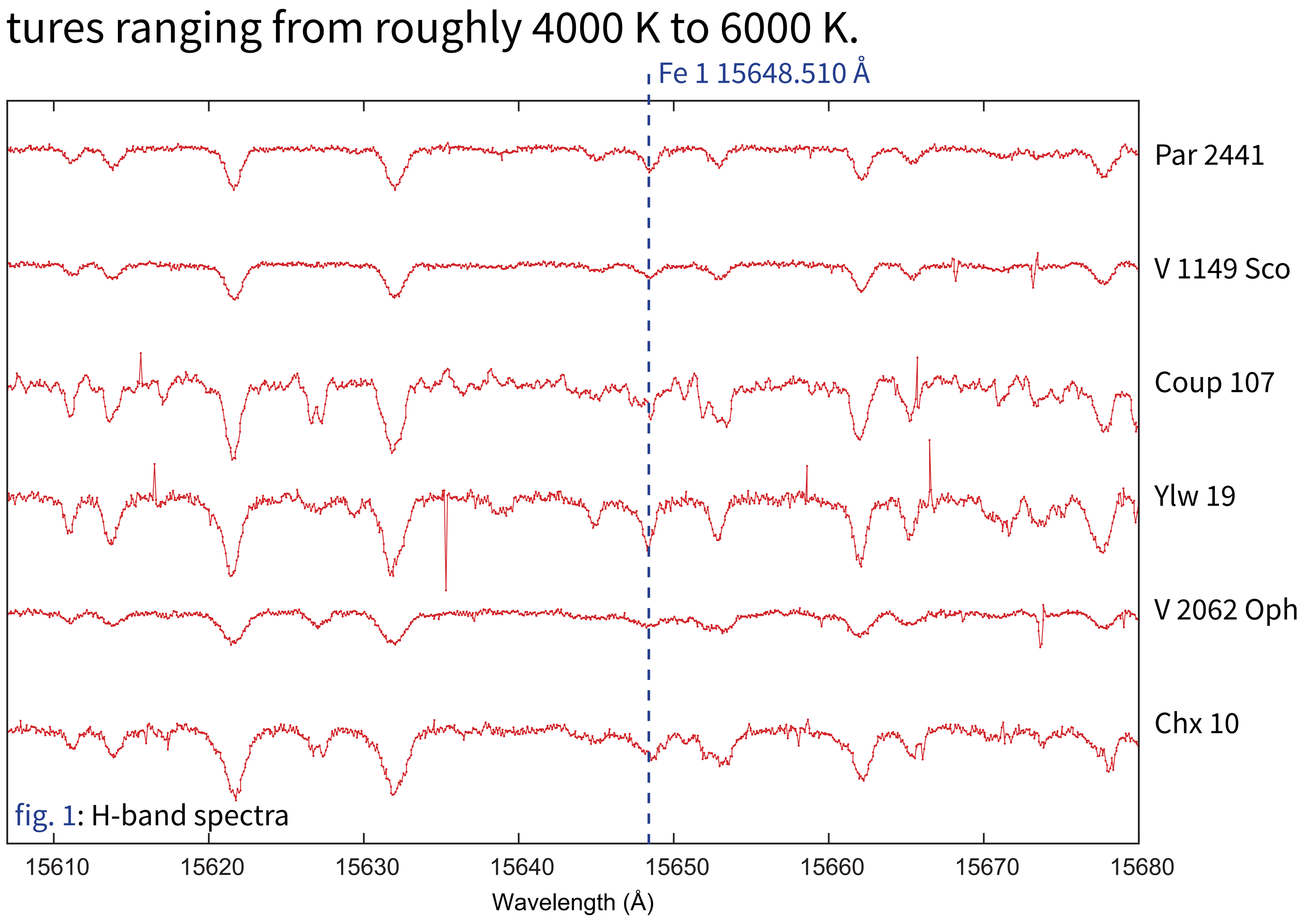

fig. 1: H-band spectra

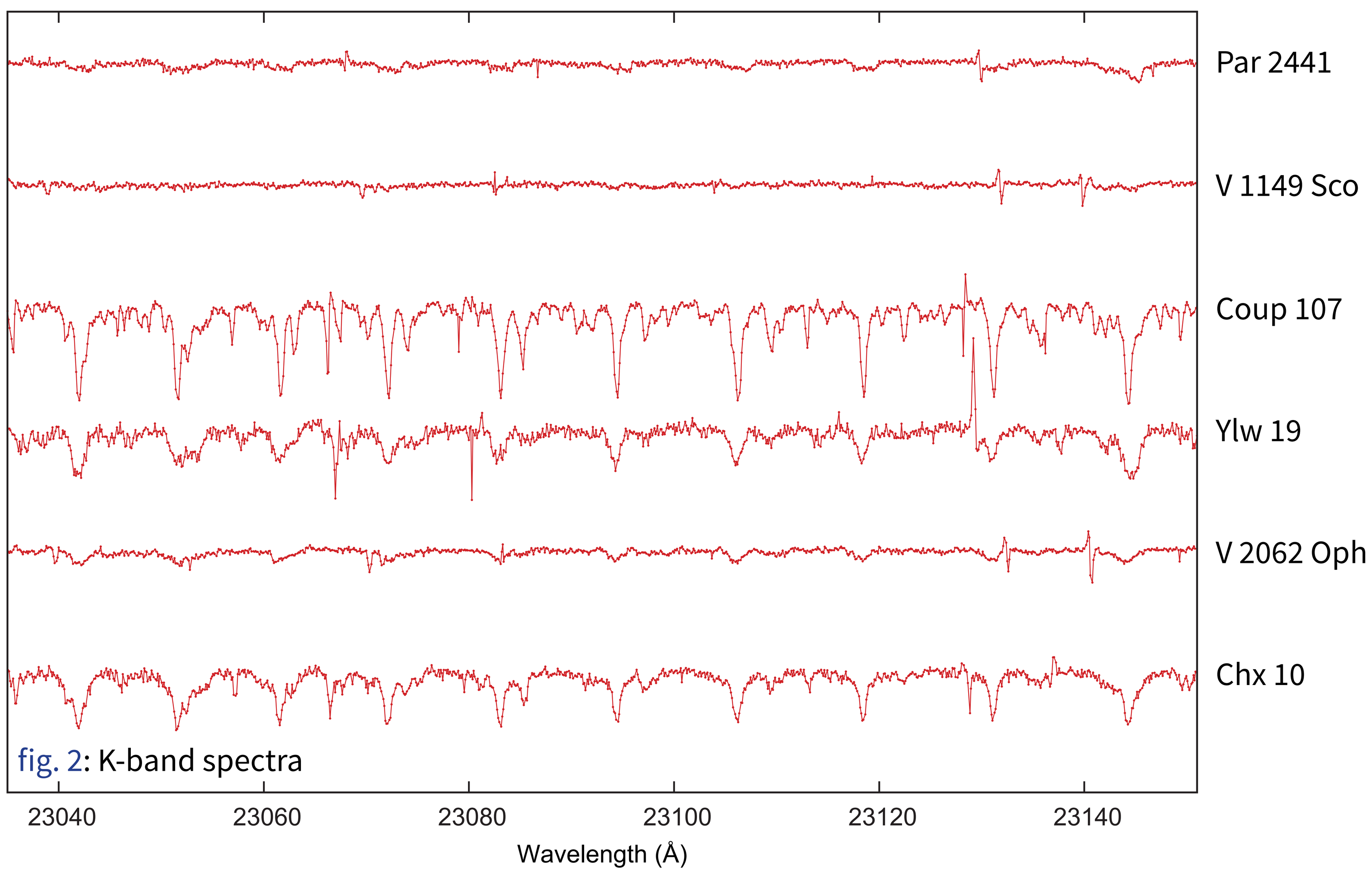

fig. 2: K-band spectra

Methods

Magnetic spectrum synthesis using

- MARCS model atmospheres (Gustafsson et al. 2008)
- Atomic data from Vienna Atomic Line Database (Kupka et al. 2000)
- SYNMAST magnetic spectrum synthesis code (Kochukhov 2010)

Detection of magnetic field

Spectral lines are broadened when emitted in presence of a magnetic field due to the Zeeman effect. Their broadening is increasing with both wavelength and magnetic field strength.

We use the magnetically insensitive CO lines in the K-band to characterize non-magnetic broadening of spectral lines (*fig. 3*), and the magnetically sensitive Fe 1 15648.510 Å line in the H-band to determine the magnetic broadening (*fig. 4*).

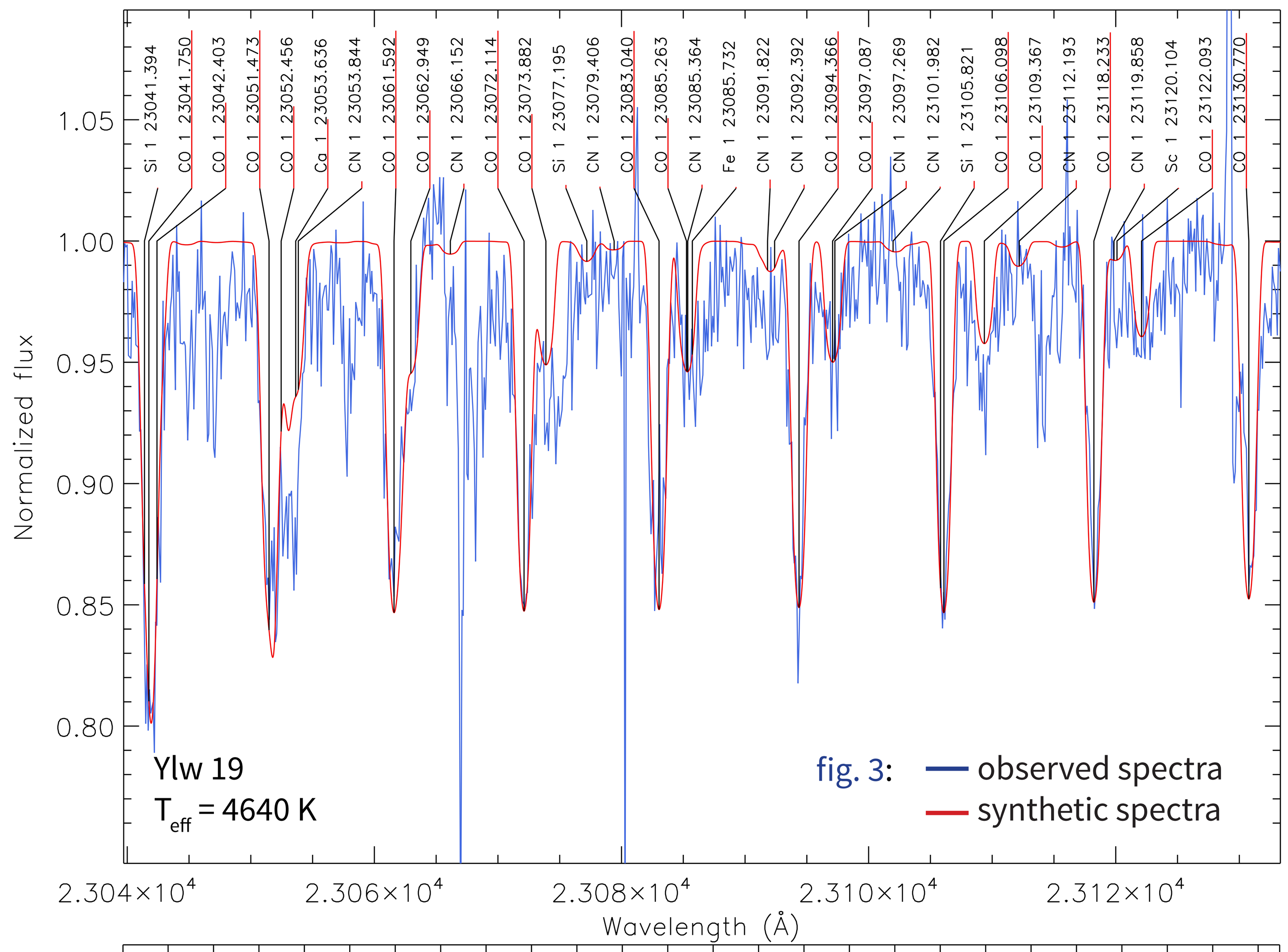

fig. 3: observed spectra / synthetic spectra

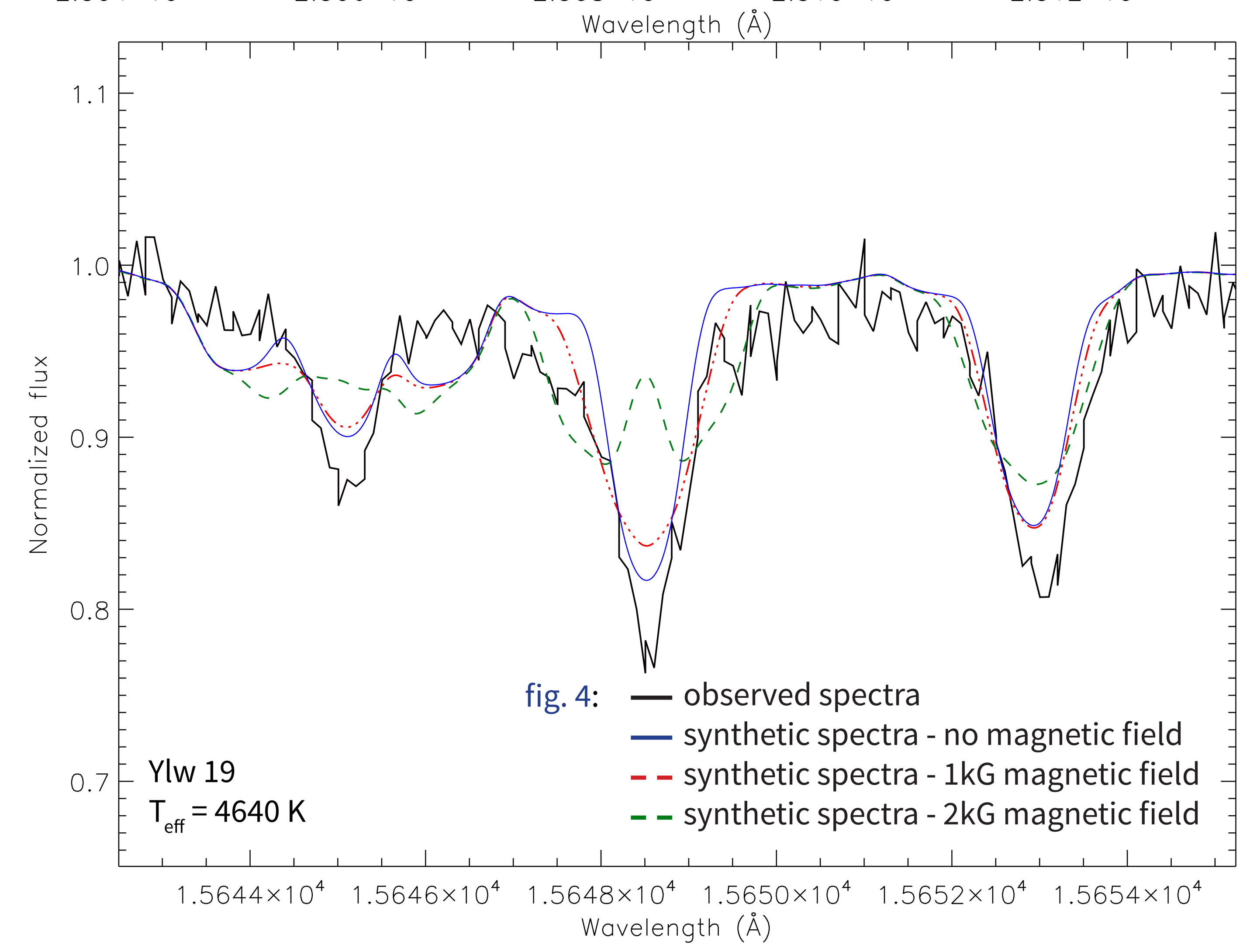

fig. 4: observed spectra / synthetic spectra - no magnetic field / synthetic spectra - 1kG magnetic field / synthetic spectra - 2kG magnetic field

Preliminary results

So far, we do not detect magnetic fields with strengths of about 2-4 kG comparable to those found in lower mass T-Tauri Stars (Johns-Krull 2007).

References

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