The Rossiter-McLaughlin effect and exoplanet transits: a delicate association at medium and low spectral resolution.

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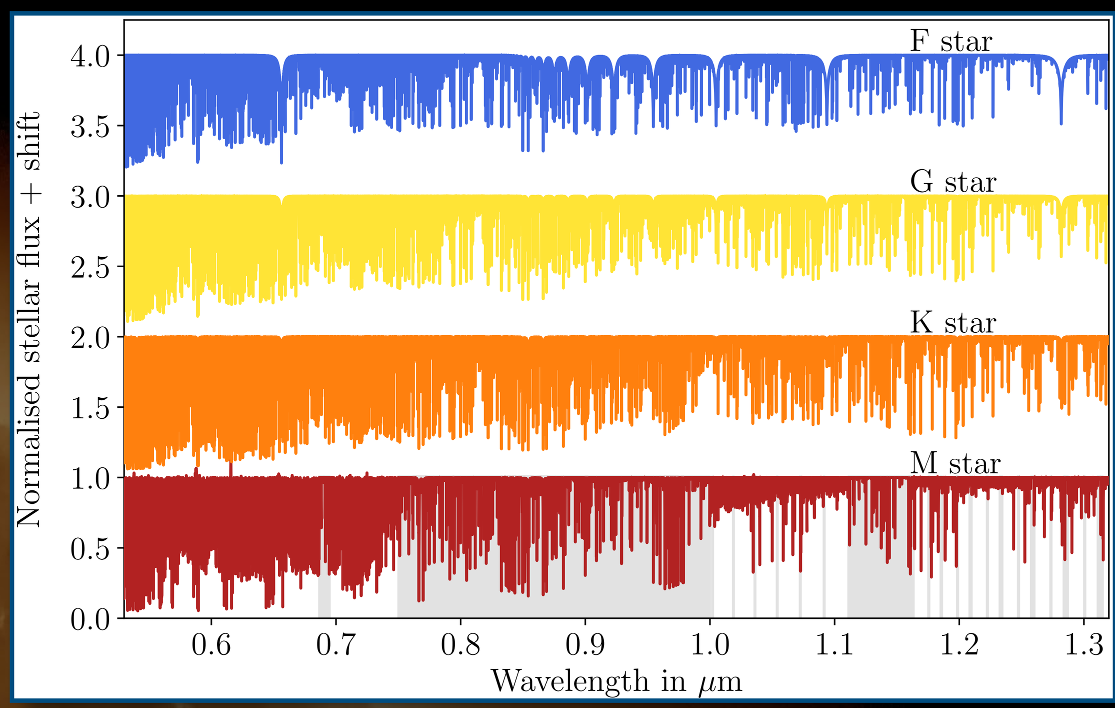
Context

The Rossiter-McLaughlin (RM) effect (Rossiter1924, McLaughlin1924) is known to bias high resolution spectroscopic absorption signatures (e.g. Dethier&Bourrier2023) by introducing line distortions during exoplanet transits. Due to the stellar rotation, the stellar surface is not homogeneous. It results that the disk-integrated stellar spectrum is not a good proxy for the local spectra occulted by the planet along the transit. These distortions are often disregarded in low resolution studies. However the question remains open on whether there exist some cases in which the RM effect cannot simply be ignored and introduces a contamination at the level of the uncertainties even at low resolution.

Modelisation

- 4 stellar type spectra generated with *Turbospectrum* (Alvarez&Plez1998).
- Planetary parameters of HD209458b with recomputed semi-major axis and orbital inclination for each star.
- Absorption time-series spectra simulated without atmosphere (only fully opaque layers) with EVE (Bourrier+2013).



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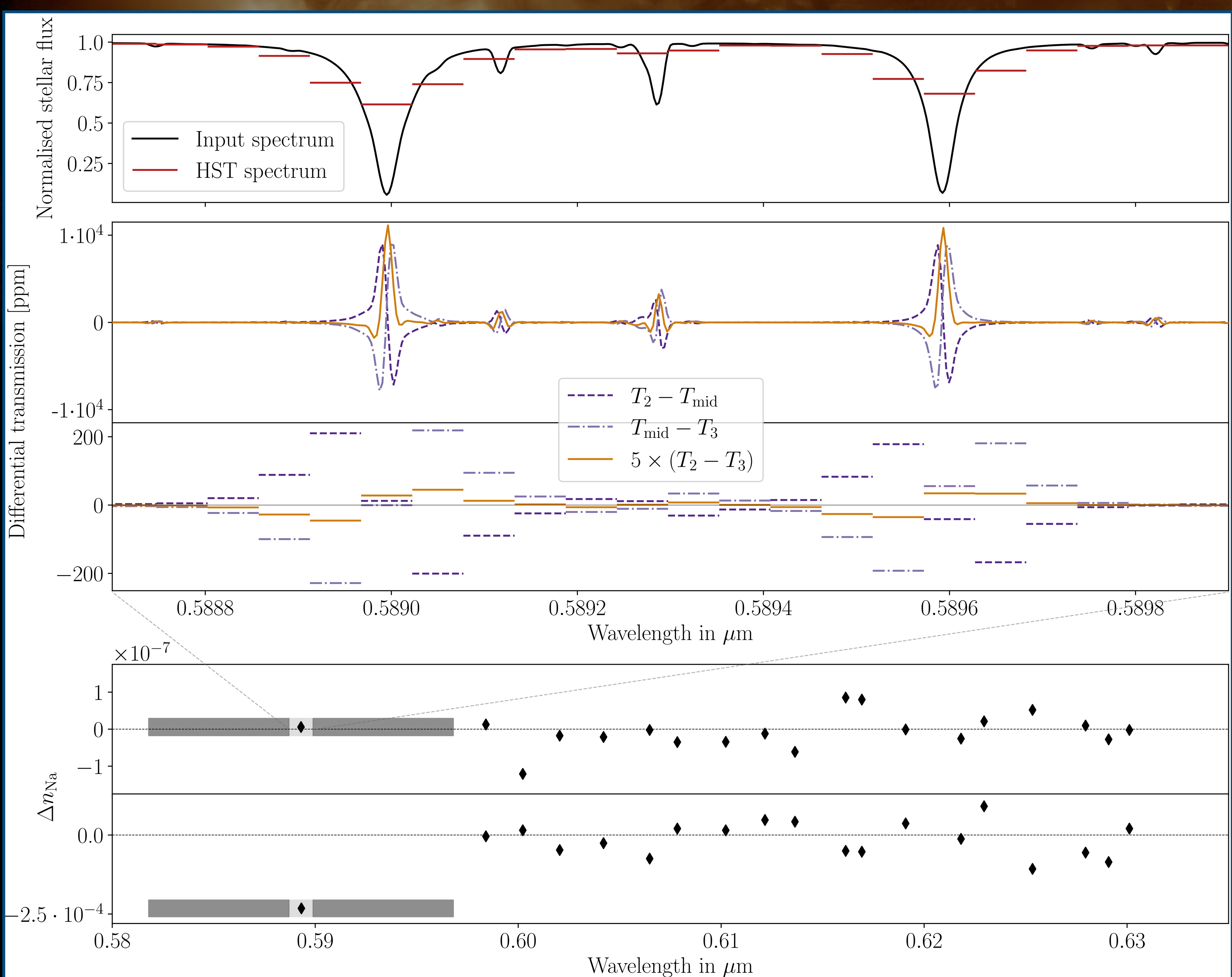
HD209458b puzzling case

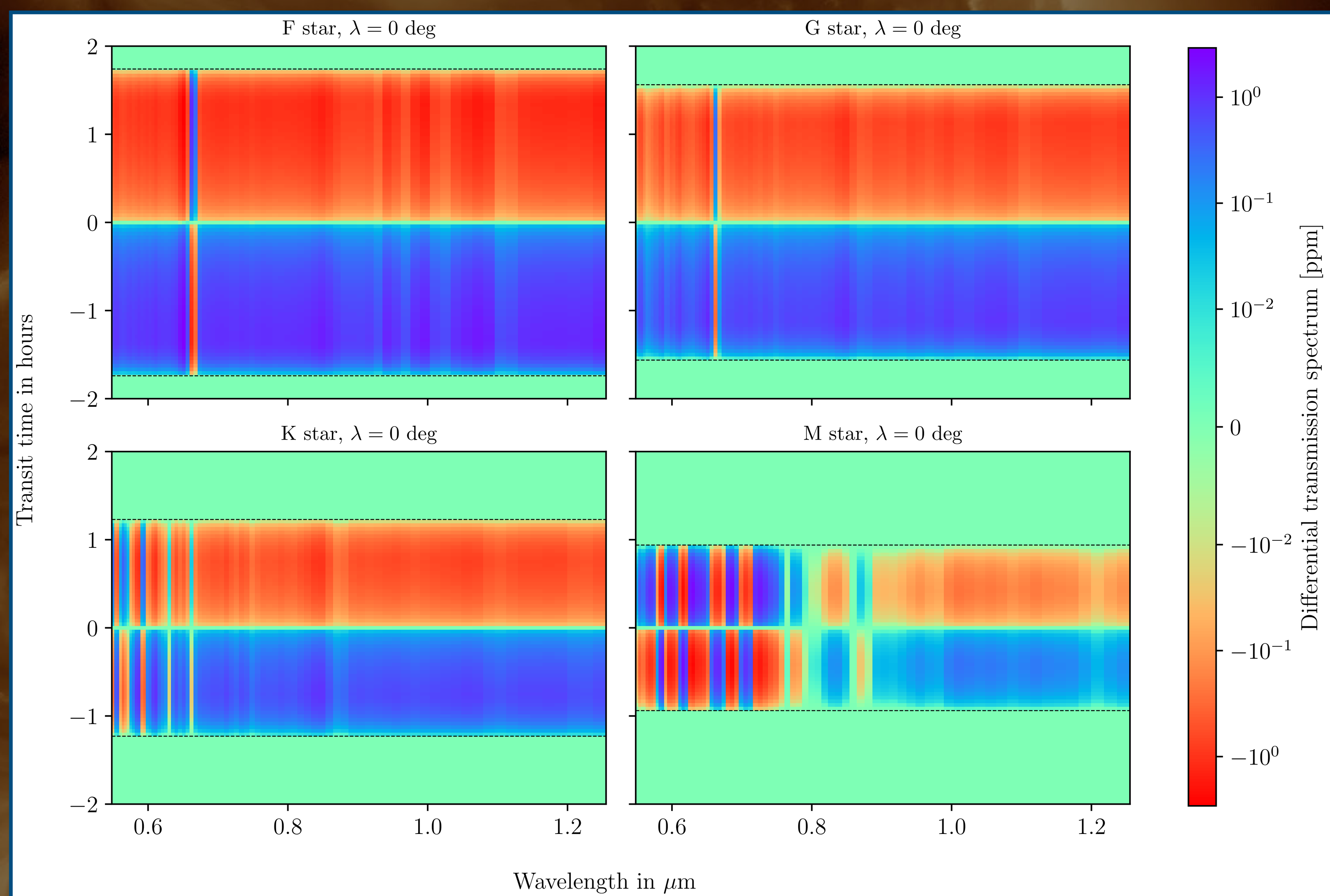
- First claimed detection of exoplanetary atmosphere (Charbonneau+2002).
- Casasayas-Barris+2021 showed that the RM fully reproduces the high resolution signal in the sodium doublet.
- Build a realistic stellar grid and simulate a transit of HD209458b.
- Compute the absorption time-series as seen with HST, $\mathscr{R} = 5440$.
- Process the simulated data in the way Charbonneau+2002 did.
- Compare the level of absorption generated by the RM effect alone and the observed signal.



Absorption in the wings of the Na doublet ?

RM bias at low resolution

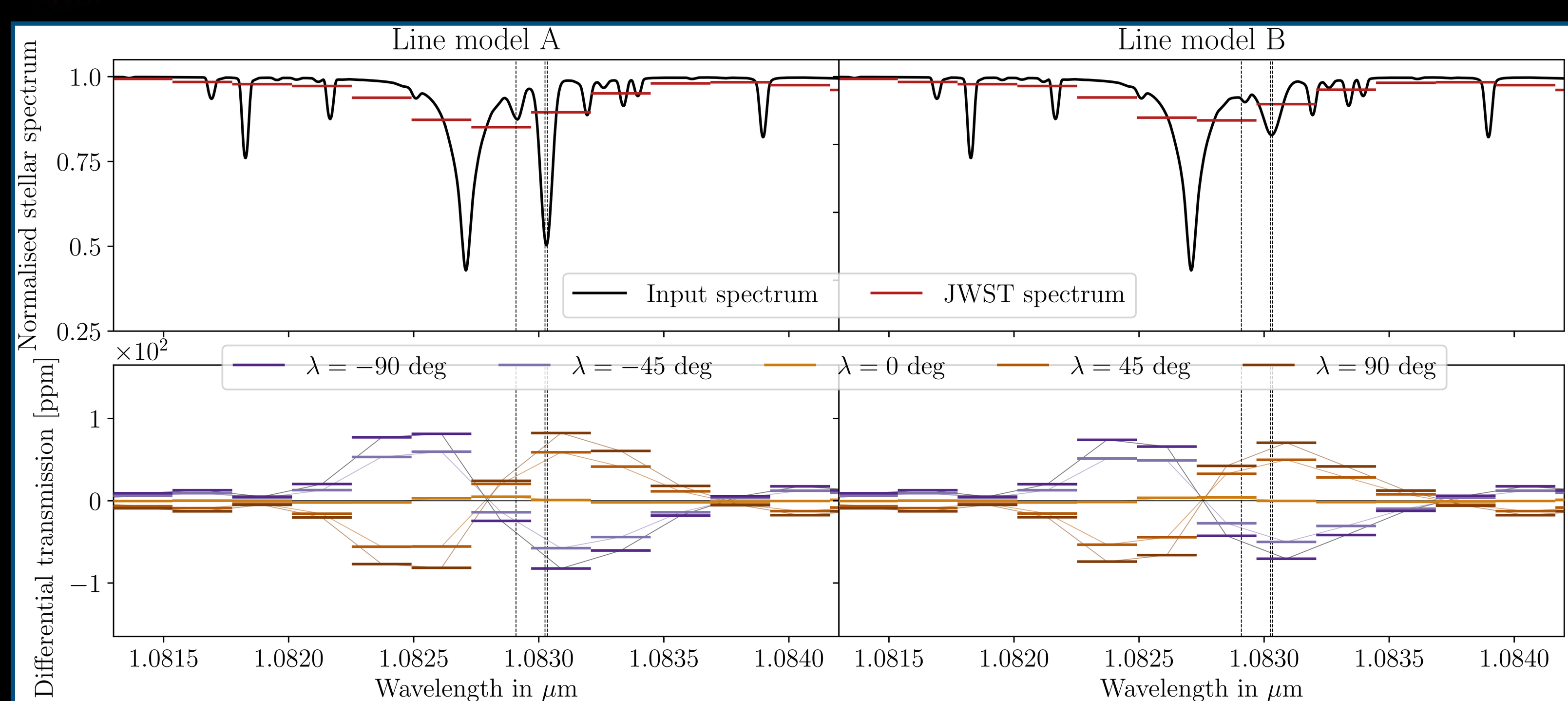
- Build stellar grids using typical rotational velocities.
- Simulate time-series of in-transit fluxes.
- Convolve and resample to JWST/NIRSPEC in prism mode, $30 < \mathscr{R} < 65$.
- Compute the absorption time-series as seen with JWST.
- Subtract the equivalent from a non-rotating star.



Bias well under uncertainties level

Atmospheric escape

- K type star used (Oklopčić2019).
- Compute the absorption time-series as seen with JWST/NIRSPEC in G140H-f70 mode, $\mathscr{R} = 2050$.
- Evaluate errors associated to the transit with *Pandexo* (Batalha+2017)



Level of RM effect comparable to uncertainties

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