An update on MAROON-X

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A new EPRV facility in the north

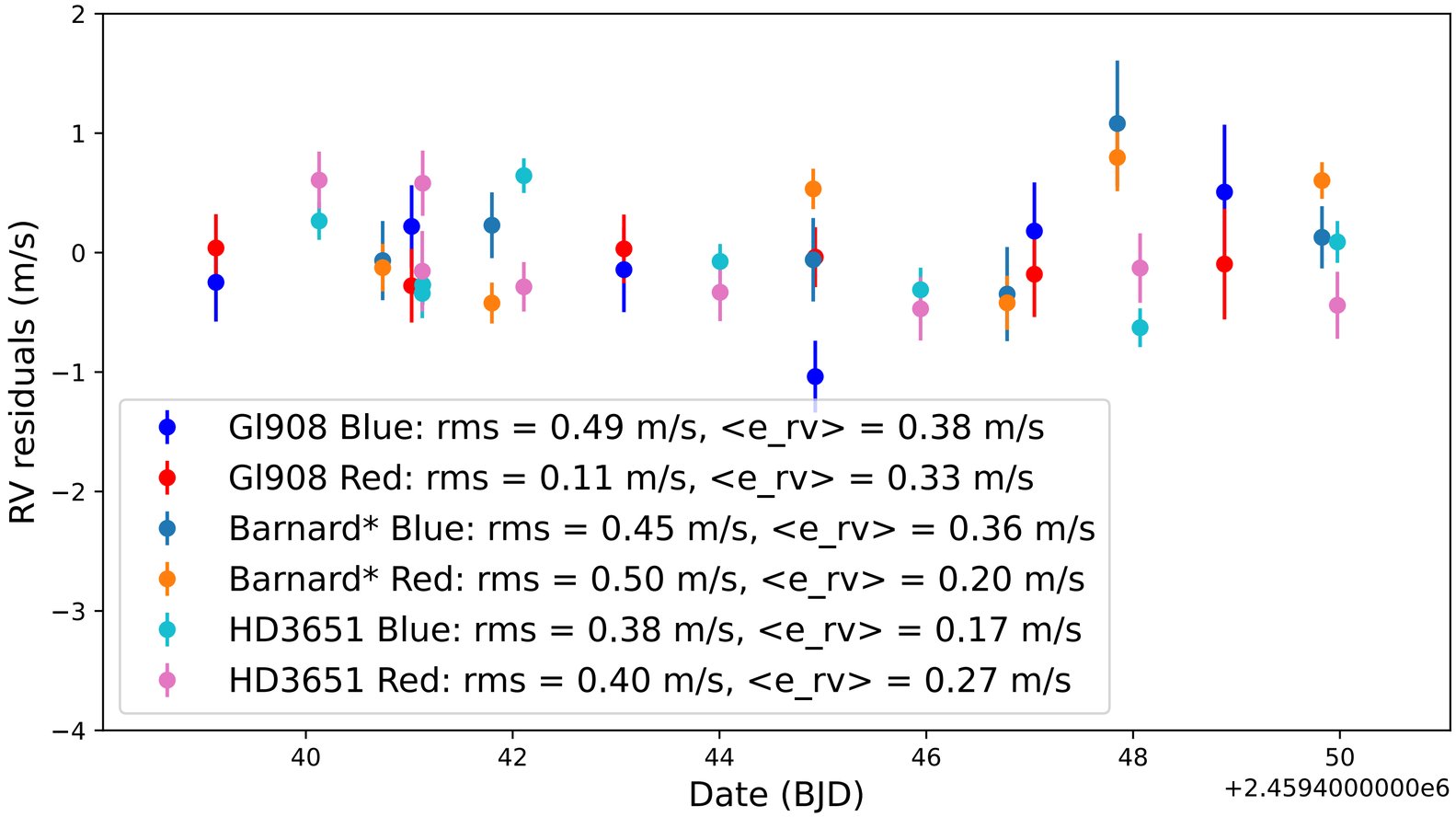
- MAROON-X is located at the 8.1-m Gemini-North telescope in Mauna Kea, HI
- Commissioned in 2019, in **regular operations since May 2020**
- Operates as a "Visitor Instrument", as of today
- Not always on the telescope! Approx. 150 nights/yr in 6 blocks of 1-5 weeks each

Instrument specs

- Highly stabilised, fibre-fed Echelle spectrograph
- **Wavelength range: 500-920 nm** divided in two arms (blue: 500-670nm; red: 650-920nm)
- 3x pupil slicer, simultaneous calibration and sky fibre
- Etalon for wavelength and drift calibration
- No technical loses so far!

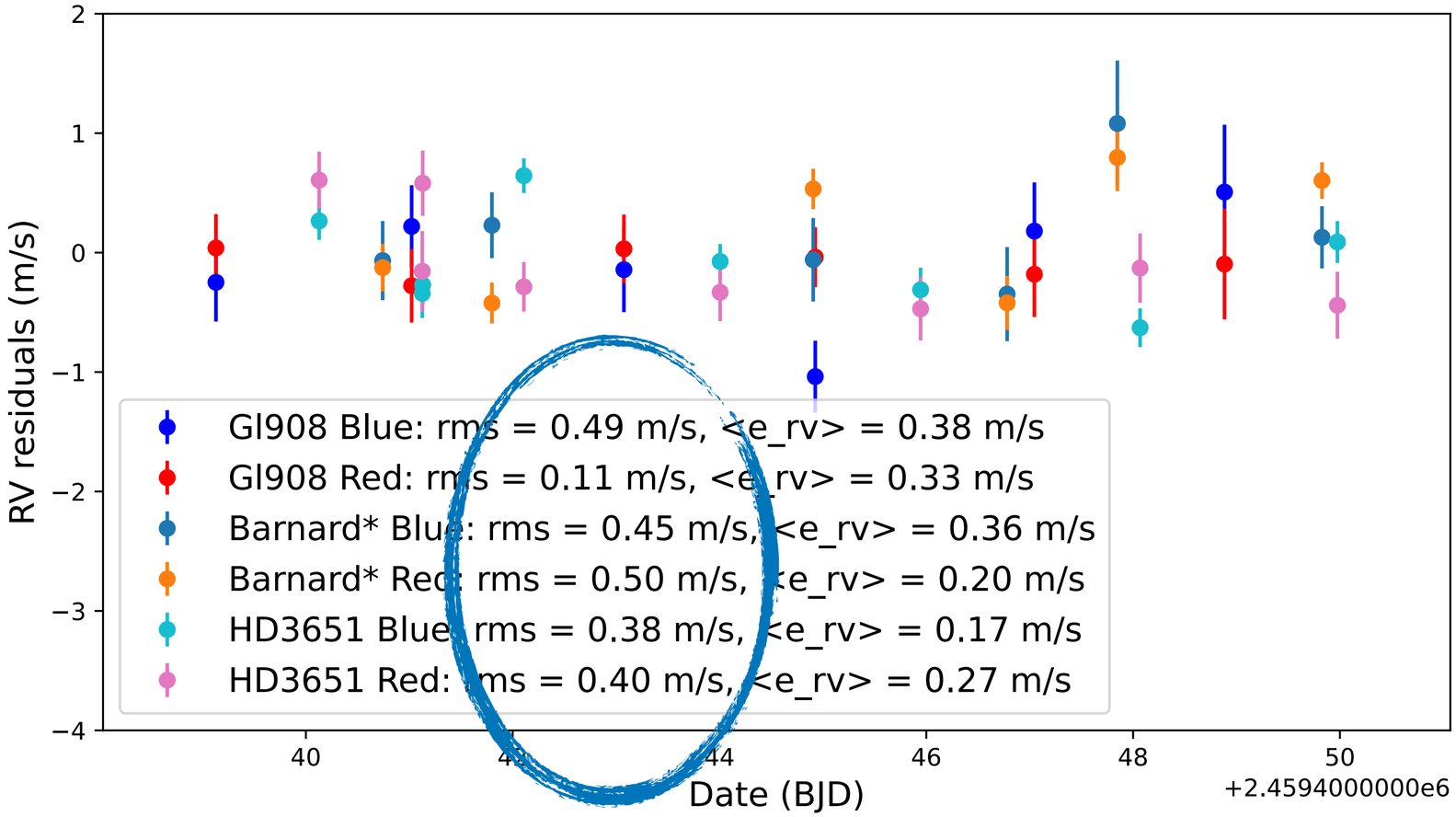
Instrument performance

- Short-term performance is **excellent**!



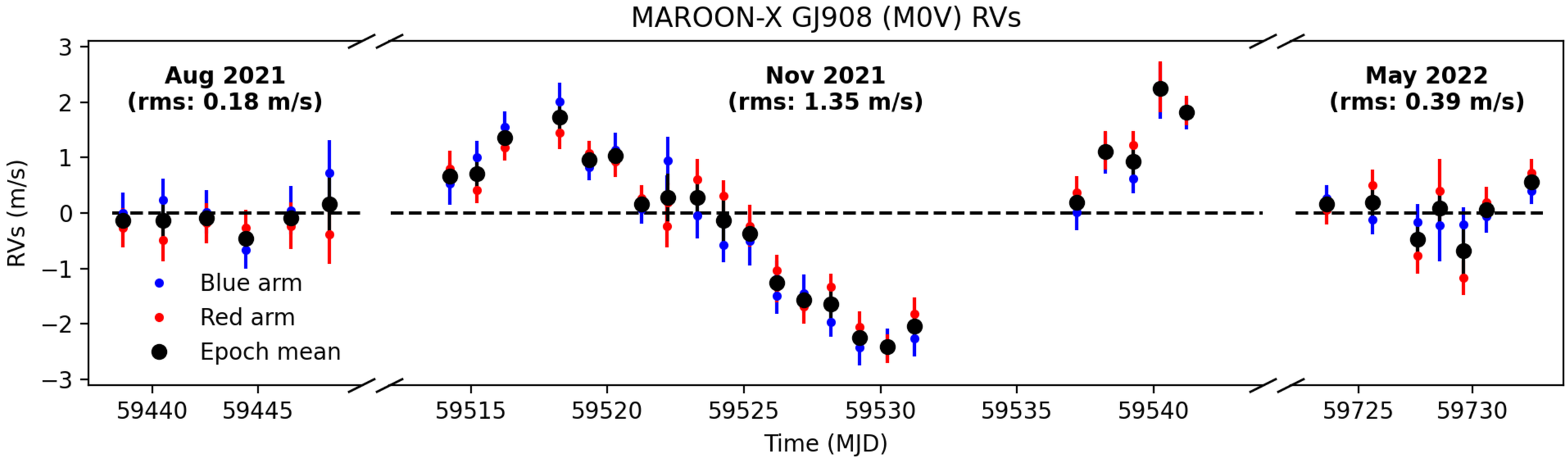
Instrument performance

- Short-term performance is **excellent**!



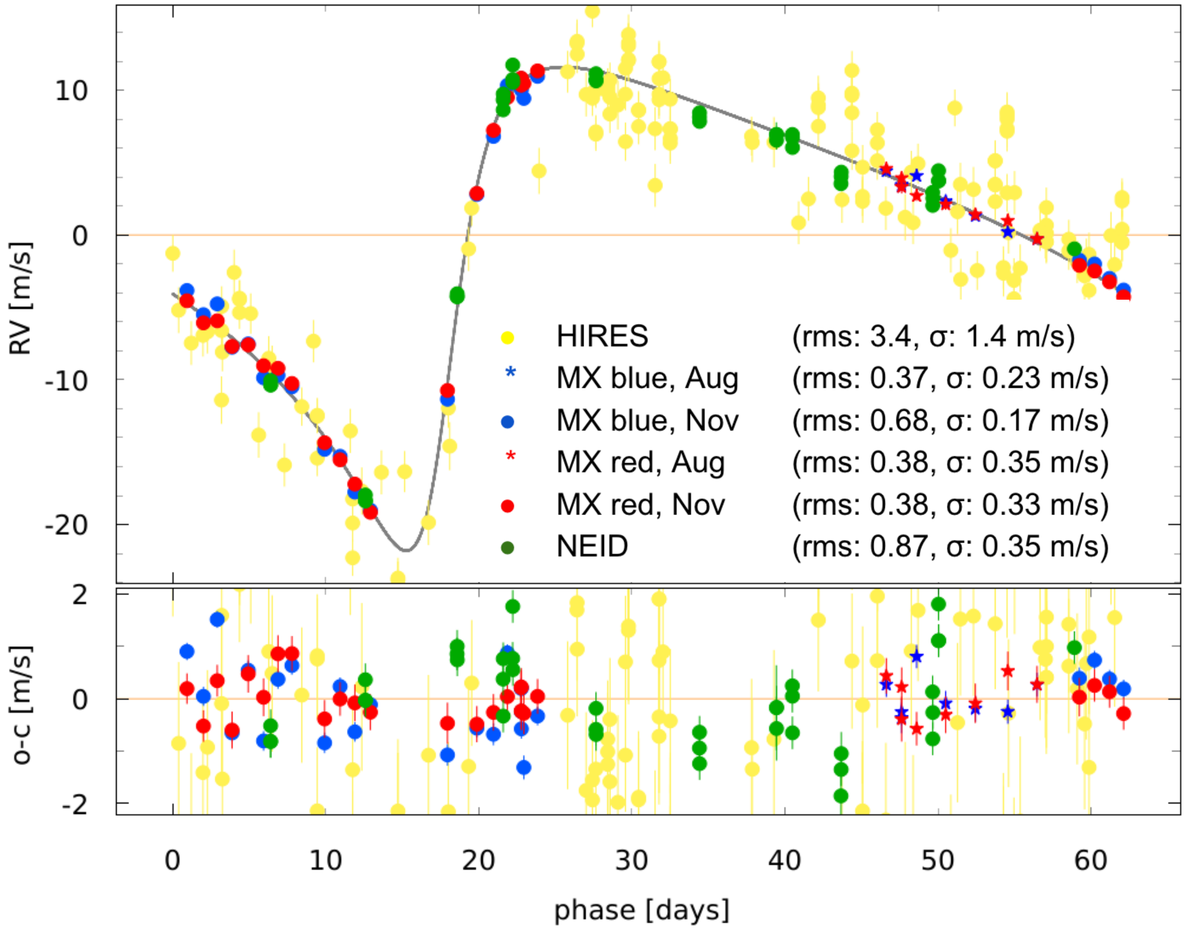
Instrument performance

- But standard stars are not always standard!
- Stellar activity and unknown planets can affect the measurements



Instrument performance

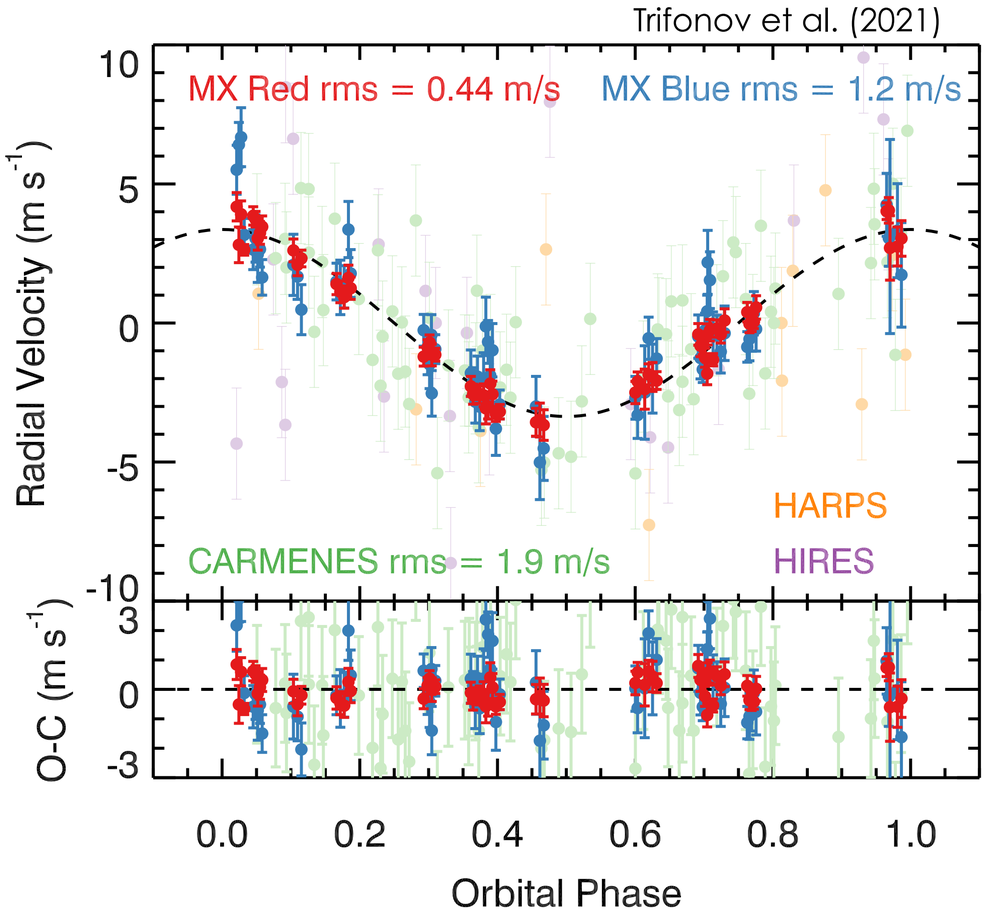
- **HD 3651** is a quiet K1 V star orbited by an eccentric Saturn-mass planet, making the system an **ideal benchmark for RV instruments**



Science results

Radial velocity follow up of transiting planets

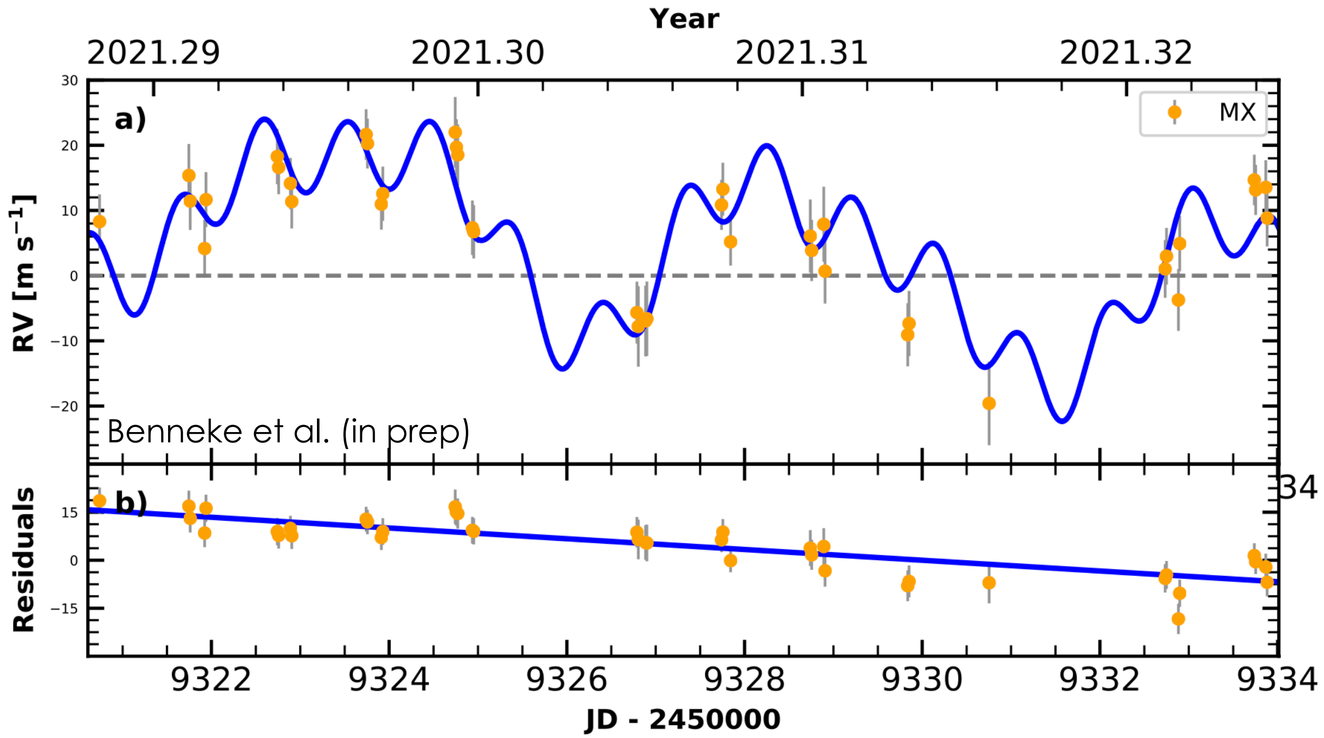
- GJ 486 was observed in May 2020
- K = 3.4 ± 0.1 m/s; M = 2.8 ± 0.12 Me
- 5% mass uncertainty without detrending!
- Residuals bin down to **30 cm/s over 30 min**



Science results

Radial velocity follow up of transiting planets

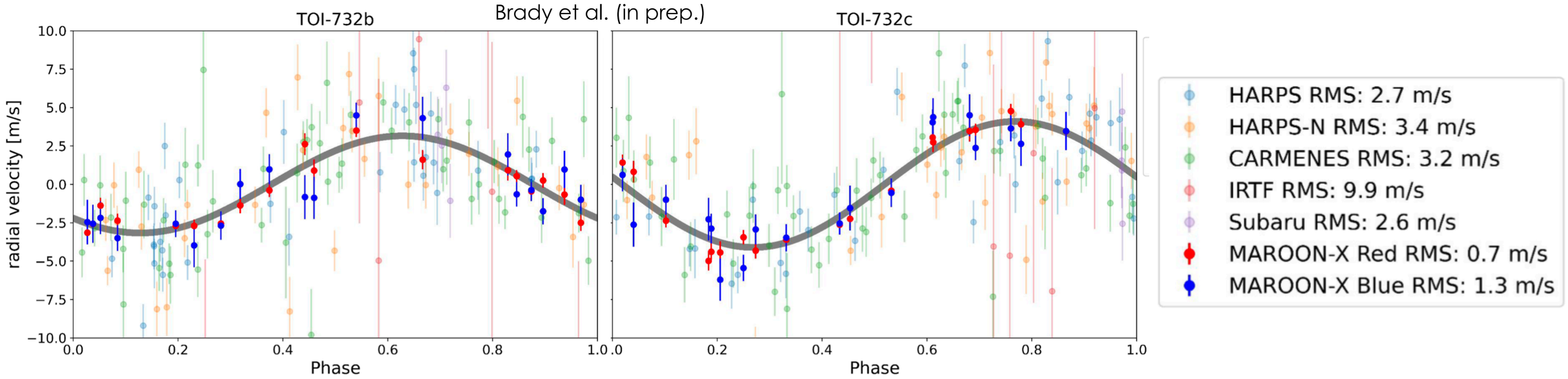
- Three small planets orbiting a M6 V star with V = 16.9 mag, obtain 2.5 m/s internal precision with only 20 min exposure times!



Science results

Radial velocity follow up of transiting planets

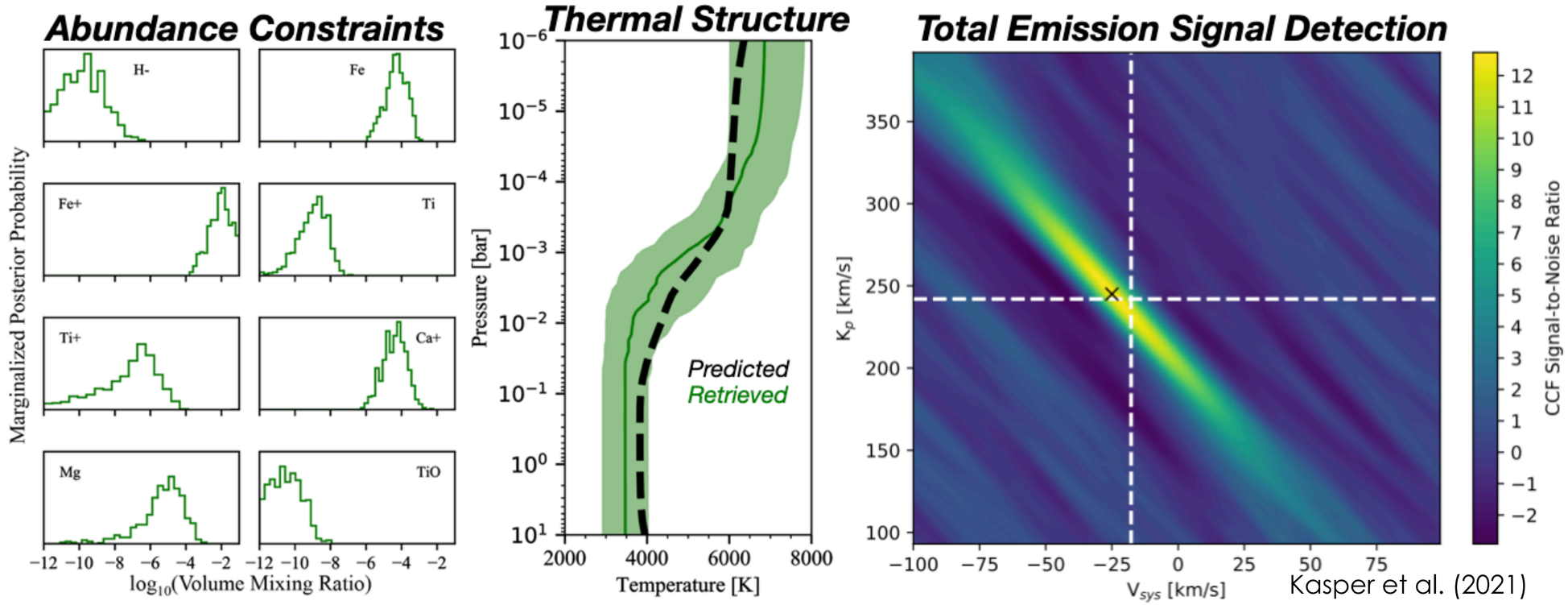
- **Ongoing program to measure 10% masses for all TESS M dwarfs within 30pc**
- Statistical constrains on the mass-radius relationship and mass function for M dwarf planets, enabling JWST characterisation, etc.



Science results

Atmospheric characterisation at high-resolution

- One of the most demanded science topics: atmospheric chemistry, winds and weather, T-P profiles, etc.

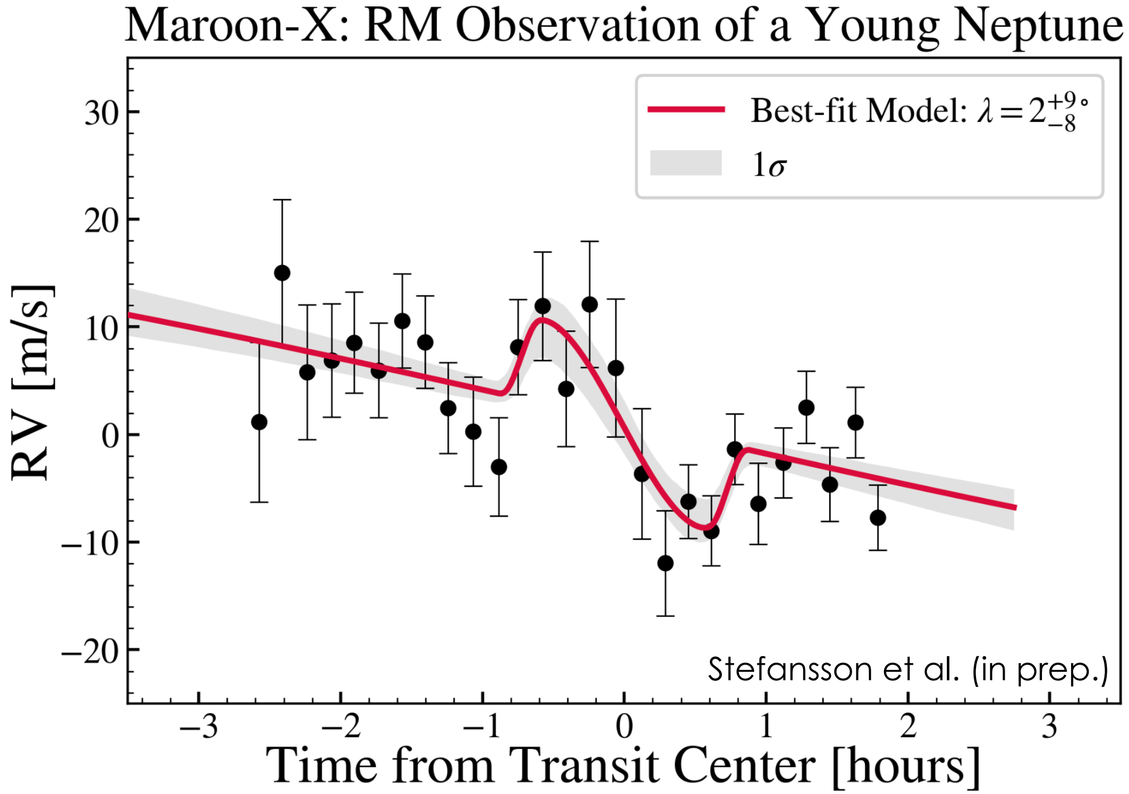


Kasper et al. (2021)

Science results

System architecture and spin-orbit measurements

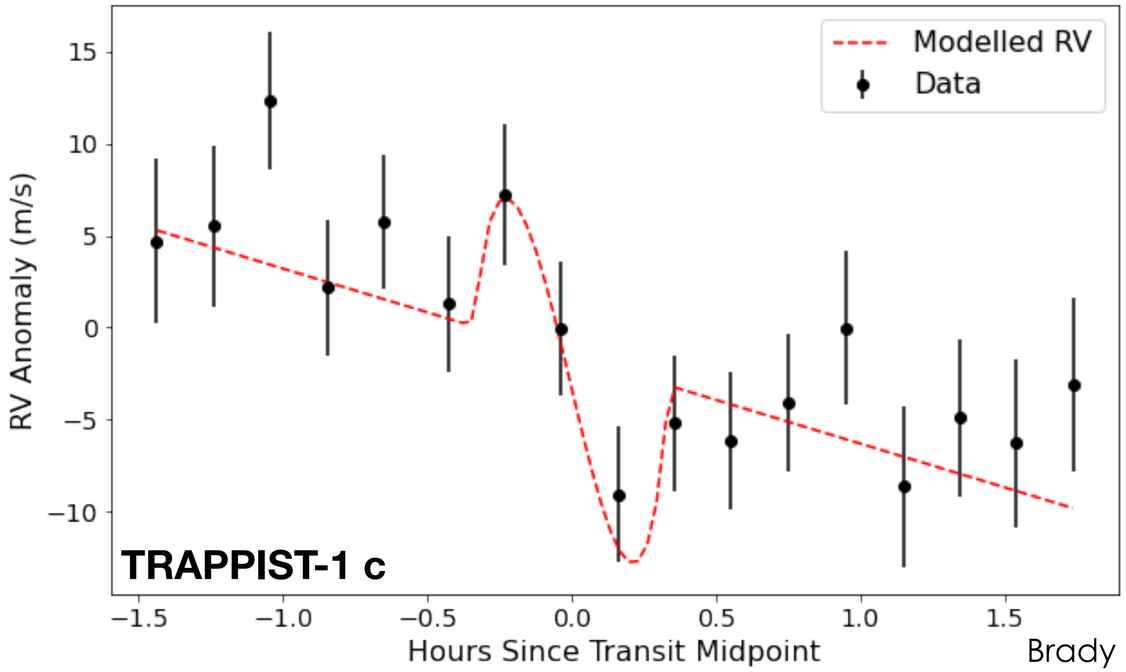
- Rossiter-McLaughlin effect measurements are highly successful

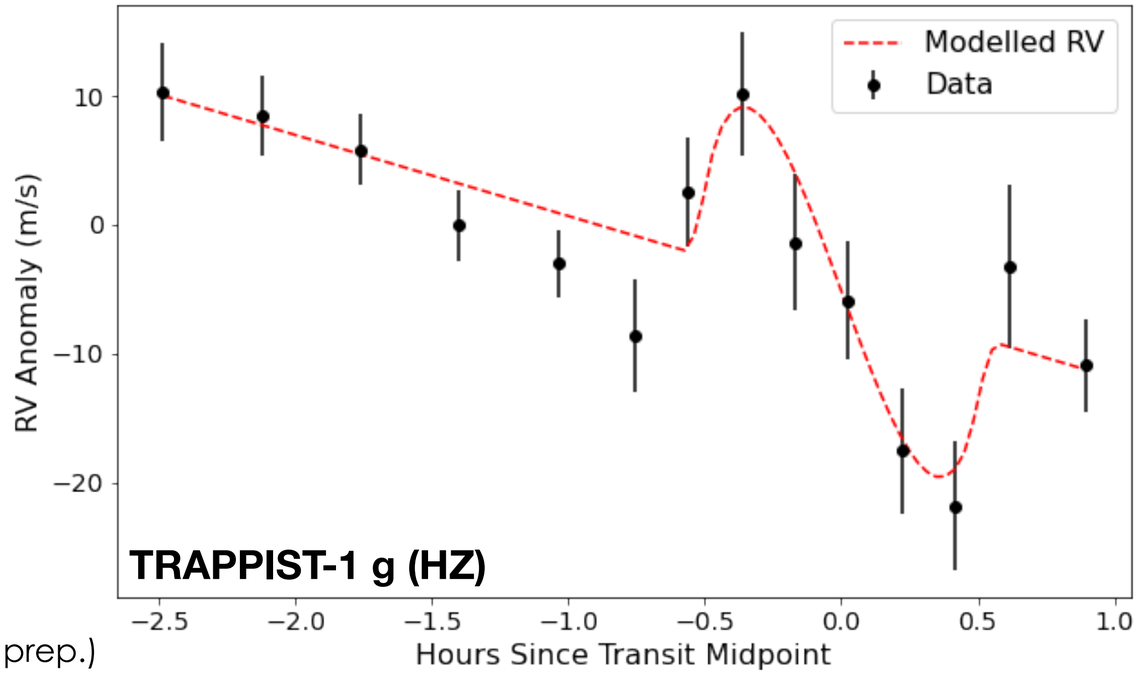


Science results

System architecture and spin-orbit measurements

- And even for the TRAPPIST-1 planets!
- **Very challenging**: V = 18.8 mag, 1h transit duration, no S/N in the blue arm





Brady et al. (in prep.)

Take-away messages

- MAROON-X is a new EPRV facility at the 8-m Gemini-N in Mauna Kea
- The performance is **excellent** and it is optimised for M dwarf hosts
- ***Everybody*** can get time in it! (through the US open skies policy of Gemini)
- The time on the telescope is driven by demand: approx. 600 h/yr
- **Two call for proposals**: September 30 (Feb 1 — Jul 31) and March 31 (Aug 1 - Jan 31)
- We carry out observations, perform data reduction and provide RV measurements using template-matching
- *Upcoming upgrades for 2023: solar telescope and laser frequency comb*