The new exoplanet spectrograph: MAROON-X

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Abstract: MAROON-X is a new high precision radial velocity instrument on the Gemini North telescope. MAROON-X is optimized in terms of its wavelength coverage, efficiency, stability, and pairing with a large telescope for following up TESS's habitable zone planet candidates. Instrument installation is now complete and a data reduction pipeline is now operational for the instrument. I present our current RV performance. MAROON-X will be a facility-class instrument at Gemini. As such, community support for use and reduction, in line with Gemini standards, is being developed.

Specs: A highly-stabilized, fiber-fed spectrograph covering 500 – 900 nm (over 2 optical arms 'blue' and 'red') over 56 orders at R=80k+ with simultaneous calibration feed and pupil slicing[1]. Five fibers total (sky, 3x target, calibration etalon). Average resolution element is 3.5 pixels. On sky acceptance angle is 0.77" on 8 m <u>Gemini North Telescope</u>. The resolving power and current total throughput (on sky) are shown below.

MAROON-X GJ908 RVs (Dec 2019)

Blue arm (rms: 1.1 m/s, $\bar{\sigma}$: 0.4 m/s)
Red arm (rms: 0.8 m/s, $\bar{\sigma}$: 0.4 m/s)
Epoch mean (rms: 0.7 m/s, $\bar{\sigma}$: 0.3 m/s)
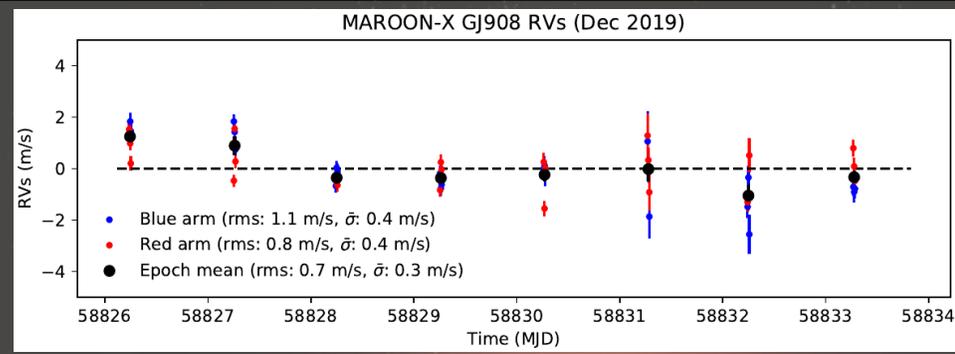
Result 1 : RV measurements against the null hypothesis for the stable M dwarf GJ908 over an eight-day period. These measurements were taken during the first ever observation run. Simultaneous sky etalon calibration was not available during this time and thus RV scatter was higher.

A common element in RV solutions is detrending with stellar activity and/or instrumental systematics, neither of which is utilized here.

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Science fiber 1
Science fiber 2
Science fiber 3

MX Red rms = 0.44 m/s   MX Blue rms = 1.2 m/s

Other Instruments rms = 1.9, 3.3, 6.2 m/s
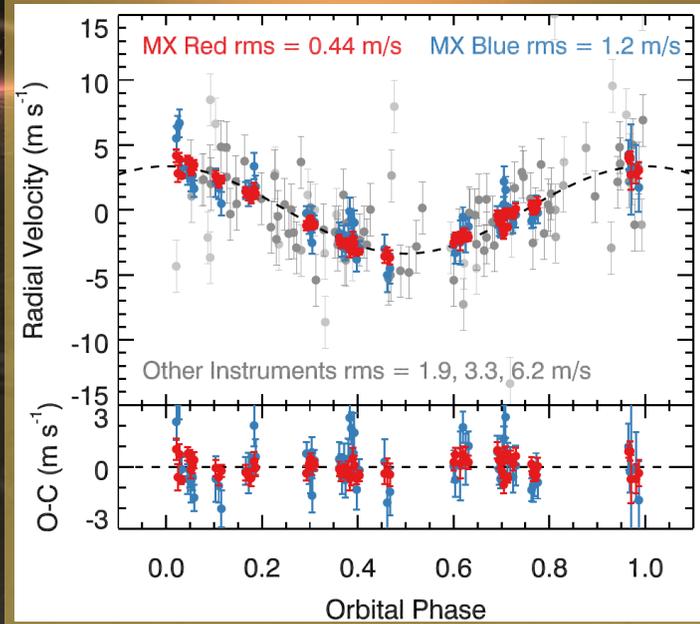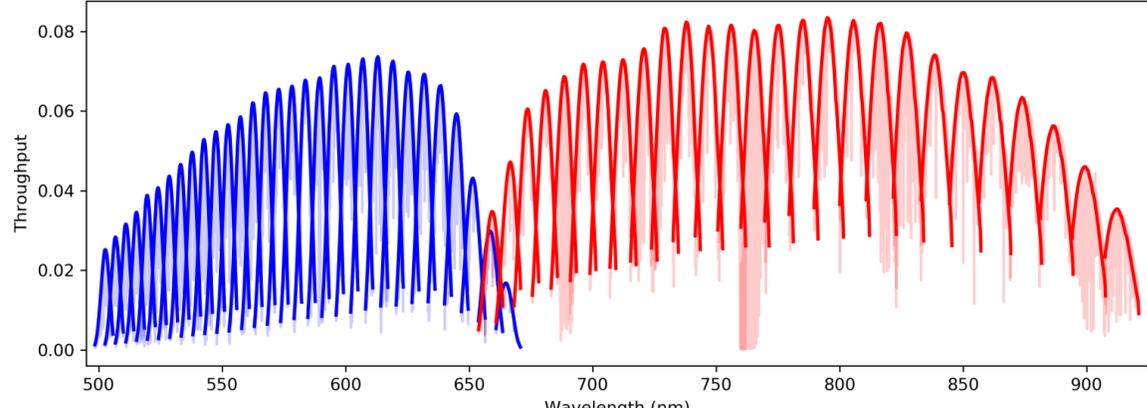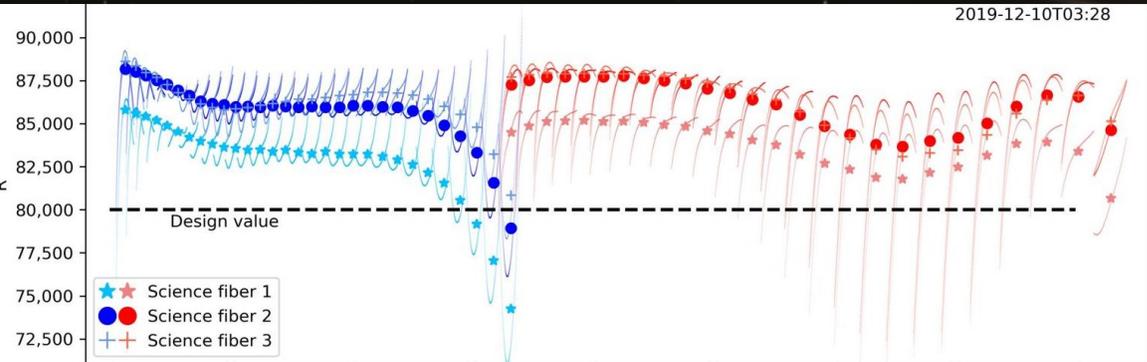
Result 2: Phase-folded RV measurements for an M dwarf hosting a TESS transiting planet. These observations were made remotely during the second ever observing run of the instrument in May 2020.

The target planet has been fit to 2.8 M_e in a combined fit with three other instruments, find in Trifonov et al (submitted).

To our knowledge this represents the most precise determination of an M-dwarf's radial velocity to-date.

Radial Velocity Solutions: We utilize the SERVAL[2] package, a spectral matching algorithm to retrieve RV measurements.

References
[1]Seifahrt A., Sturmer J., Bean J. L., Schwab C., SPIE, 10702 (2018)
[2]Zechmeister, M., Reiners, A., Amado, P. J., et al., A&A, 609, A12, (2018)