The Keck Planet Finder (KPF) was designed with an RV stability of 0.5 m/s on all timescales (goal: 0.3 m/s). This is accomplished through 1) an instrument design that promotes thermomechanical and optical stability and 2) a wavelength calibration system with multiple calibration sources (laser frequency comb = LFC, stabilized etalon, thorium-argon (ThAr) lamp) that can account for instrumental drifts.

During May 1 to August 1 2025, the wavelength calibration subsystems had compromised functionality. The LFC did not operate reliably for most of that period. The KPF etalon lost thermal control for most of that period (stability was not regained until approximately July 5). The RV stability from uncorrected systematic errors during that period is at the sub-m/s level during a single night (and is usually linear in time, making it easy to model out) and is ~10 m/s over timescales of a few months. Importantly, KPF is performing as designed on night-long timescales (e.g., for transit observations), but is not meeting spec for longer RV time series. The RV stability numbers are based on the current algorithms in the KPF data reduction pipeline (DRP) that require LFC and etalon spectra to derive precision wavelength calibrations and instrumental drift corrections. The DRP development team hopes to incorporate additional calibration strategies that will provide wavelength solutions (of somewhat lower precision) without the primary sources (e.g., using the ThAr spectra and measured spectrometer temperatures to independently model instrument drift). The timescale for implementing these strategies in the DRP (which can be applied to past and future data) to recover ~m/s-level performance on the May-August data is of order several months. The outcome is not guaranteed.

KPF has other sources of systematic RV errors. First, the detectors and spectrometer have gone through thermal cycles that distort the point spread function and led to RV offsets before/after the disturbance that are difficult-to-impossible to calibrate out. One such thermal cycle is planned in September 2025 for a KPF “service mission”. The cryostat for the Green CCD has also had operational challenges that have resulted in previous warmups. The KPF team will attempt to solve this issue during the service mission, but success is not guaranteed and possible future RV offsets are possible. Second, increased read noise since November 2024 (from ~4-5 electrons to ~12-15 electrons per CCD pixel) reduces the signal-to-noise ratio of KPF spectra, especially for faint stars and/or lower signal spectra. This directly affects the signal-to-noise limits for faint objects and will impact the exposure time required to reach a desired RV precision for an exposure. The KPF Exposure Time Calculator is in the process of being updated to account for increased read noise. The KPF team is actively working to resolve this issue, with interventions planned in September 2025.

Expectations for 2026A: the wavelength calibration subsystem problems described above are expected to be resolved for 2026A. Resolution of the read noise and cryostat thermal control issues are less certain. At least two conditions are required for KPF to achieve its design performance of 0.5 m/s on all timescales (goal: 0.3 m/s). First, the above known issues must be resolved. Second, the various subsystems of KPF must function reliably so that thermal stability is maintained and regular, high-quality calibrations are produced. The KPF team is working diligently on these issues. For 2026A, the performance of KPF within a single night, e.g. for a

Rossiter-McLaughlin measurement, should be <~ 0.5 m/s. For longer timescales, proposers should plan for a night-to-night precision of 1-2 m/s with the expectation that ongoing modifications to the data processing pipeline (DRP) could eventually recover <1 m/s.