

The iLocator spectrograph: An optimized architecture for future diffraction-limited EPRV instruments

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iLocator is a new, near-infrared, extreme precision radial velocity (EPRV) spectrograph under construction for the dual 8.4m diameter Large Binocular Telescope (LBT). Operating in the diffraction-limited regime, iLocator uses adaptive optics to efficiently inject starlight directly into single-mode fibers that illuminate a high spectral resolution ($R=190,000$ median), cryogenic, diffraction-limited spectrograph. The instrument is optimized to undertake precision radial velocity studies of Earth-like planets orbiting low-mass stars, and with its on-sky diffraction-limited input, is uniquely positioned to undertake spatially resolved studies of exoplanets within binary star systems.

We present the final optical and optomechanical designs of the spectrograph system in addition to the overall program status. The iLocator spectrograph design uses a new strategy for EPRV instruments, combining intrinsically stable materials for its optomechanical fabrication (Invar) with precision optical fabrication (silicon). Ensuring the as-built spectrograph achieves its designed spectral resolution and diffraction-limited performance has required careful control of the end-to-end system wavefront error. We discuss the efforts undertaken as part of the fabrication and integration process to achieve this goal, enabling diffraction-limited performance and high-resolution across the full instrument bandpass. Combined with a precision (sub-mK) thermal control, and an high-optimized H4RG-10 detector, iLocator's design minimizes instrument systematics and serves as an optimized architecture for future diffraction-limited EPRV spectrographs.