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Electro-optic laser frequency comb for spectrograph calibration

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Laser frequency combs (LFCs) comprising thousands of evenly spaced laser lines with absolutely and precisely known optical frequencies can meet the calibration requirements for extreme precision in radial velocity measurements.

We present a LFC for accurate and precise spectrograph calibration in the near-infrared. The LFC is based on electro-optic modulation of a continuous-wave laser and provides comb lines readily resolvable by an astronomical spectrograph without the need for spectral filtering. After temporal compression and spectral broadening, the system currently provides more than 5'000 comb lines spaced by 14.5 GHz covering the wavelength range from 1280 nm to 1880 nm. The spectral coverage and the LFC's line spacing can be modified to accommodate the specific needs of the spectrograph. Owing to its all-fibre design, the system is alignment-free and of low operational complexity. As all critical components rely on mature optical telecommunication technology, the system is inherently robust and suitable for long-term and low-maintenance operation. Successful performance test of the LFC was performed on the GIANO-B spectrograph demonstrating a photon-noise-limited spectrograph calibration precision of <10 cm/s and an on-sky performance only limited by telluric interference. Current efforts are concentrated on extending the spectral span, which will lead to increased radial velocity calibration precision.

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