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Stellar radial velocities using a laser frequency comb: Application and observations in the near infrared

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The laser frequency comb presents the potential for a revolutionary increase in radial velocity precision by providing a calibration reference of unprecedented quality in terms of wavelength knowledge, repeatability, number, density, and regularity of lines. However, implementation has proven challenging, particularly in the near infrared. Nevertheless, with the right combination of comb and instrument, promising first steps have been taken, allowing for the derivation of stellar radial velocities in a wavelength range which is well suited to the observation of M dwarfs. These stars, with low mass and low luminosity, are the most prevalent class of stars within 10 parsecs and can be expected to yield a higher reflex velocity for a terrestrial mass planet in the liquid water habitable zone than would be the case with a more massive star such as our own. We present the design and both laboratory and on-sky performance of an H-band laser frequency comb used in conjunction with the Penn State Pathfinder testbed spectrograph and discuss lessons learned and plans for follow on testing with both the Pathfinder and the CSHELL instruments.