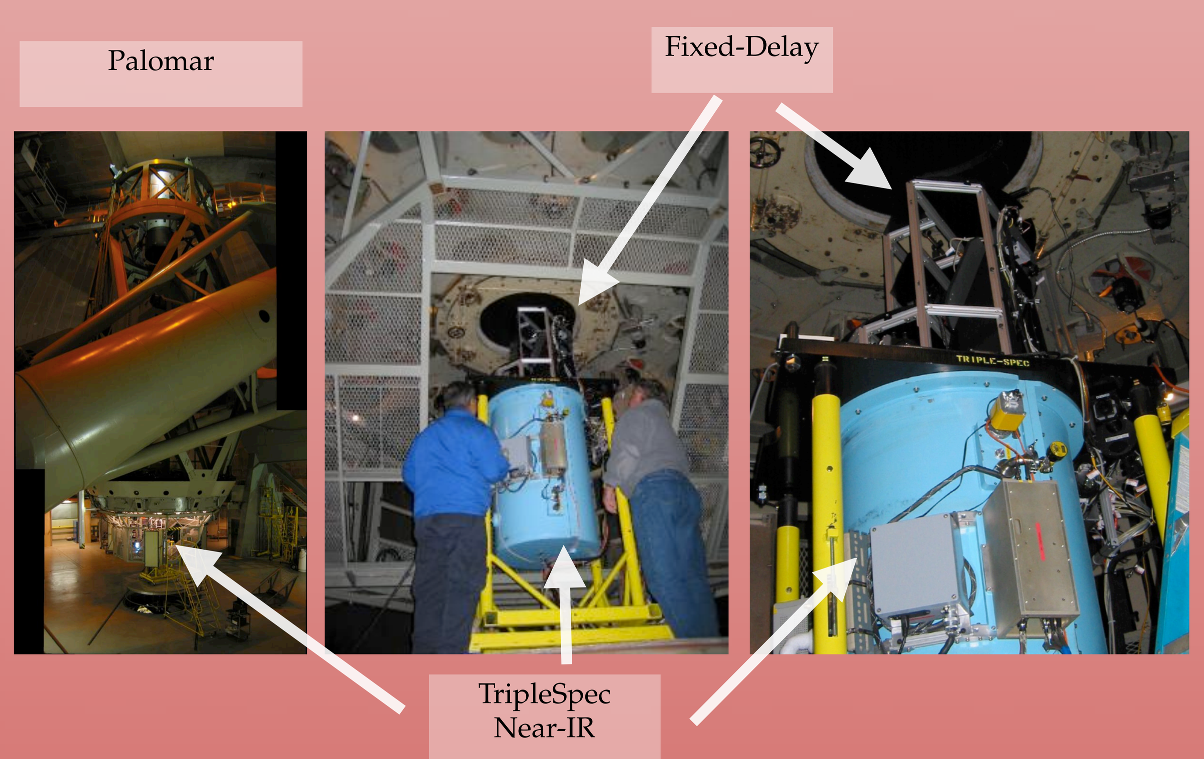
TEDI: A New Instrument for Planet Hunting at Palomar

Jason T Wright, James P Lloyd, Philip Muirhead (Cornell University)
David Erskine (LLNL), Jerry Edelstein, Matthew W Muterspaugh (SSL, UC Berkeley)

We are commissioning TEDI (the **T**ripleSpec **E**xoplanet **D**iscovery **I**nstrument), a new radial velocity instrument at Palomar designed to detect planets orbiting low-mass stars in the near infrared (simultaneous JHK). By passing starlight first through an interferometer, an unresolved comb is superimposed on the stellar spectrum. Analysis of the resulting moiré patterns allows for high velocity precision despite the moderate spectral resolution (R ~ 2700) of the TripleSpec spectrograph.

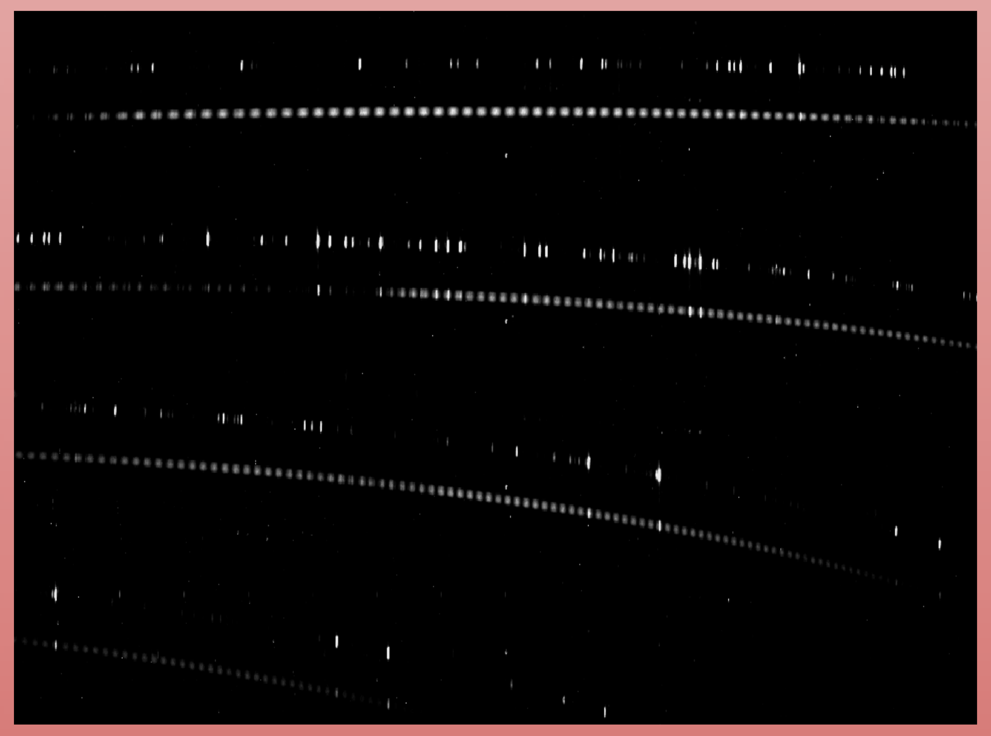
Method



A fixed-delay interferometer superimposes a fine, usually unresolved pattern of fringes on starlight before passing it on to the TripleSpec spectrometer.

The resulting moiré pattern reveals spectral information beyond the nominal resolving power of the spectrometer. This method is analogous to heterodying in radio astronomy: we access high optical frequencies by down-mixing against a the interferometric fringes (our "local oscillator").

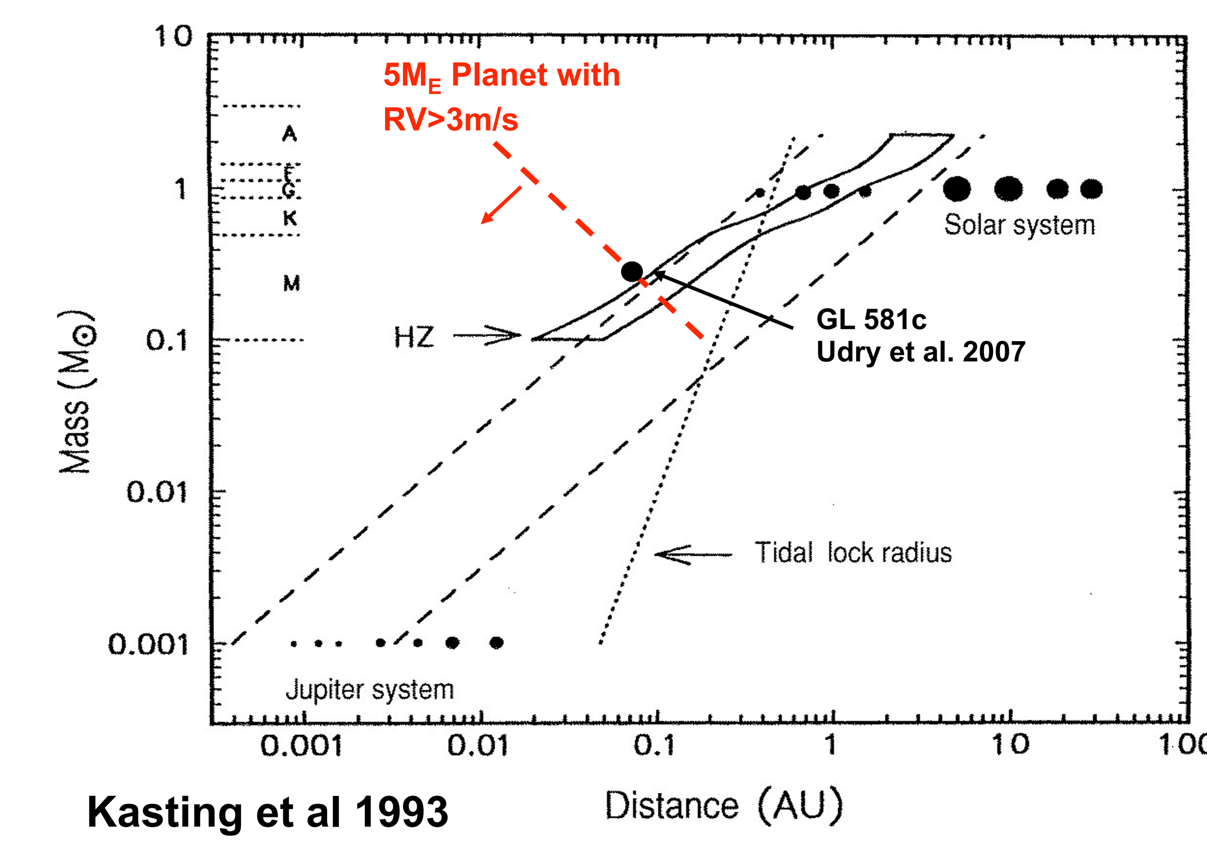
Progress



Above: Example of an early, raw stellar spectrum showing fringes.

We achieved first light and fringes on Dec. 29, 2007. Our preliminary data analysis pipeline (using only 1 of 5 spectral orders) produces intra-night stability of ~60 m/s after correcting for instrument drifts, and 12 m/s on our reference lamp. We have modified our observing technique for our May '08 observing run, and anticipate at least a factor of 2 improvement in the short term.

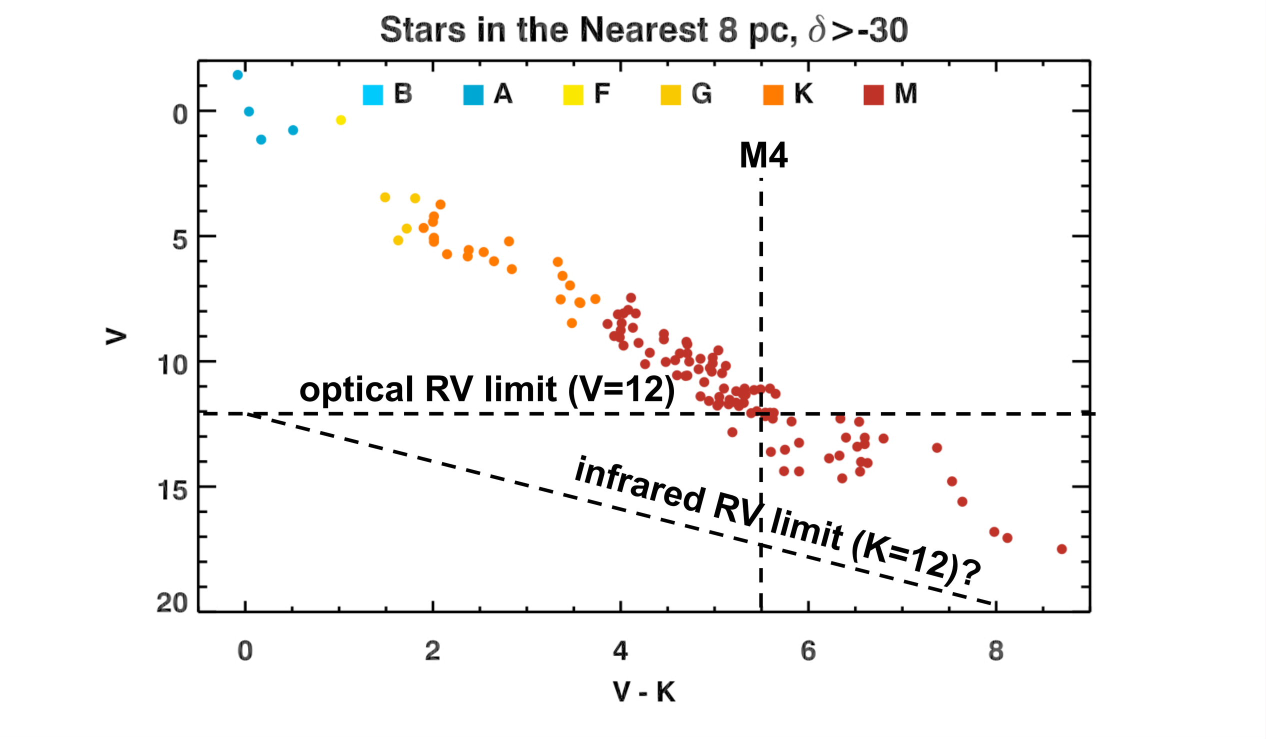
Science



Because it works in the infrared, TEDI is ideally suited for precision RV work on M4 and later targets, including brown dwarfs, where all optical instruments struggle for photons.

M dwarfs are good targets because the RV amplitude of rocky planets in the Habitable Zone is of order a few m/s, compared to 10 cm/s for a G2 star (since the stars are lighter and the HZs are closer). Such planets are also more likely to transit.

Targets



Our current, commissioning target list consists of known exoplanet-bearing stars, RV-stable M dwarfs, and a few very late M dwarfs to establish performance and determine optimum observing procedures.

Ultimately, TEDI will perform an original survey of the local late M dwarf and BD population (300 H < 12 candidates) and will be an ideal follow-up instrument for transit surveys with late-type targets.