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The Exoplanet Tracker: Data Reduction and Latest Results

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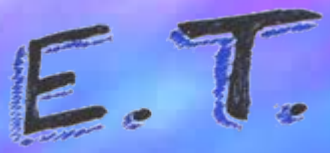

A new type of RV instrument

- Michelson interferometer + R~5000 spectrograph (at ~500-550 μm).
- Erskine & Ge, 2000, etc.
- Relatively high throughput (~18%).
- No wavelength calibration required.
- Multi-object potential.
- Has confirmed several known planets, including 51 Peg (van Eyken et al. 2004).
- Has reached ~3m/s RMS.

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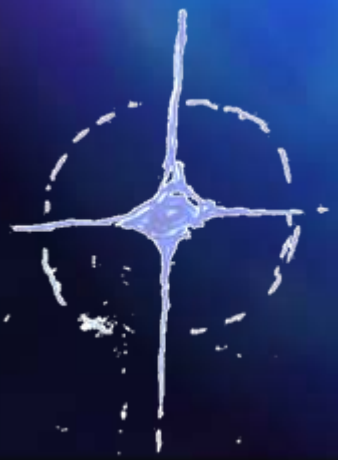
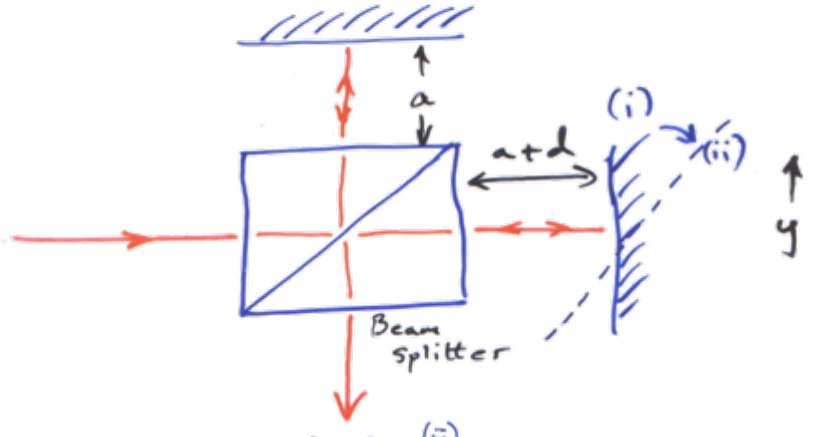
Principles



How does it work?

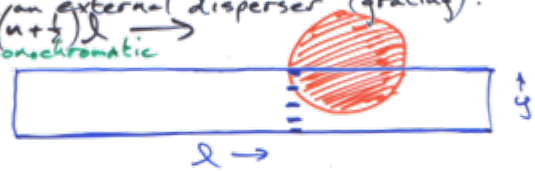


(i) Collimated, monochromatic:

$d = n\lambda$ — DETECTOR

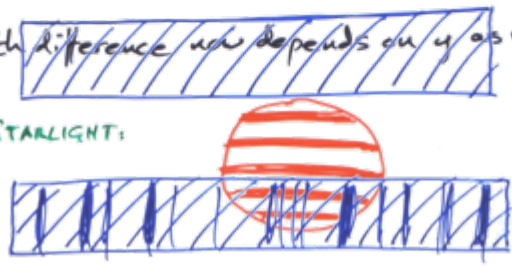
(iii) Add an external disperser (grating):

$d = (n+\frac{1}{2})\lambda$ → Monochromatic



(ii) Tilt white light:

Path difference now depends on y as well as d:



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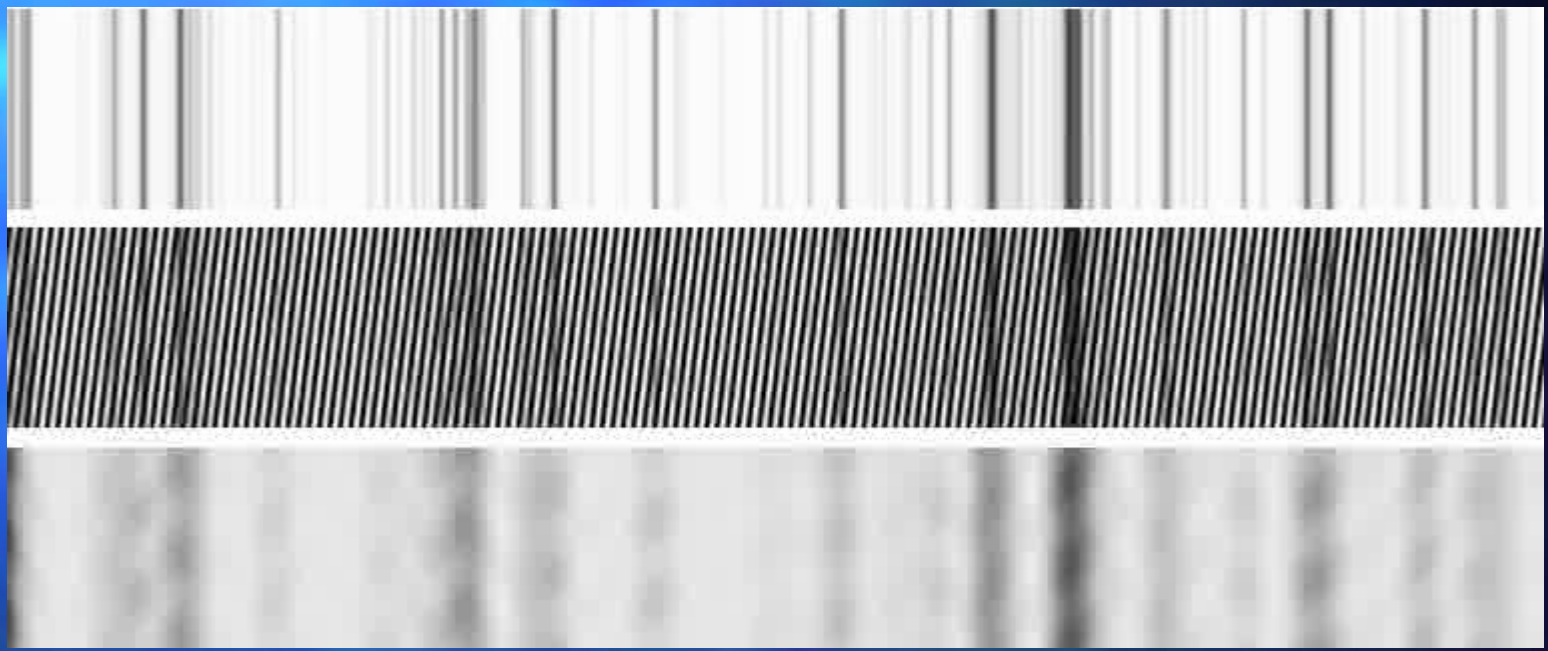
A simulation…

Stellar spectrum

X comb

ET spectrum



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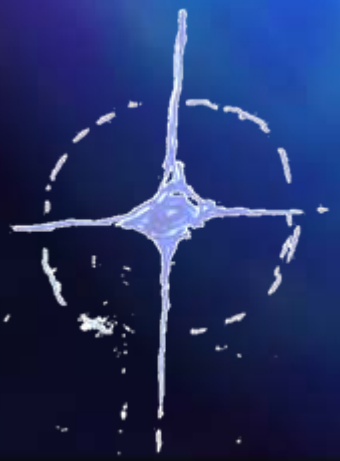
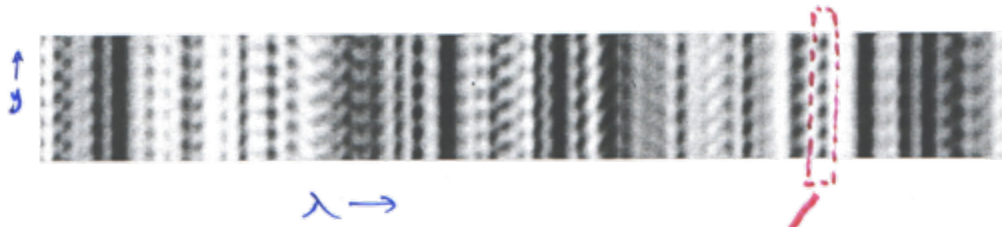
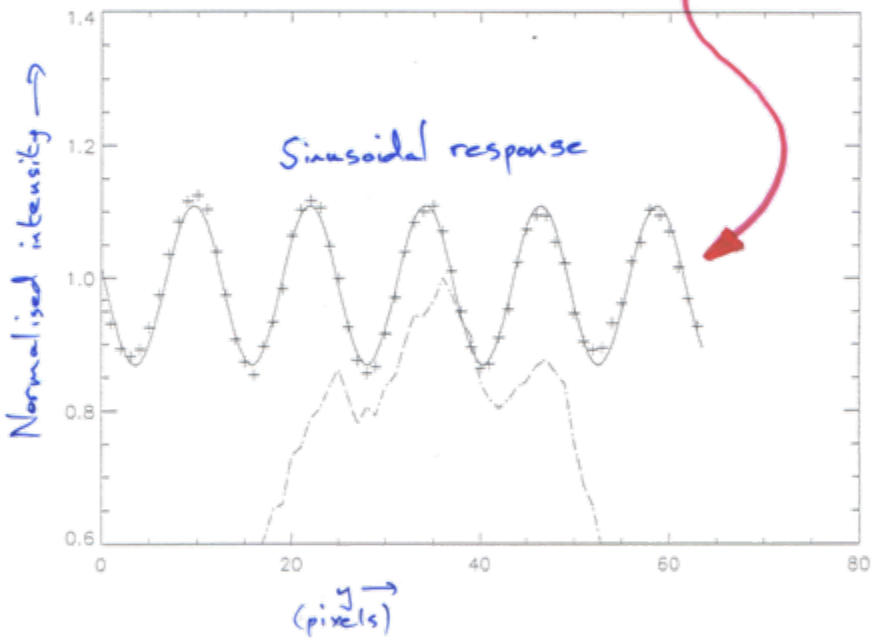
Principles



Measuring the fringes





Fit a sin wave ⟶ measure phase

$$\Delta v \propto \Delta \lambda \propto \Delta \phi$$

∴ Can measure velocity shifts

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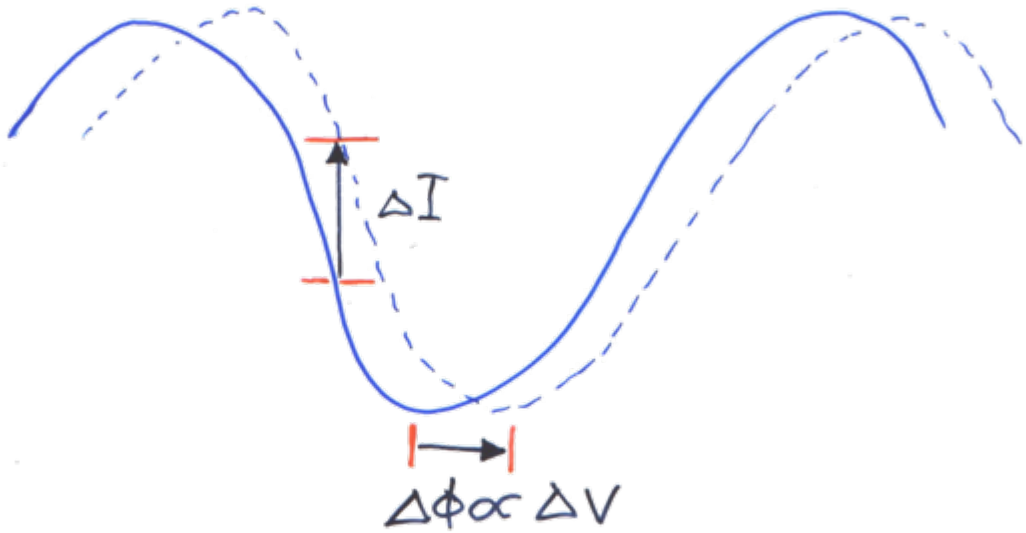
Principles

The Photon Limit



- Can relate: $\Delta V \leftrightarrow \Delta I$

→ ΔV for each pixel

→ Overall ΔV for each spectrum.

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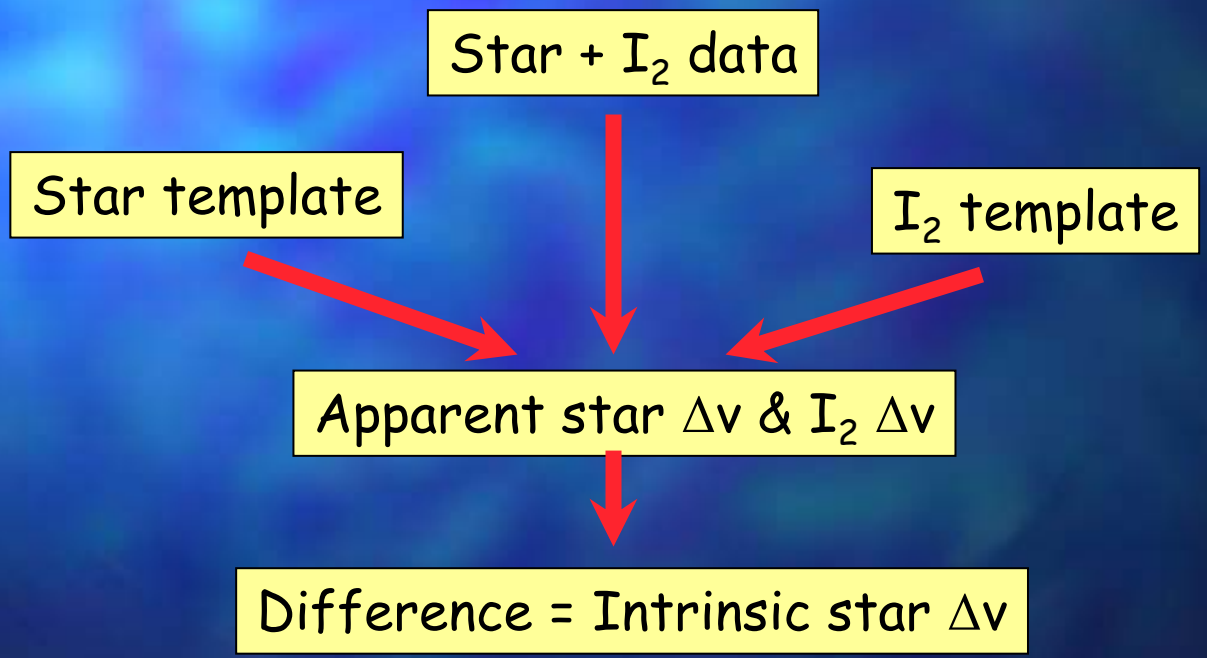
In practice…

- Need iodine vapour fiducial to calibrate out instrument drift.



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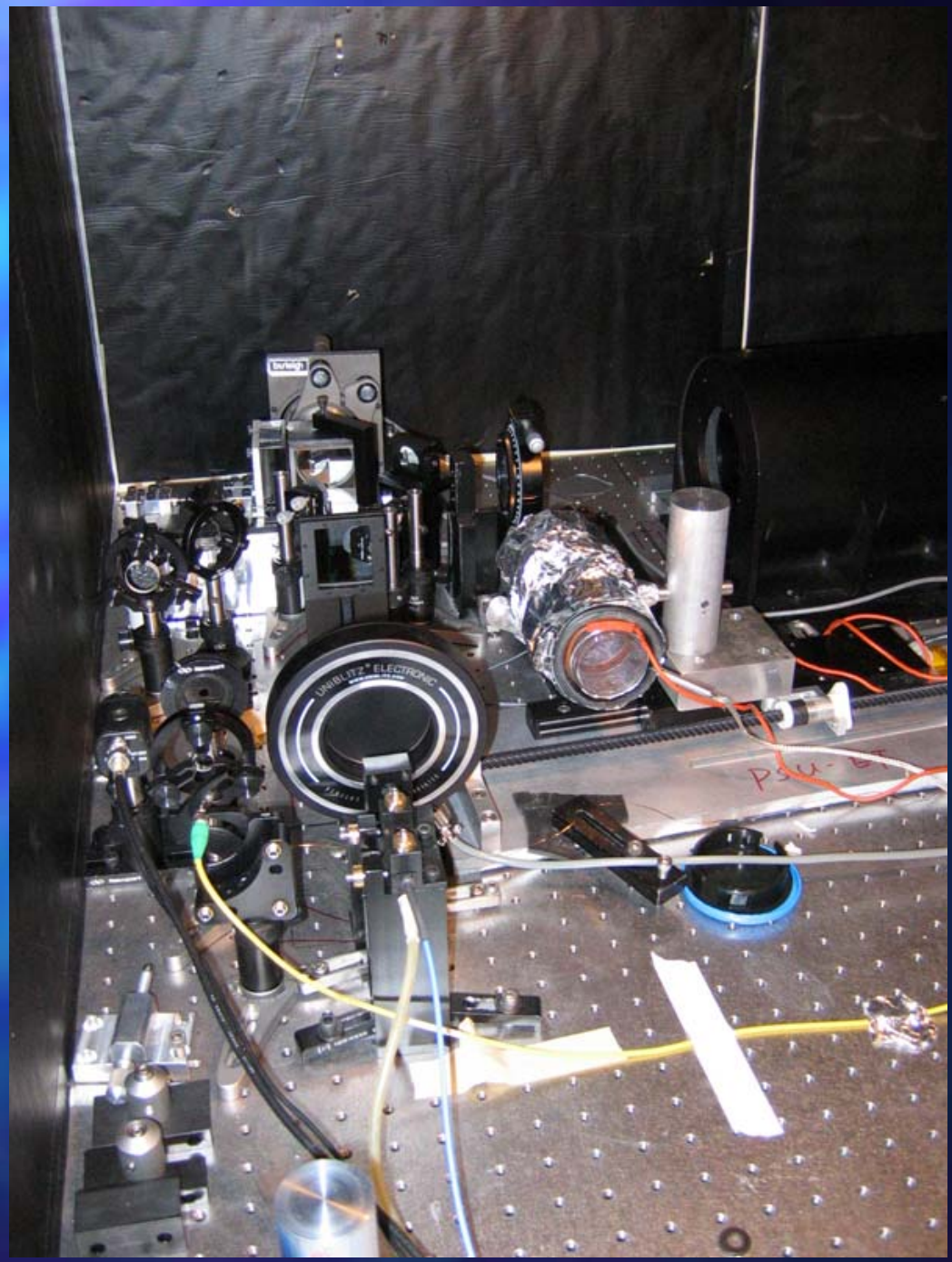
The instrument

Front end – fibre input, interferometer, iodine cell



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The instrument

Interferometer w/ beam splitter

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Planet survey: ET's homes

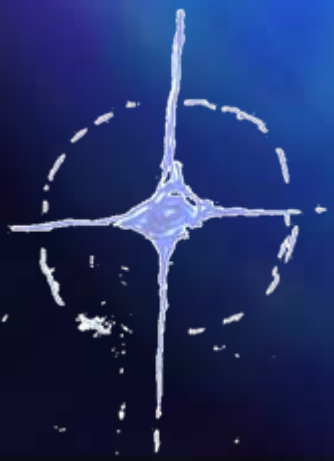
- F-K type stars
- High metallicity
- Slow rotators
- Low activity

KPNO Coudé 0.9m

- V~8-9 mag
- 20-30 min exposures
- Precision ~20 ms^{-1}
- Single object

KPNO 2.1m

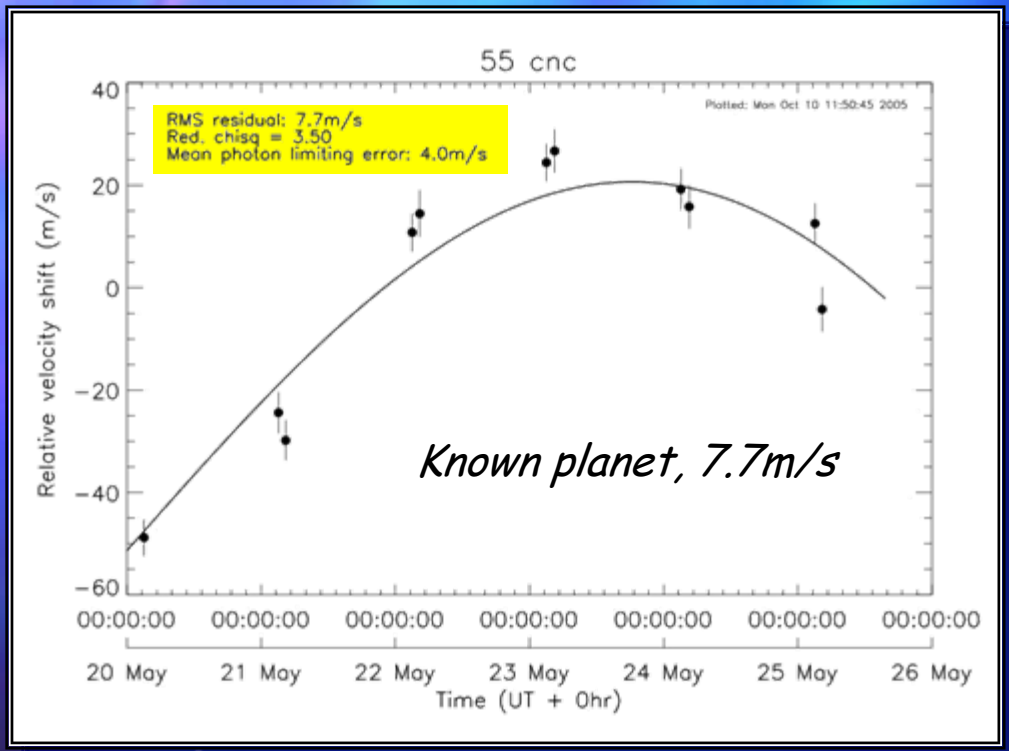
- V = 8-9 mag
- ~10 min exposures
- Precision ~17.5 ms^{-1} (best ~7 ms^{-1})
- Single object

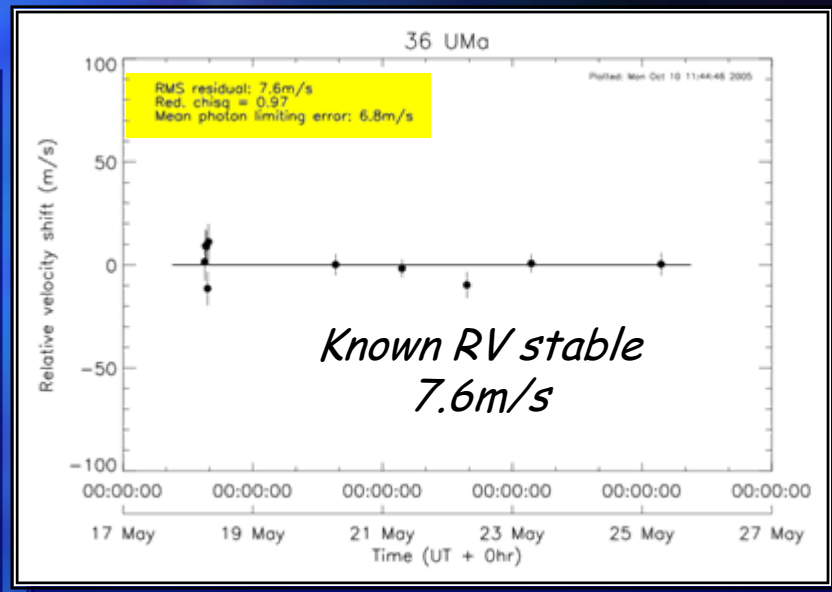


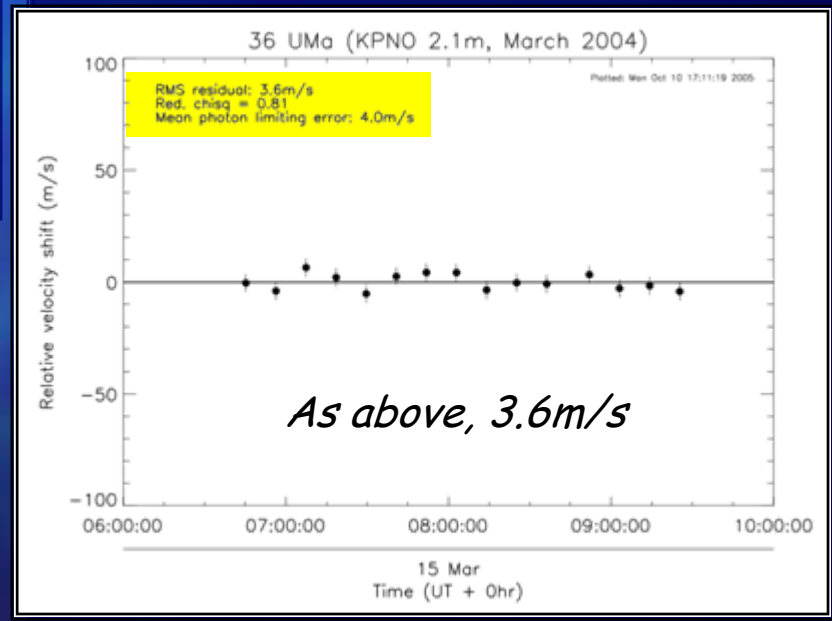
SLOAN:

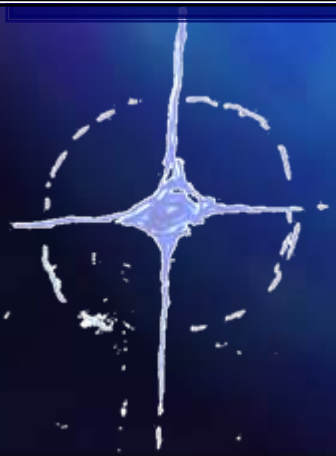
- V = 8-11 mag.
- ~30-45 min exposures
- Precision ~30-80 ms^{-1} (best 10 ms^{-1})
- First light multi-object

Results – reference stars





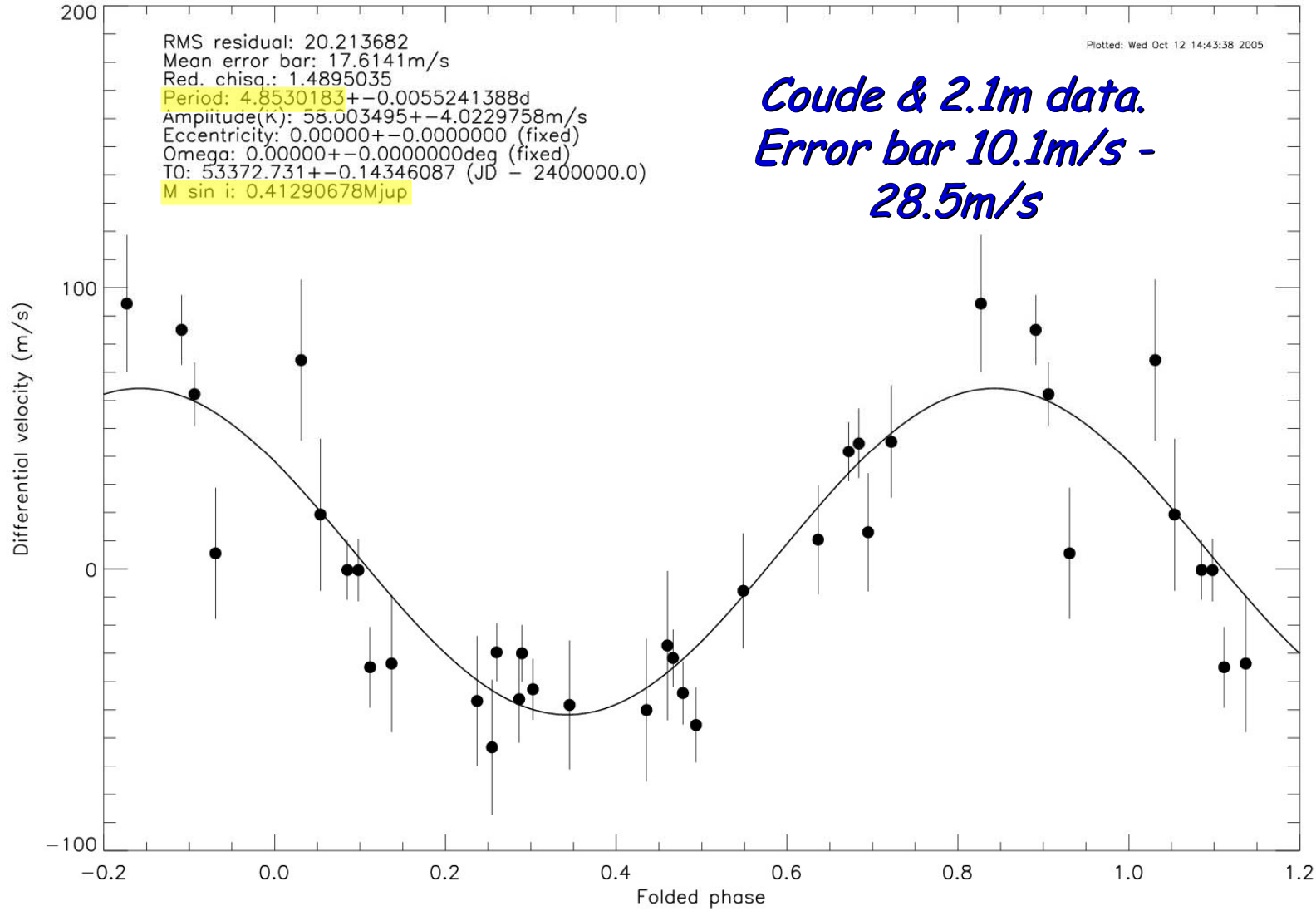




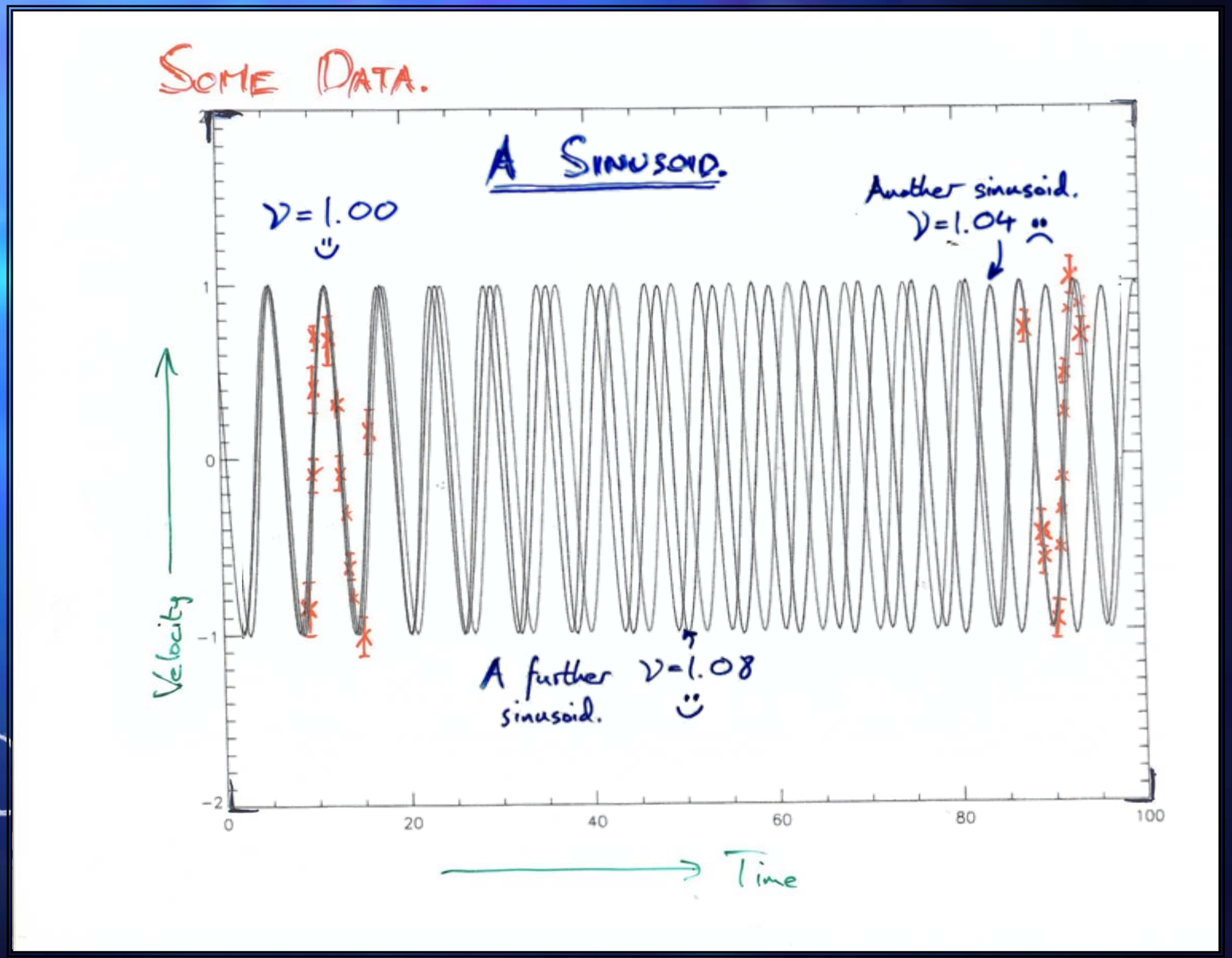
- All error bars are photon limit errors.

Results – a new planet?

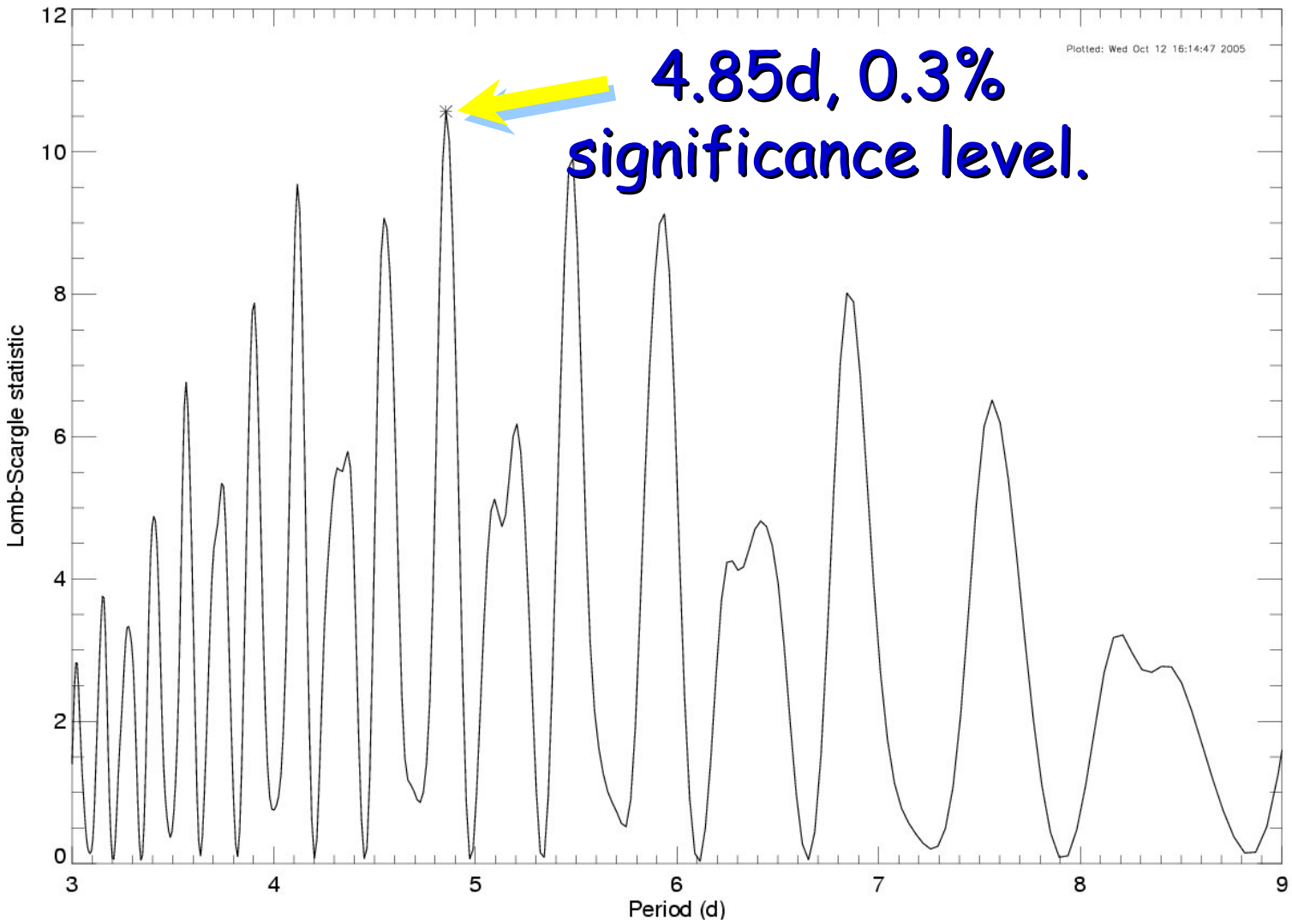
(a very preliminary fit…)



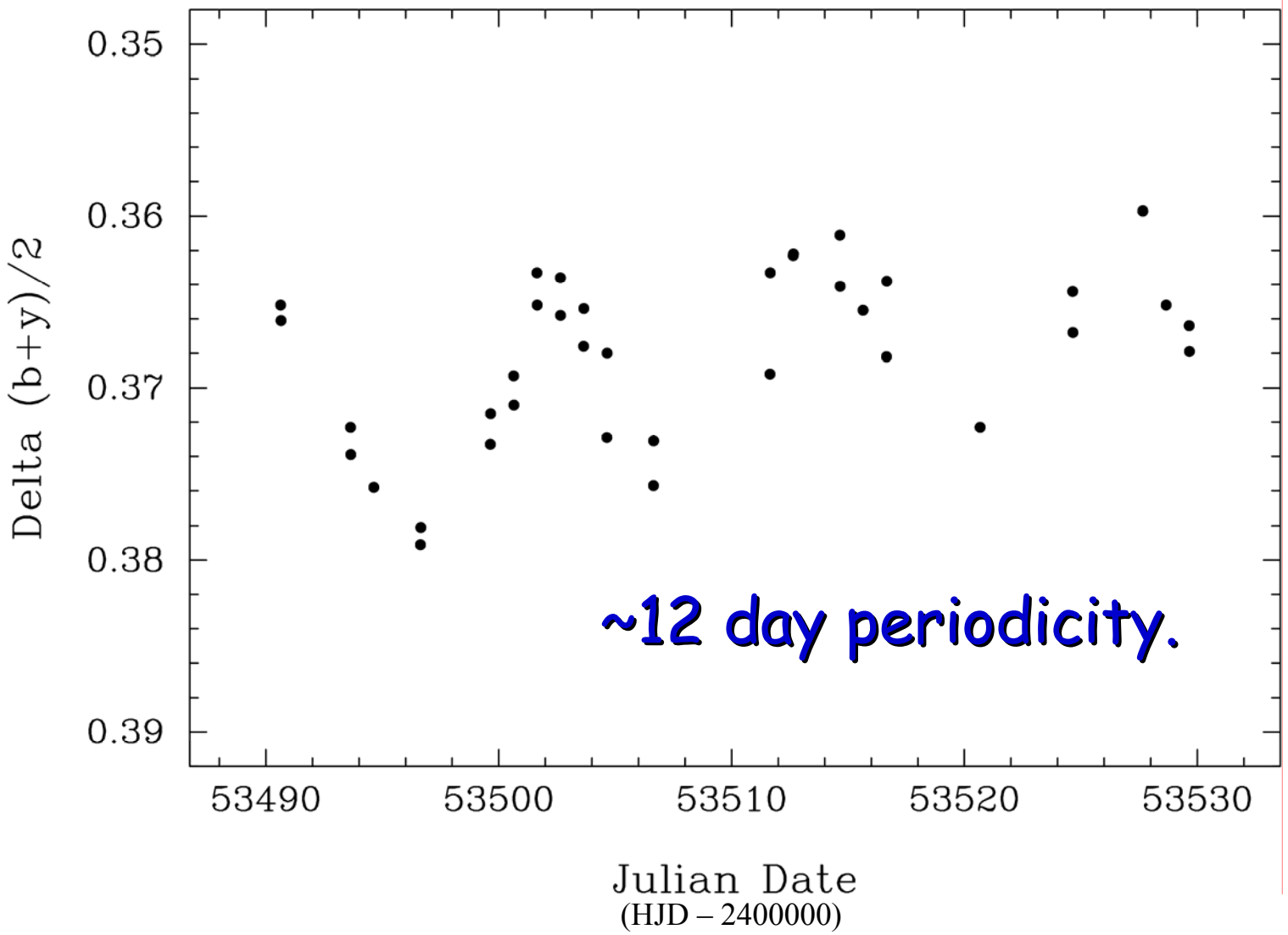
Period fit degeneracy



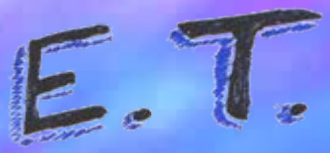
Periodogram analysis



Photometry

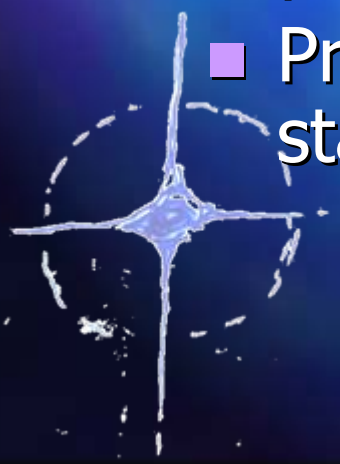


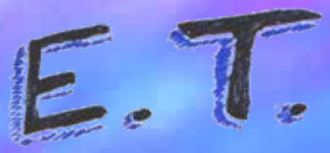
Courtesy Greg Henry, Tennessee State U. (APT, Fairborne Obs.)



What's next…

- More data on candidate – real planet or not?
- Follow up further possible candidates at 2.1m/coude.
- Continue progress on multi-object ET.
- Cross dispersed ET at 2.1m → v. High precision (1m/s @ v=8 in 40min)
- Prototype 'blue ET': look at late A – early F stars.





References

- Erskine, D. J., & Ge, J., 2000, ASPC, 195 501E
- Ge, J., Erskine, D. J., & Rushford, M., 2002, PASP, 114 1016
- Ge, J., 2002, ApJ, 571, L165
- Van Eyken, J. C., Ge., J., Mahadevan, S., & DeWitt, C., 2004, ApJ, 600, L79

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