Detection of a Model Extrasolar Planet Candidate with the VLTI/AMBER

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Outline

1. Scientific Rationale
   - Motivation
   - The Young Fictitious RadVel Planet SciFi 4 b
2. Observational Feasibility
   - Observability
   - Visibility Function
3. Data Reduction and Analysis
   - Data Reduction
   - Data Analysis
4. Conclusions

Outline

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FIGURE: by Greg Martin

The Search for Exoplanets

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Why Young Low-Mass Stars?

- luminosity ratio between star and planet is lower in young systems
- planet radiates a significant amount of grav. energy in IR

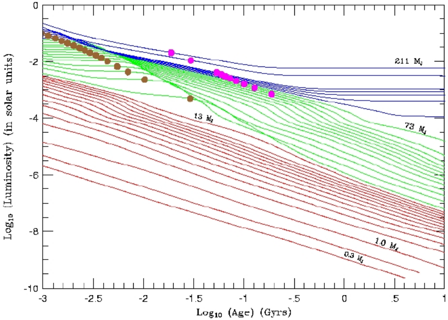

FIGURE: Age vs. luminosity for low mass stars and substellar objects (Burrows et al. 2001)

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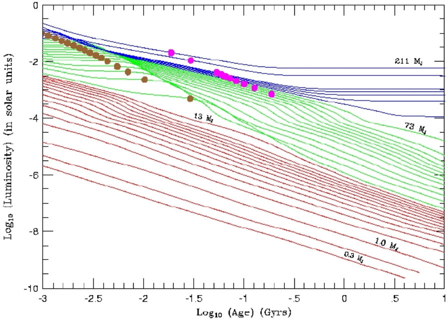

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Why a Fictitious Object?

What we need

A very young, very nearby star with a known high mass radial velocity planet in a moderate distance (far enough, within FoV).

What we got

NOTHING!!!

No such system out there

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- $\alpha = 15^h 48^m 09.5^s, \ \delta = +01°34'18.3''$
  Science Fiction star forming region
  (based on HD 141272, member of the Her-Lyr Association)
- $K = 6.24$ mag $\rightarrow$ SpT of M2
  $M = 0.3 M_\odot$
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- $m \cdot \sin i = 8\,M_J$
- orbital elements:
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  $P = (185 \pm 1)$ days
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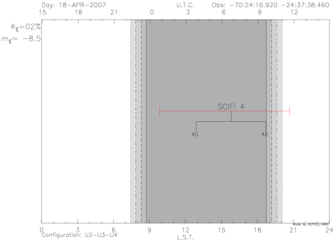
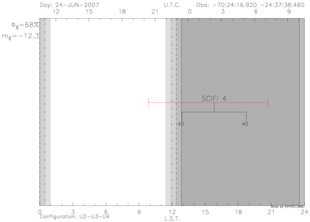


(a) begin



(b) end

FIGURE: Observability of SciFi 4

ORBITAL SOLUTION

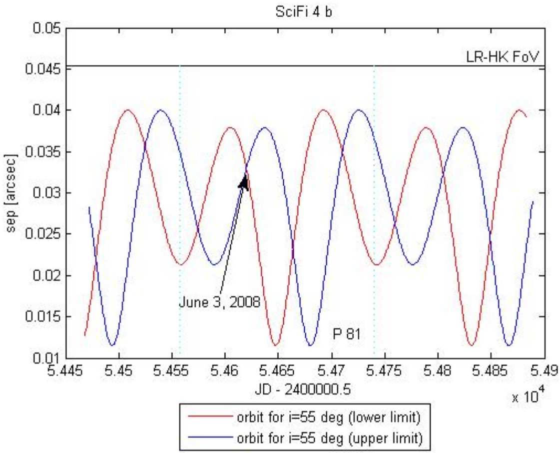
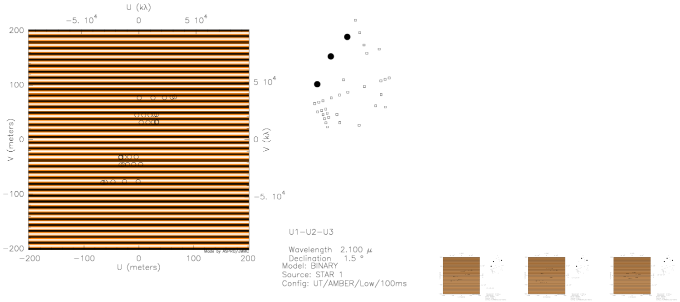


FIGURE: Projected orbit of SciFi 4 b

Baselines and (u, v) – *coverage*



(a) U1-U2-U3 (b) U1-U2-U4 (c) U1-U3-U4 (d) U2-U3-U4

Figure: (u, v)-coverage with UT baselines

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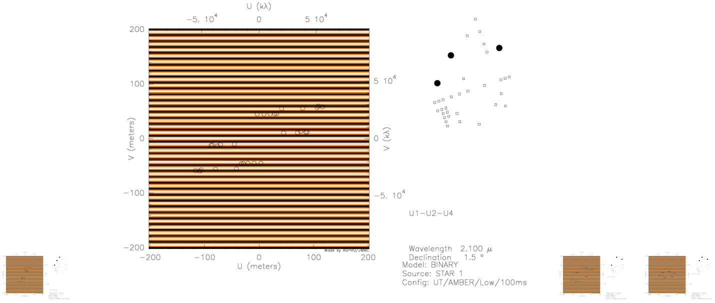

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FIGURE: (u, v)-coverage with UT baselines

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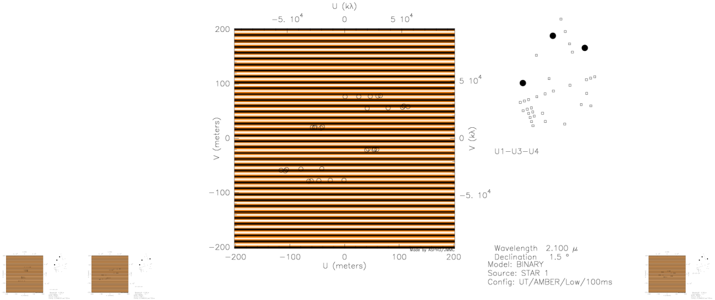

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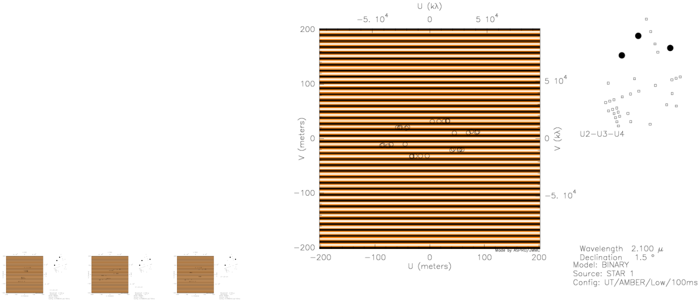

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FLUX RATIO $L_*/L_P = 10^2$

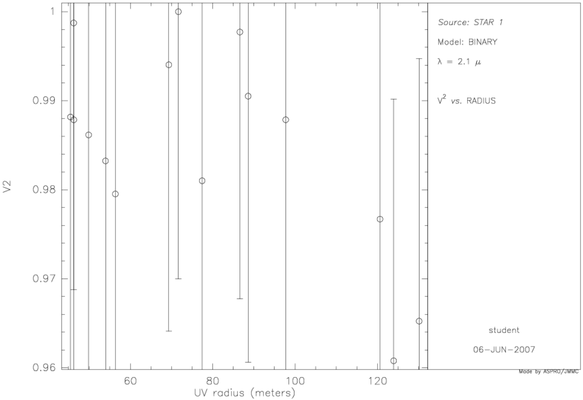

FIGURE: Visibility of an $\sim 14\,M_J$ companion with U1-U2-U4 baseline

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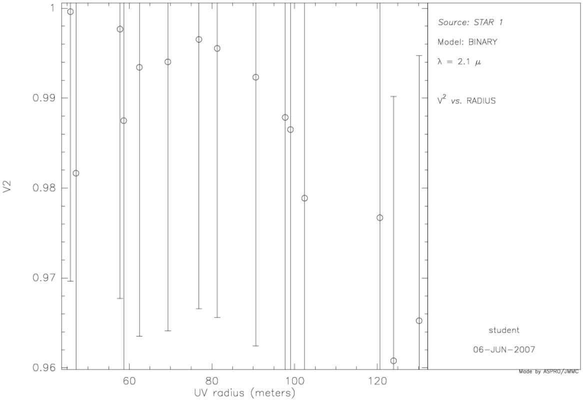

FIGURE: Visibility of an $\sim 14\,M_J$ companion with U1-U3-U4 baseline

FLUX RATIO $L_*/L_P = 10^1$

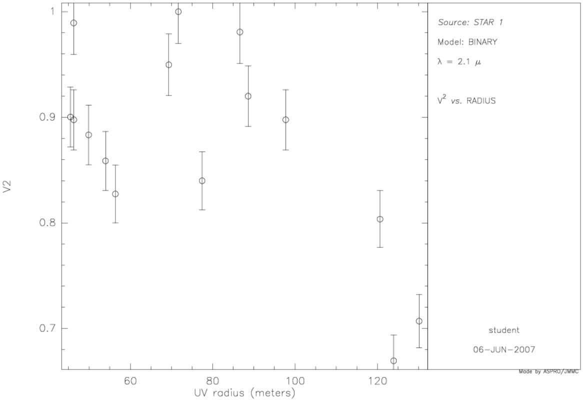

FIGURE: Visibility of an $\sim 50\,M_J$ companion with U1-U2-U4 baseline

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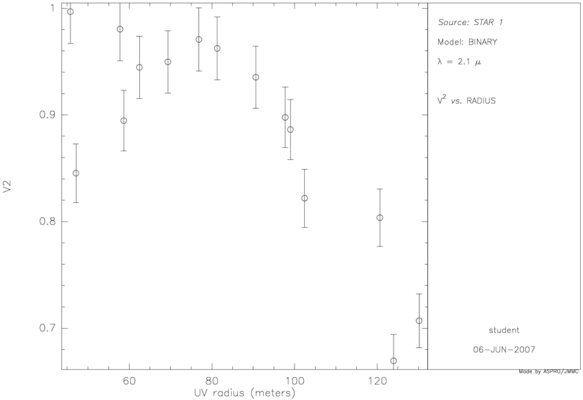

FIGURE: Visibility of an $\sim 50\,M_J$ companion with U1-U3-U4 baseline

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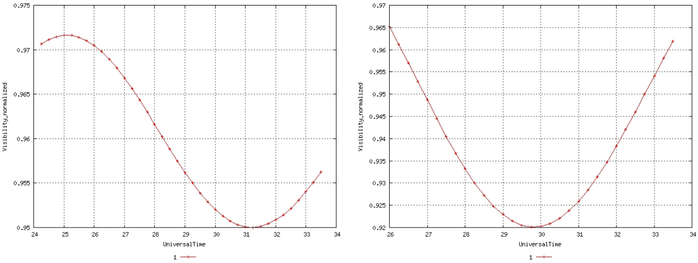
GASGANO AND REFLEX

REFLEX
The ESO Recipe Flexible Execution Workbench

We will use public ESO software, as well as the AMBER data reduction pipline from ESO



(a) U1-U2 (b) U1-U4

FIGURE: Calibrator (HD 141144) visibility vs. time for different baselines

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MODELING

- errorbars are to large for ASPRO modeling (at least in the planet case), BUT
- using the properties and orbital parameters of the planet from RadVel measurements reduces the parameter space and the possible models
- combination with other observing techniques, e.g. 'doppler imaging' possible

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CONCLUSIONS

- with current performance of AMBER it is hardly possible to confirm RadVel planet candidates, even for young and nearby systems
- only with largest baselines on UTs
- range of possible orbital constellations (separation, flux ratio ...) is very small
- Orbital phase of companion should be known
- Models has to be constrained by other observations, e.g. radial velocity measurements
- the things are getting better in the brown dwarf regime
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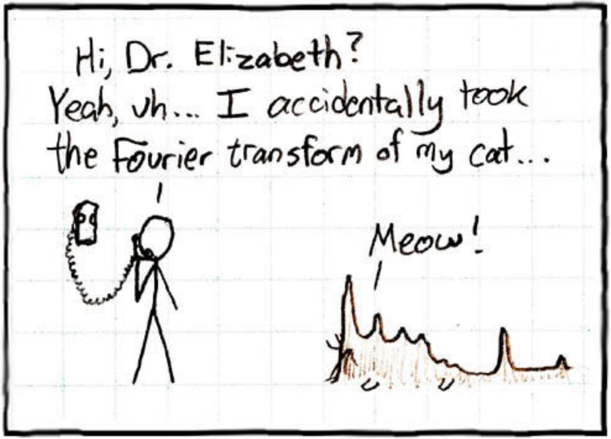
Hi, Dr. Elizabeth?
Yeah, uh... I accidentally took the Fourier transform of my cat...
Meow!

Thank you