GQ Lupi and its companion

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The star GQ Lupi

- K7V T Tauri star in Lups I cloud
- YY Orionis star --> whole in disk
- Distance 100 or 140 pc
- Extinction : A_v=0.4+/-0.2 mag

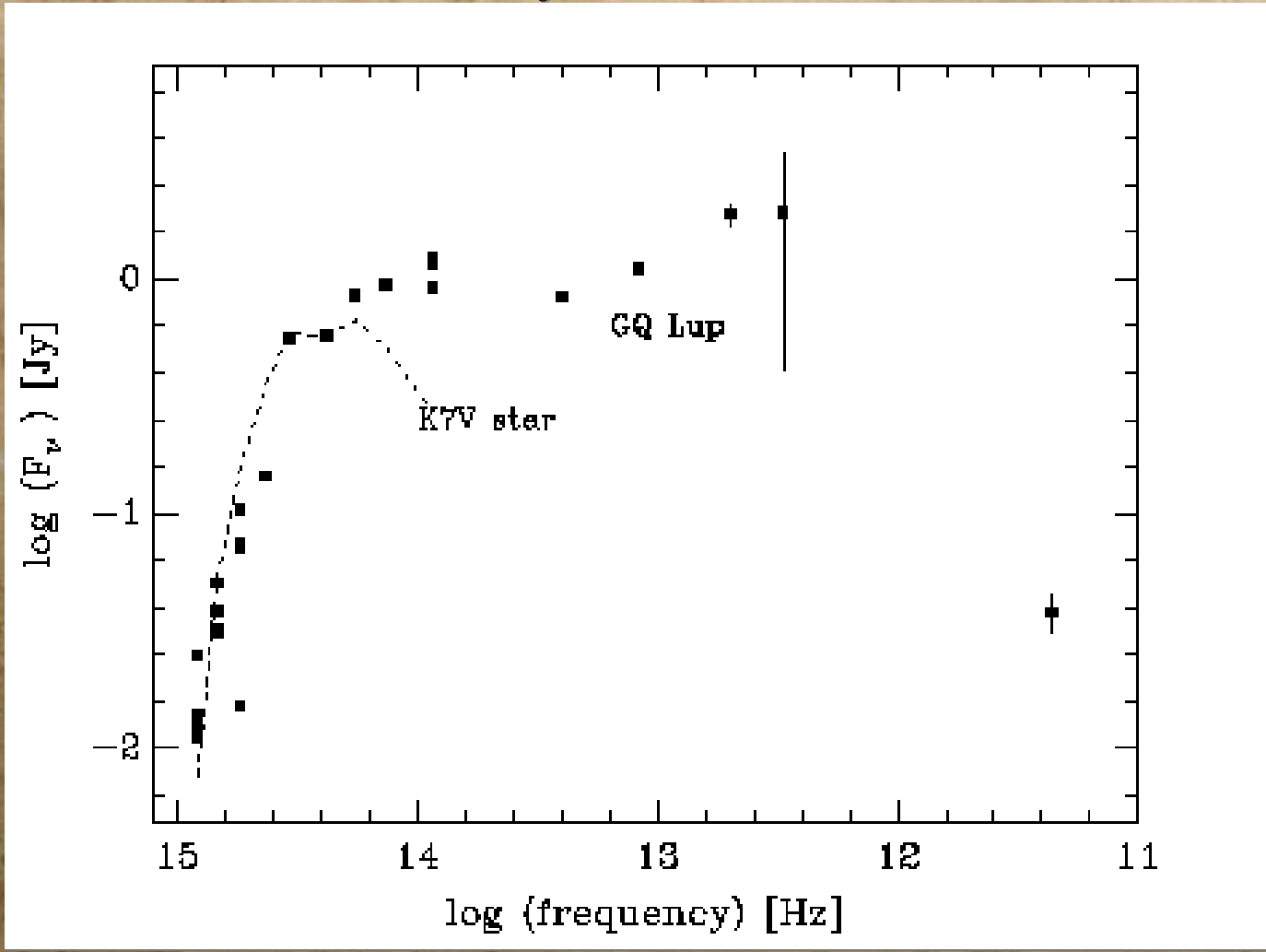
  A_k=0.04+/-0.02 mag

  A_L=0.02+/-0.01 mag
- Veling : 0.5 to 4.5

Photometric period : 8.41 days, vsini=2.8+/-0.8 kms^{-1}

--> i=35+/-12°

Mass of disk: 4.3 10^{-3} $M_{\odot}$ (Nürnberger et al. 1997)



Our observations and data from archives

- 10Apr1999: HST-WFPC2

  F606W and F814W
- 17Jul2002: Subaru/CIAO

  K and L´-band
- 25Jun2004: VLT/NACO

  K-band
- 25AUG2004:VLT/NACO

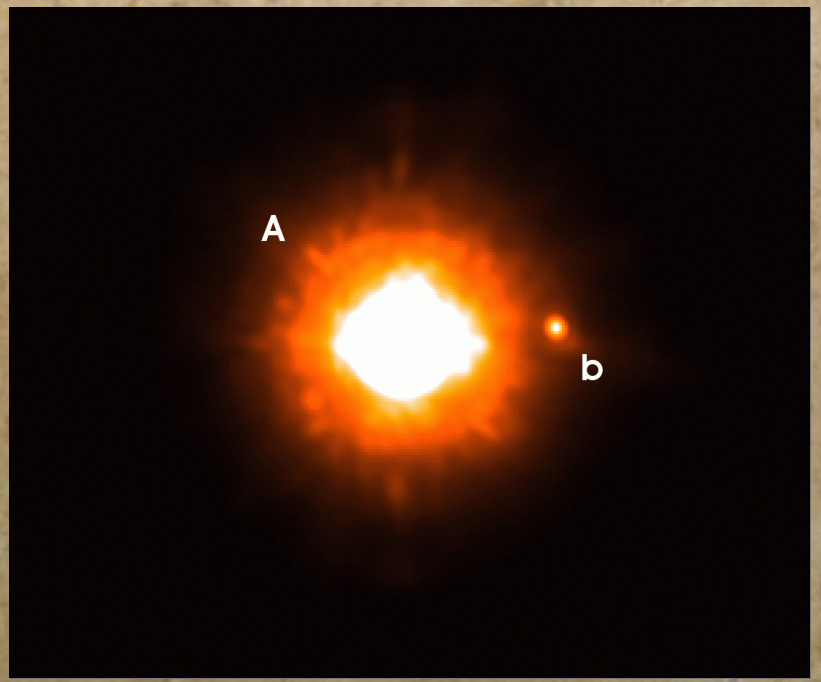
  K-band

Photometric measurements of the companion

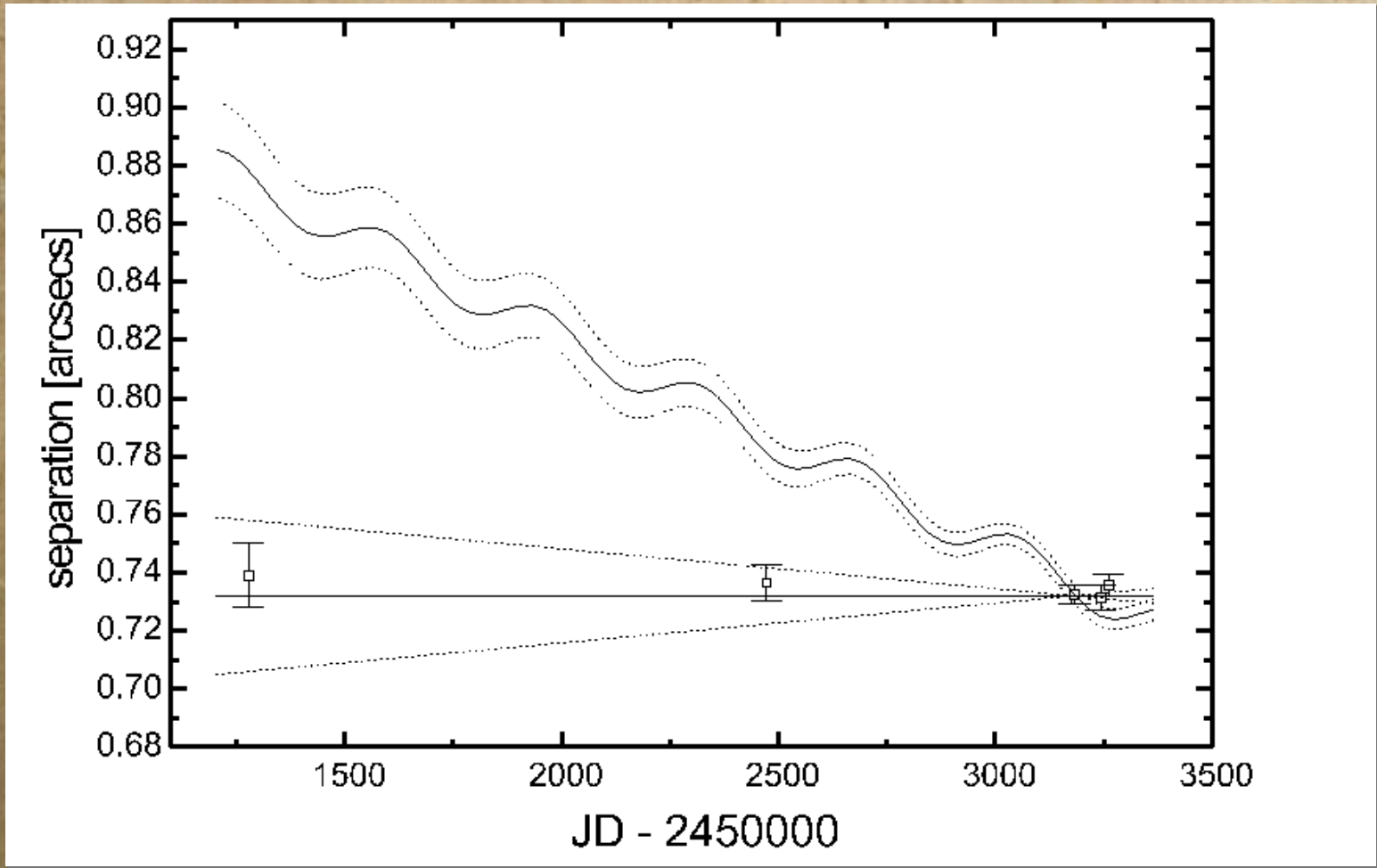
- K=13.1 +/-0.1 mag
- L´=11.7+/-0.3 mag

K-L=1.4+/-0.4 mag

---> L2 ...L6



IF the companion candidate were a background object, the separation between it and GQ Lup would change, because of the proper motion of GQ Lup of -27+/-3 and -14+/-3 mas/yr



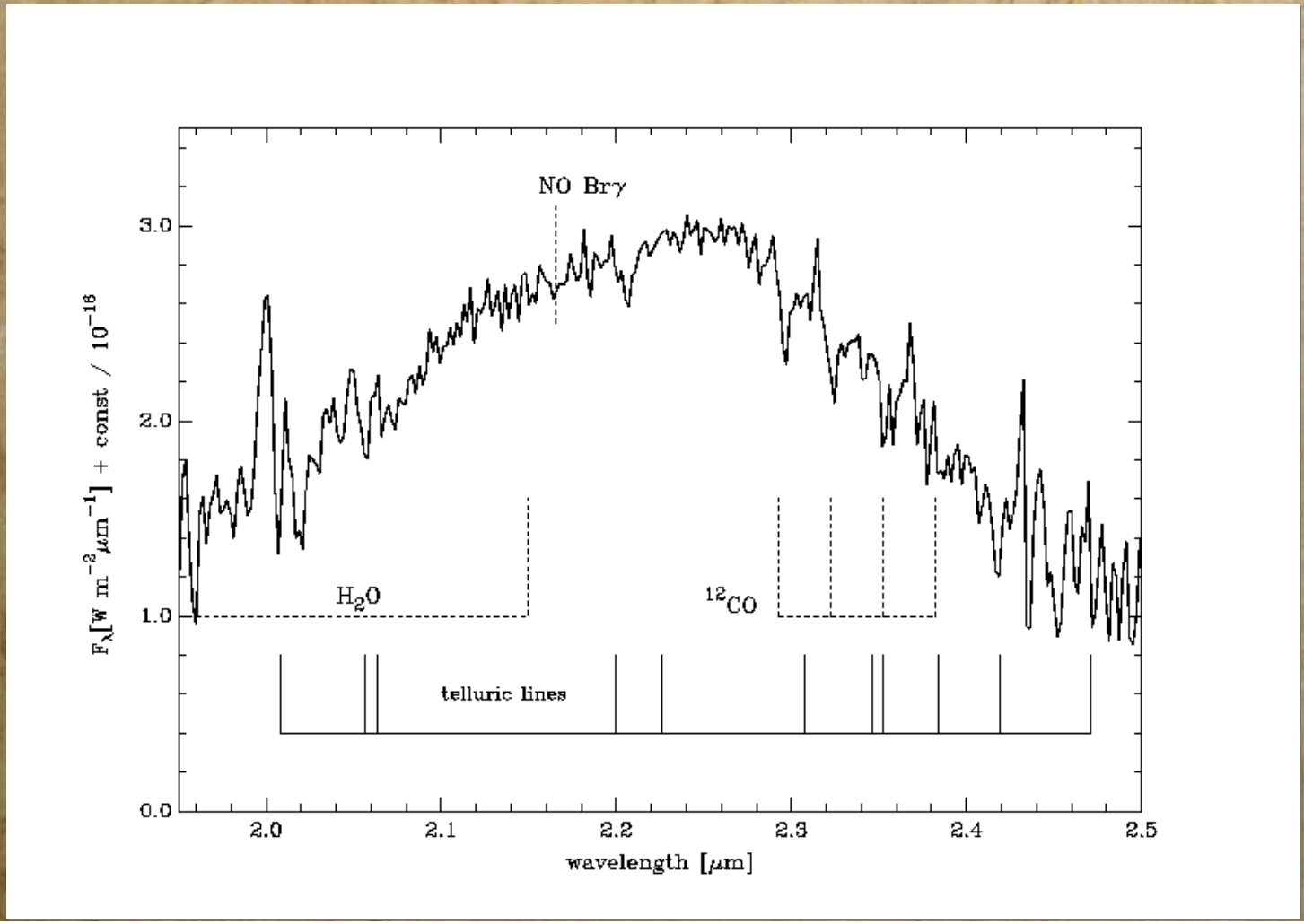
Background Hypothesis rejected at 7.2 Sigma level.

K-band spectrum

2 spectra taken with VLT/NACO

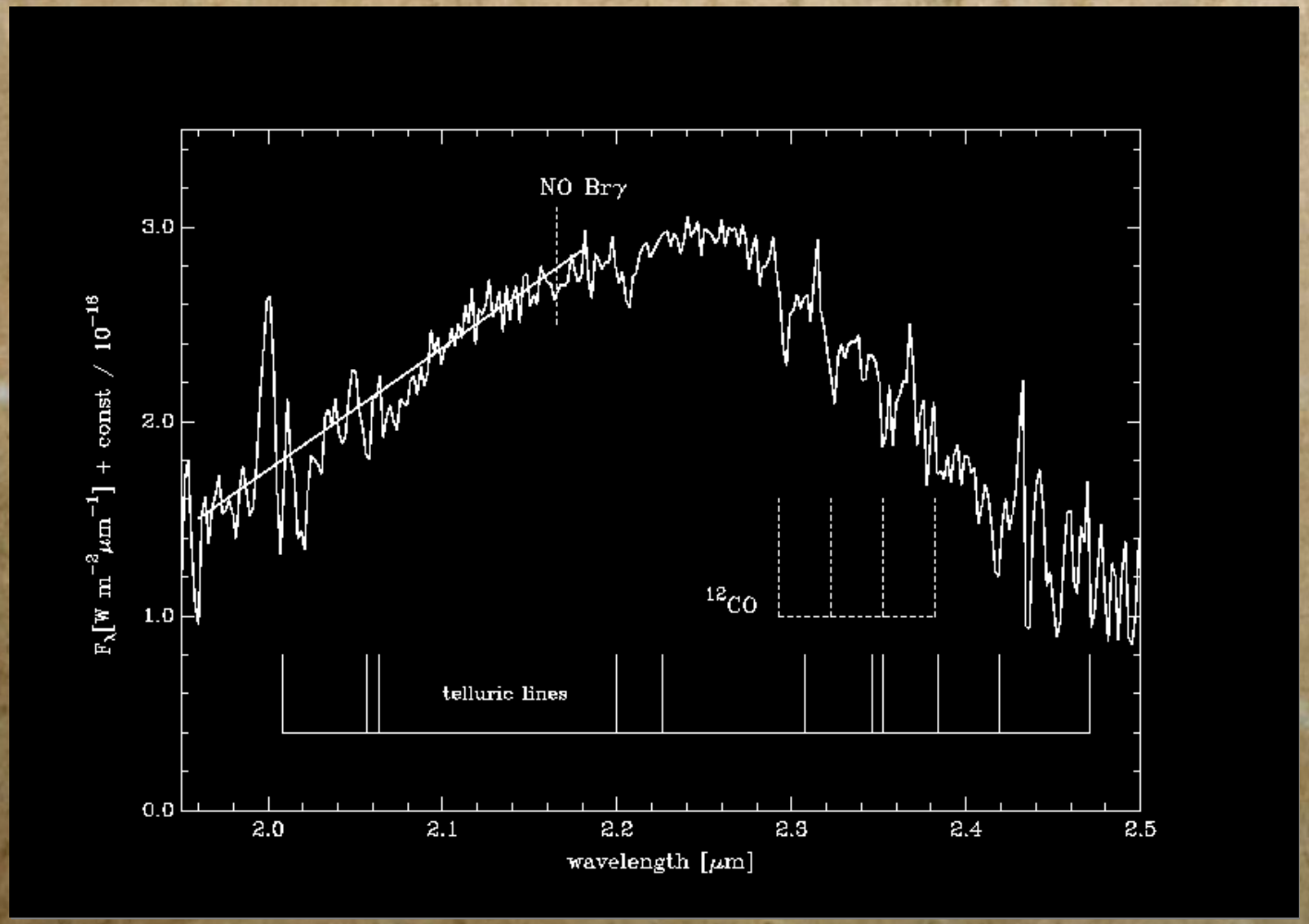
R=700 Sli-wdith 172mas -->

Flux-loss due to different Strehl-Ratio at 1.79 and 2.57mu +refraction : 1.5-1.6%



Spectroscopic determination of the T_{eff} of the companion I

- K1 spectral index (Reid et al. 2001):---> M9-L3
- H_2o-D ratio (McLean et al. 2003): --> L2-L7

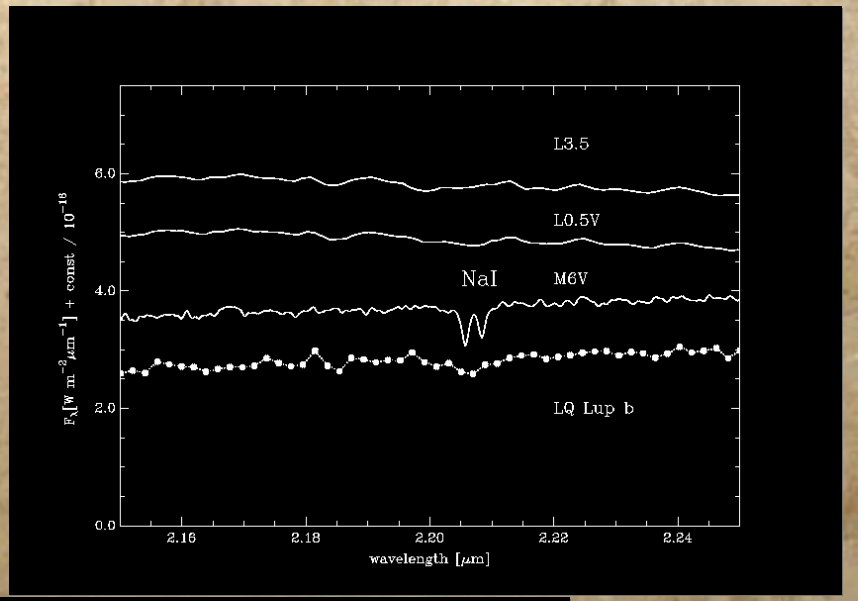


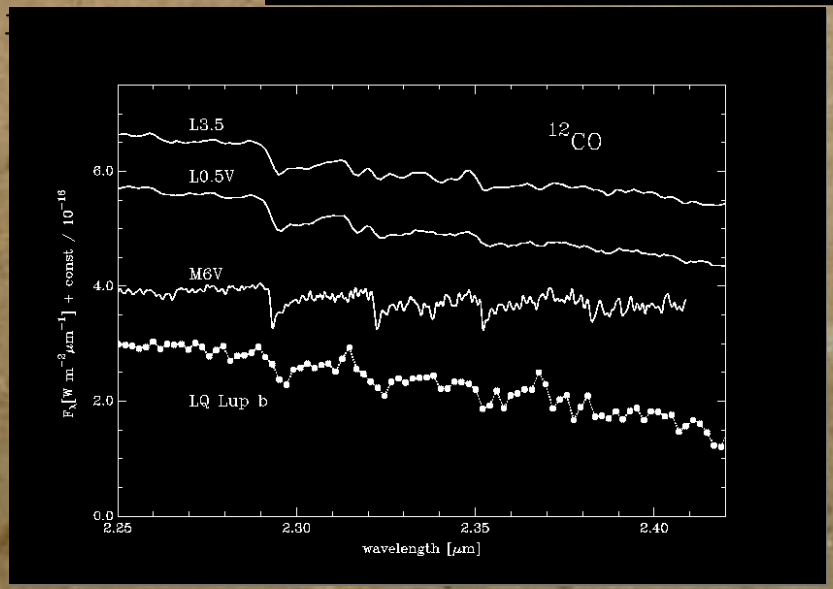
Individual features: NaI doublet and CO-bandhead

- NaI doublet (blended with telluric line H_2O-line): line is absent at L and strong at M6.

  W_{lambda} <2 AA implies M9 or later

- CO 2.295 mu band-head: rest-intensity 0.86 consistent with late M, o early L





Comparing spectra with NEW AMES-dusty models I

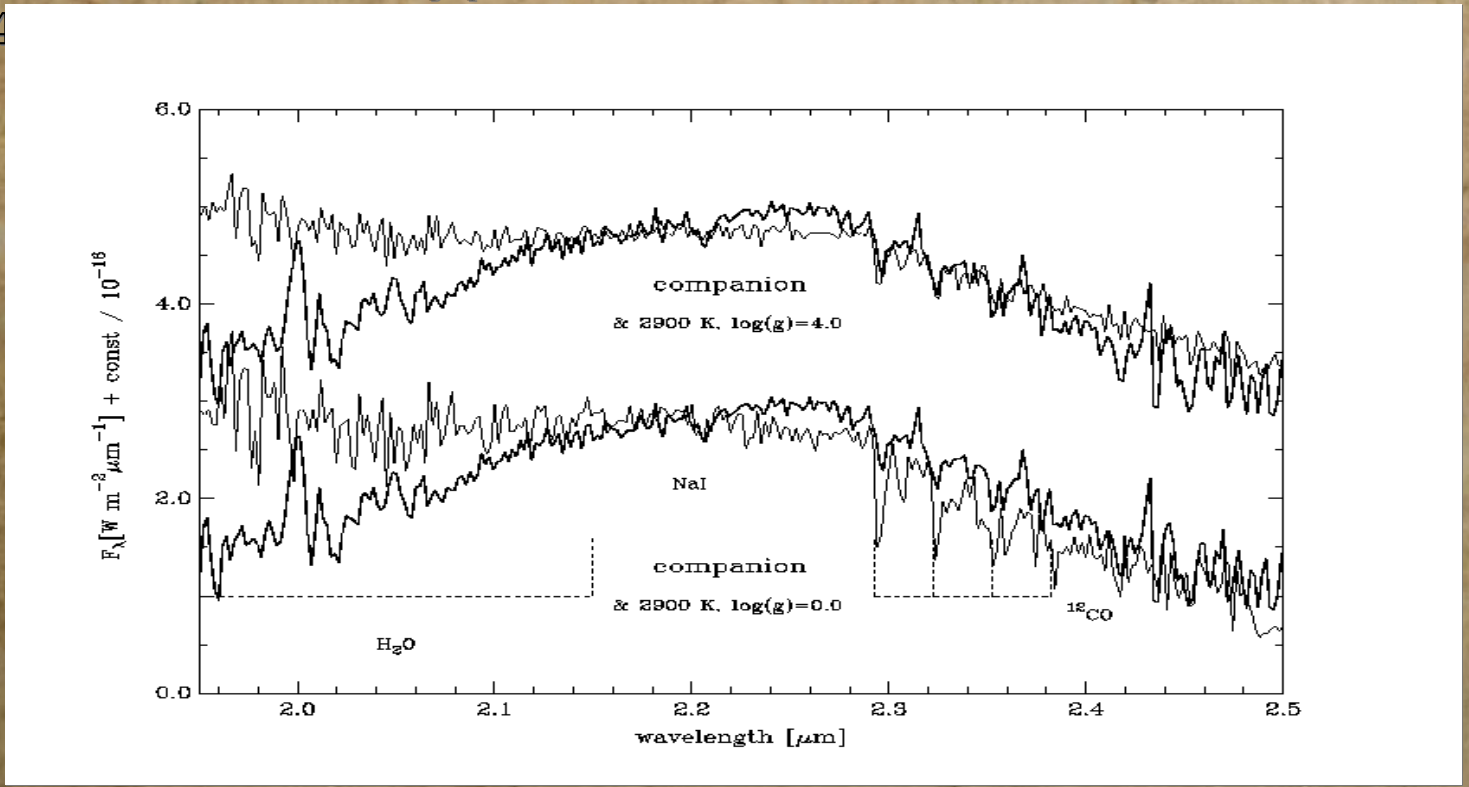
A try with 2900 K:

R=0.7 R_{jup}

(d=100pc)

R=1.0 R_{jup}

(D=14

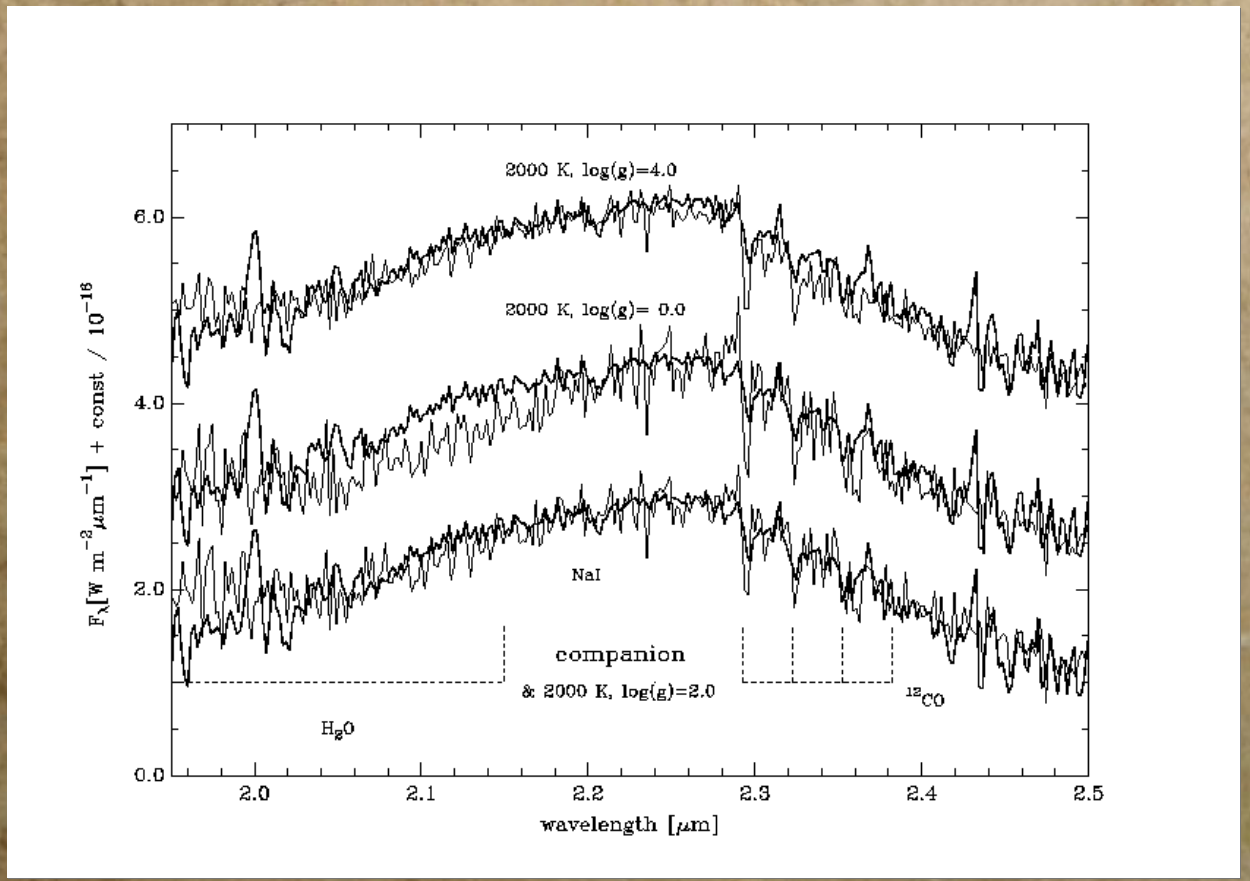


Comparing spectra with NEW AMES-dusty models II

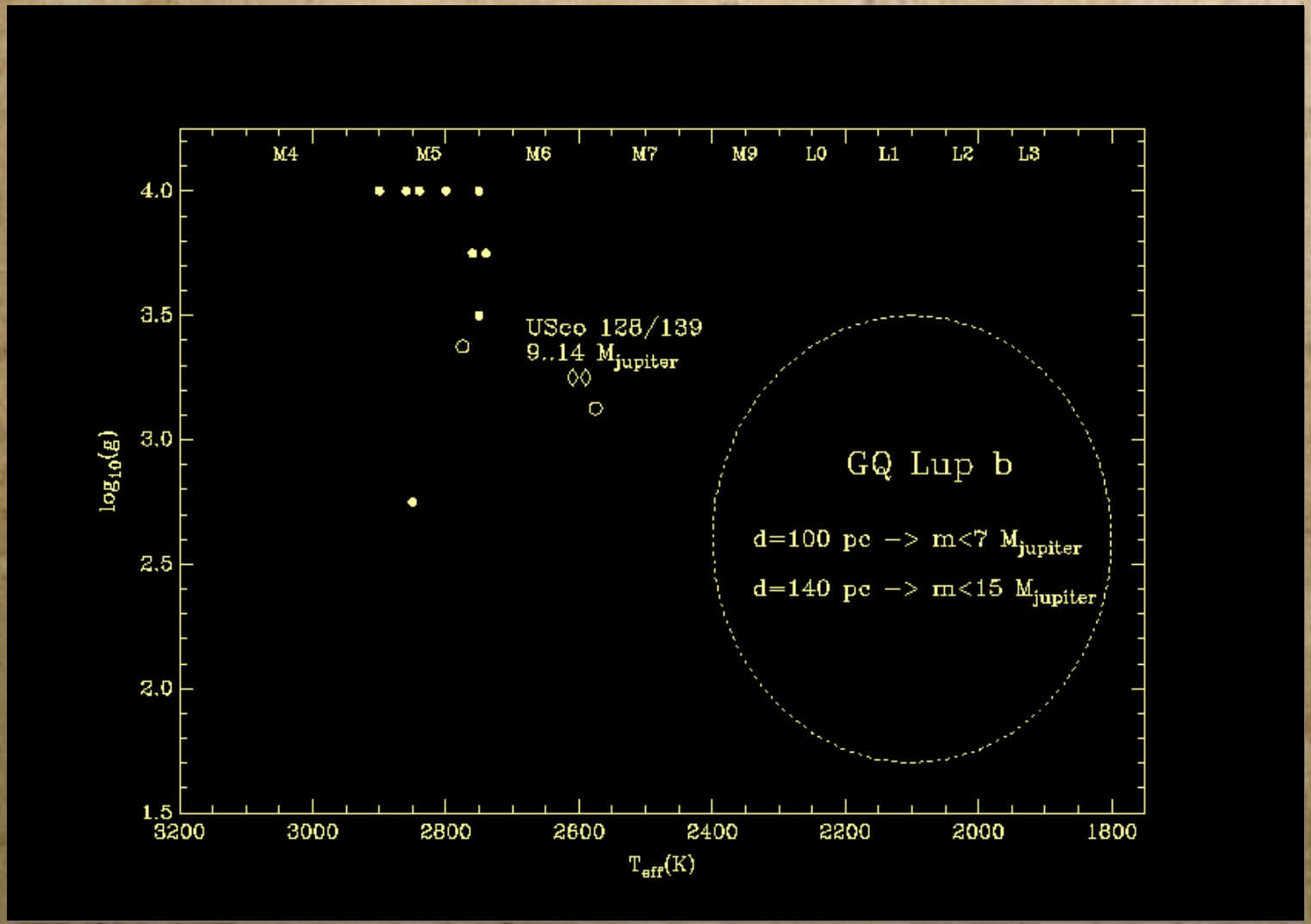
A try with 2000 K:

R= 1.2 $R_{jupiter}$(100pc) 1.8 $R_{jupiter}$(140pc)

...best fit for log(g)= 1.7...3.4

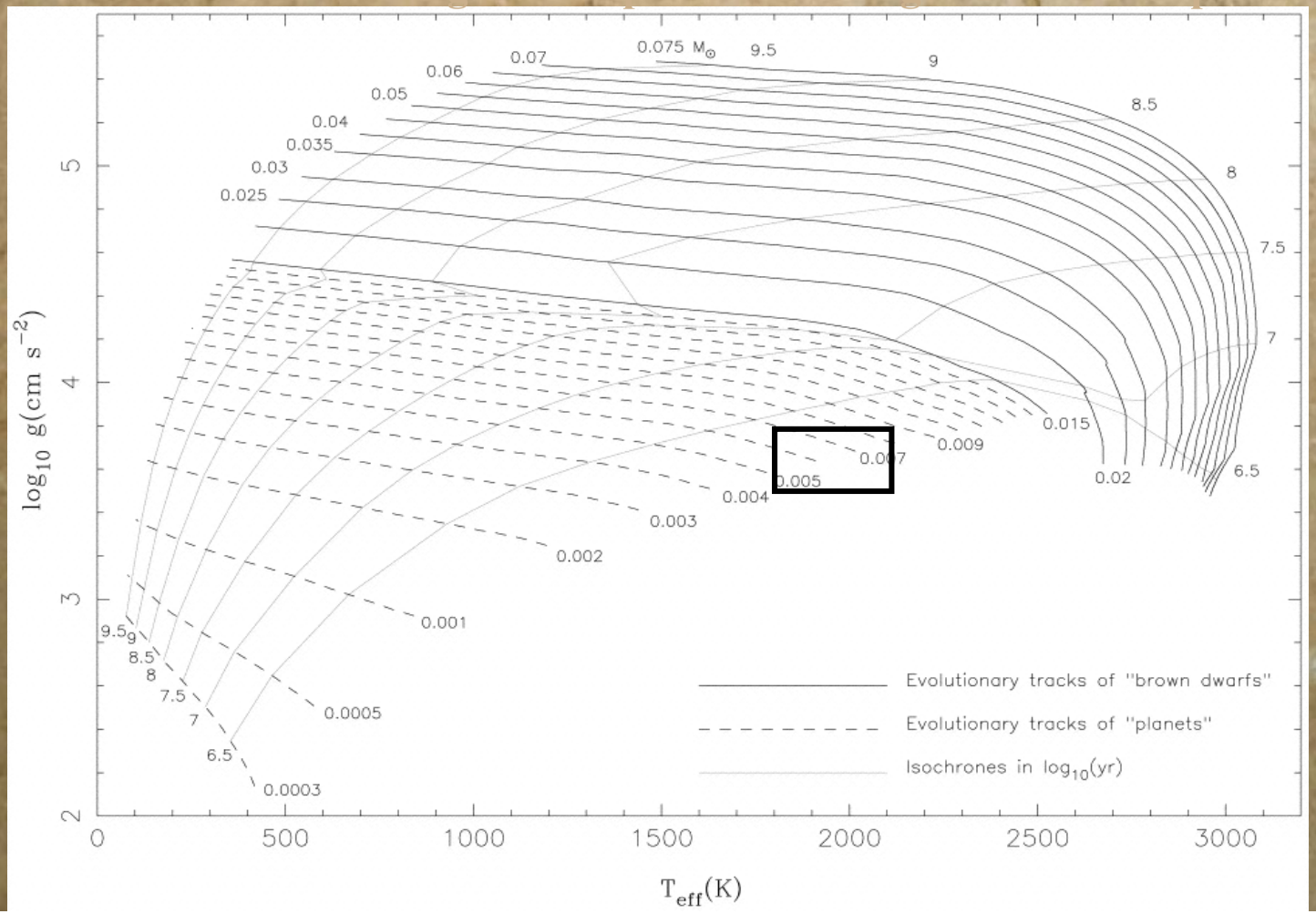


Trying to give a mass estimate I
log(g)-T_{eff} („Mohanty et al. Test“)



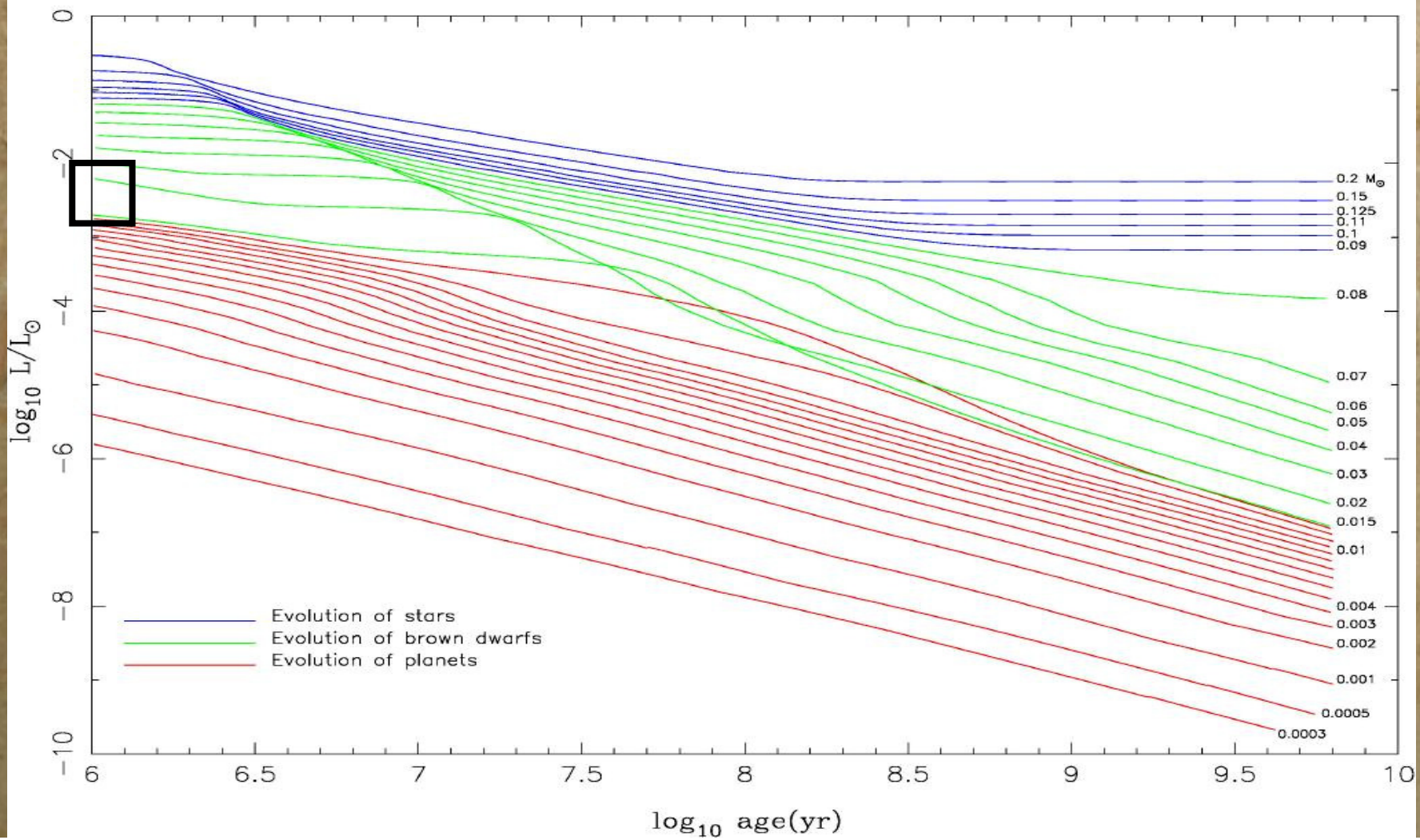
Trying to give a mass estimate II
Burrows tracks

GQ Lup b: Teff :1800...2400 KLog(g):1.7...3.5 -> 3-9 $M_{Jupiter}$

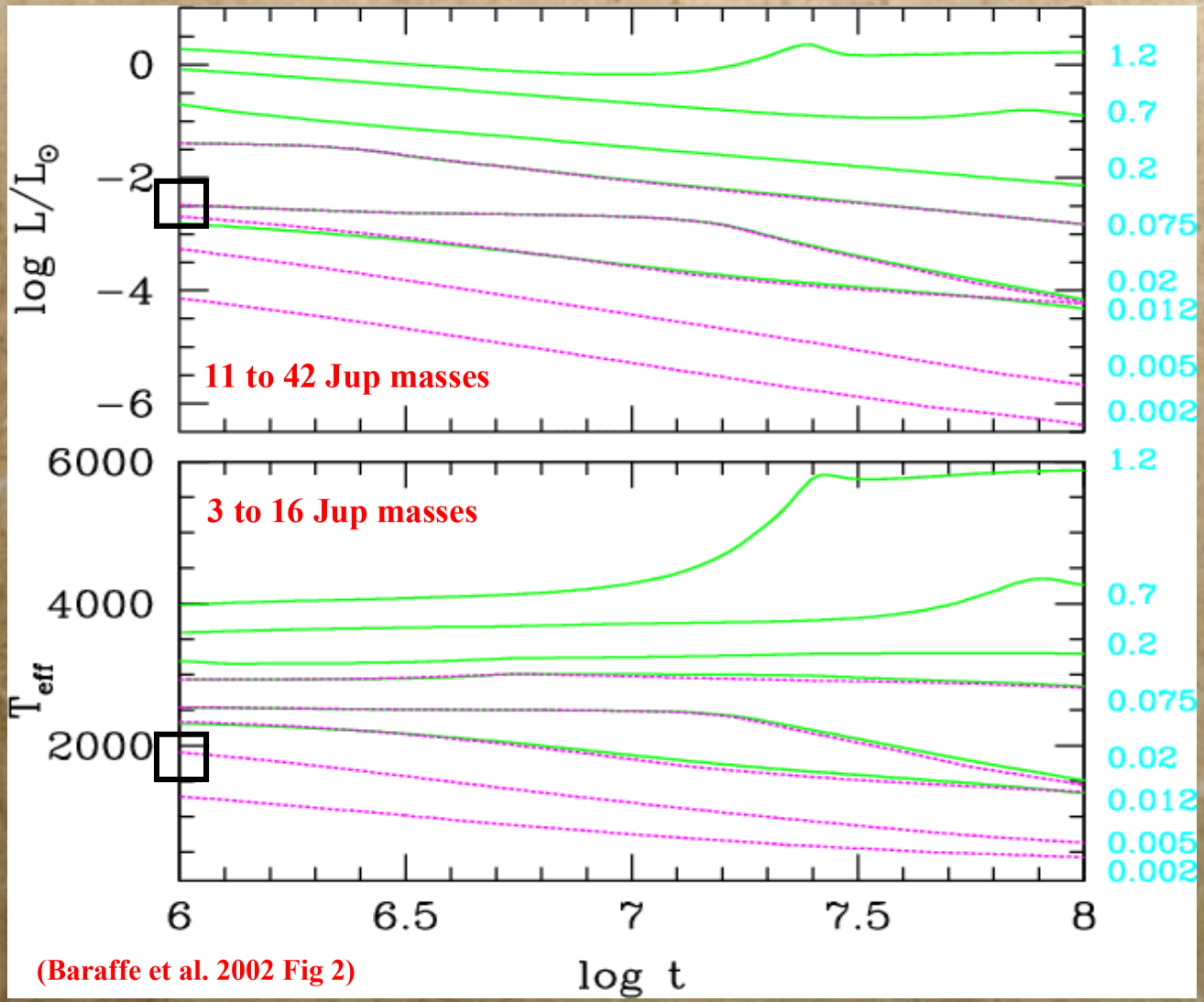


Trying to give a mass estimate III
Burrows tracks

Burrows et al. 1997 Fig. 7: Age and luminosity ➔ **15 to 30 Jup masses**

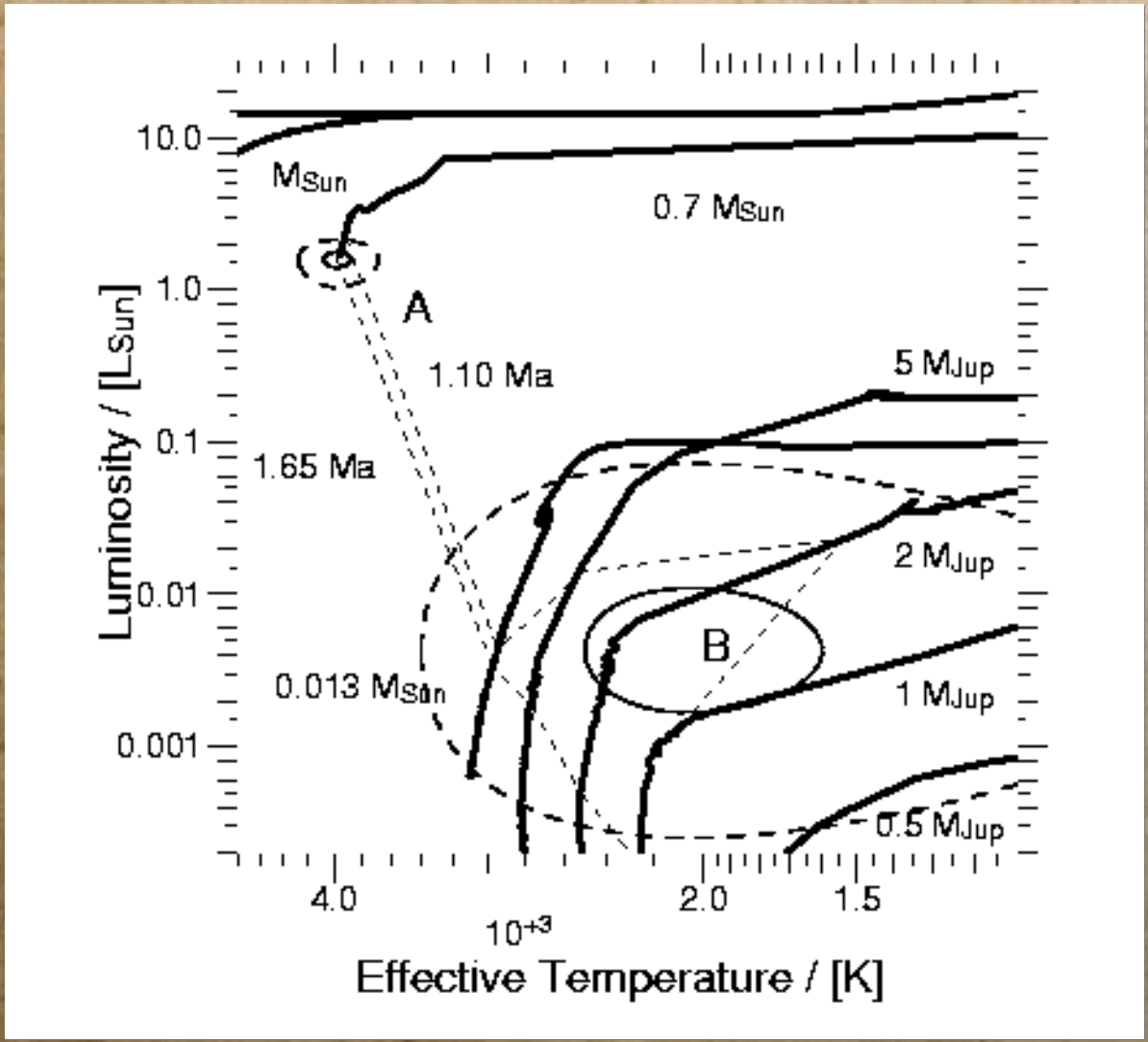


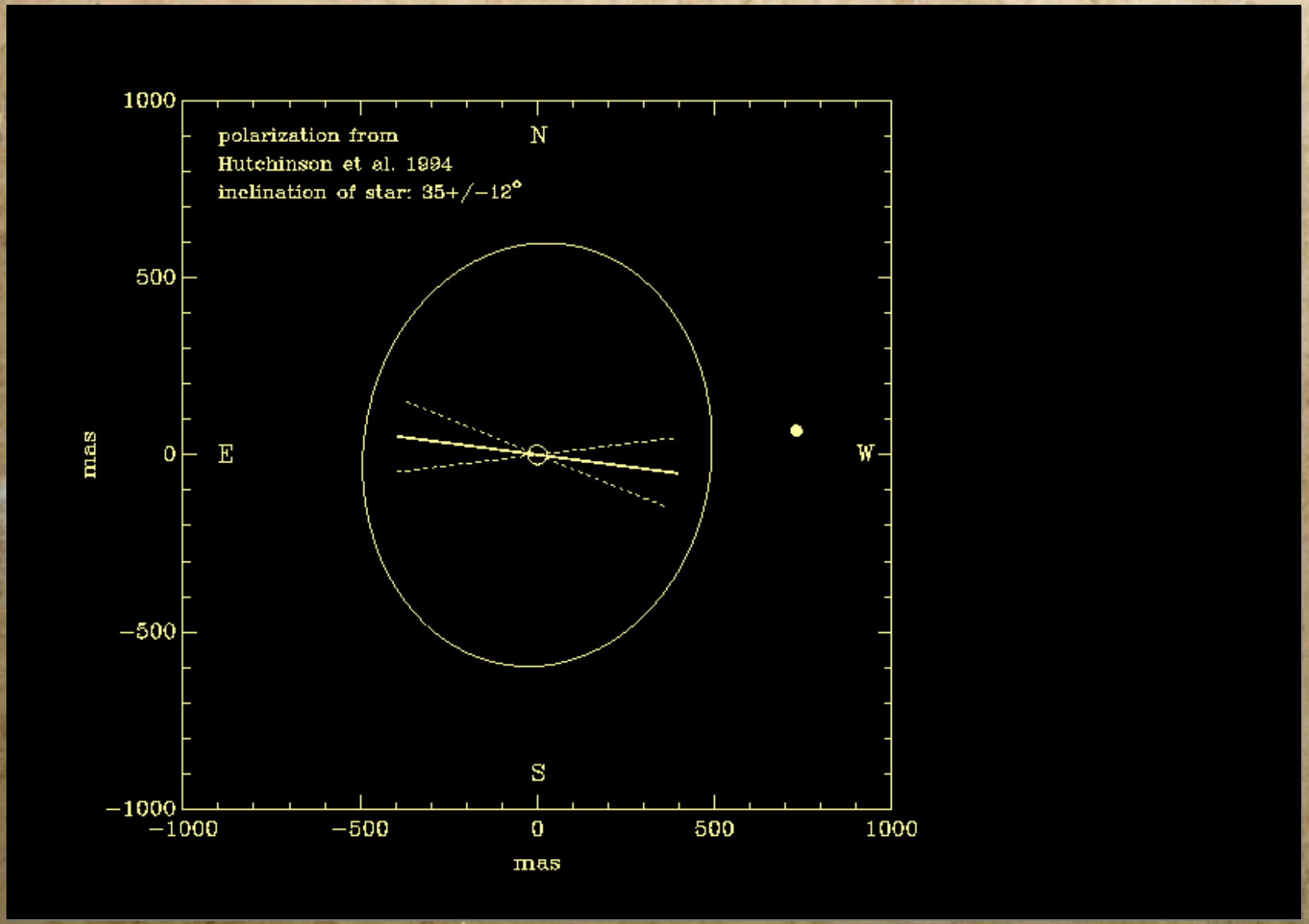
Trying to give a mass estimate IV
Baraffe (2003)tracks
(„not allowed to be used at 10^6 years")



(Baraffe et al. 2002 Fig 2)

Trying to give a mass estimate V Wuchterl (2005)tracks




polarization from
Hutchinson et al. 1994
inclination of star: 35+/−12°
N
E
W
S
1000
500
0
−500
−1000
mas
−1000
−500
0
500
1000
mas

So what?

- GQ Lupi is an intersting object
- Allows study the formation of a low-mass object close to star.
- We need emprical test of evolutionary tgracks -->

1.) log(g): high-resolution IR spectrograph+AO system at big telescope needed (=NAHUAL).

2.) RV survey for young planets that can be resolved with VLTI (survey on-going with HAPRS, TLS).