

MAD Observations of the Orion Trapezium Cluster

M. Petr-Gotzens, J. Kolb, E. Marchetti (ESO Garching)

D. Nürnberger, V. Ivanov, M. Sterzik (ESO Chile)

R. Köhler (Zentrum F. Astronomie, Heidelberg)

H. Bouy, E. Martín (Inst. de Astrofísica de Canarias)

D. Barrado y Navascués, N. Huélamo (LAEFF – Madrid)

MAD targeting the Orion Trapezium Cluster

Young star cluster, ~ 1 Myr

High- and low-mass star formation, $r \sim 440$ pc



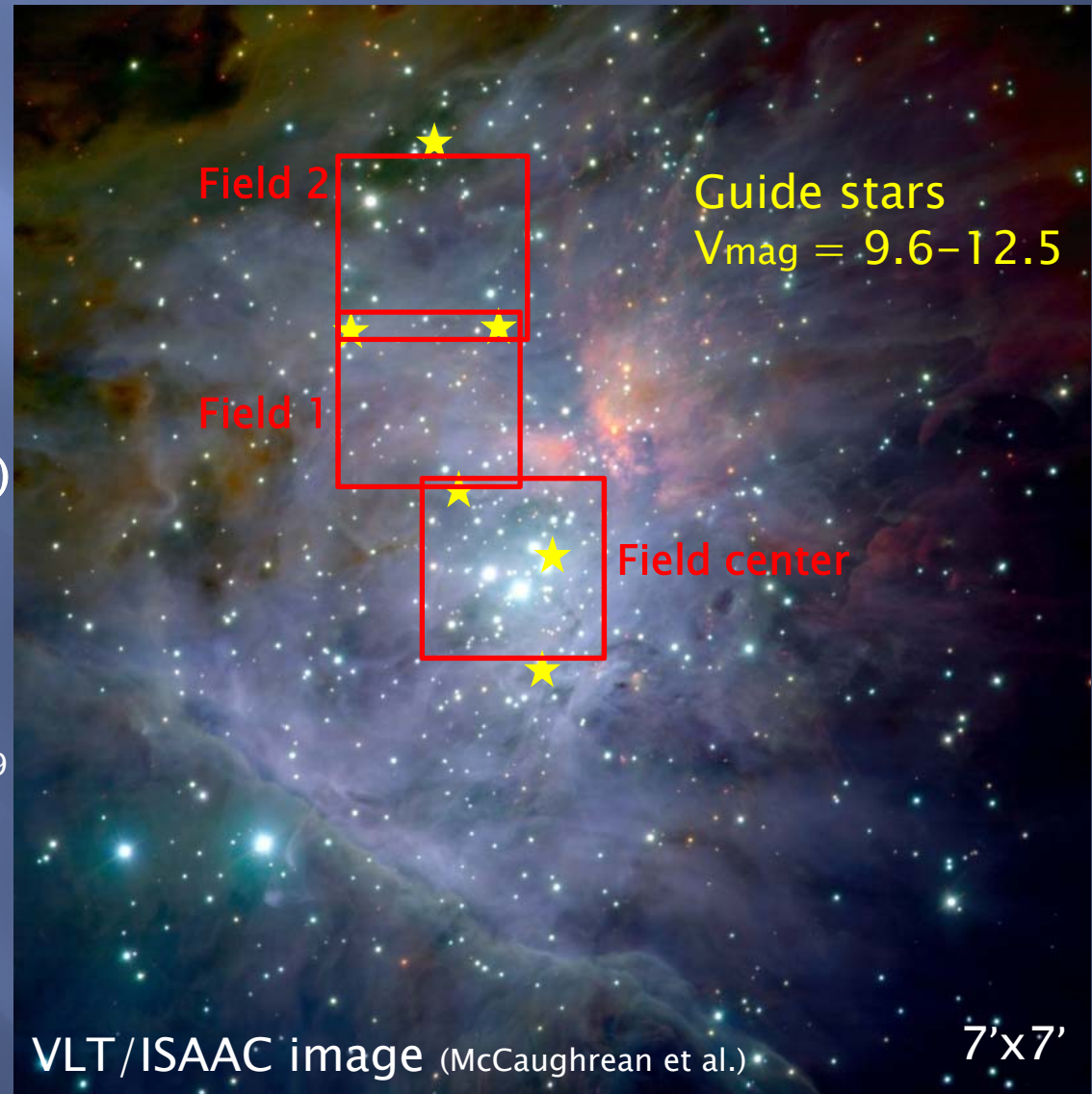
① Sub-stellar IMF and planetary mass ($3-13 M_{\text{Jup}}$) objects in the Trapezium Cluster Center ??

Muench et al. 2002, ApJ 573
Slesnick et al. 2004, ApJ 610
Lucas et al. 2005, MNRAS 361
McCaughrean et al. 2002, Mess. 109

② Binary brown dwarfs ??

Why MAD?

Sensitivity and spatial resolution!



MAD targeting the Orion Trapezium Cluster

40 min. at H-band (1.65mic) per field

12 min. at K-band (2.20mic) per field

Observed in Nov 2007 and Jan 2008

65"x65" → Bouy et al

600 images

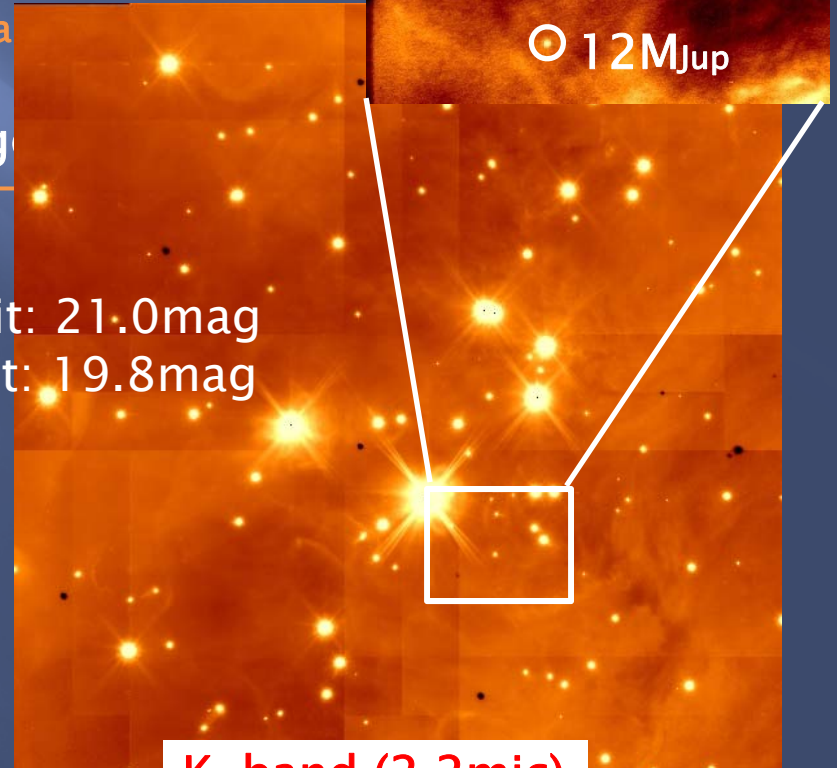
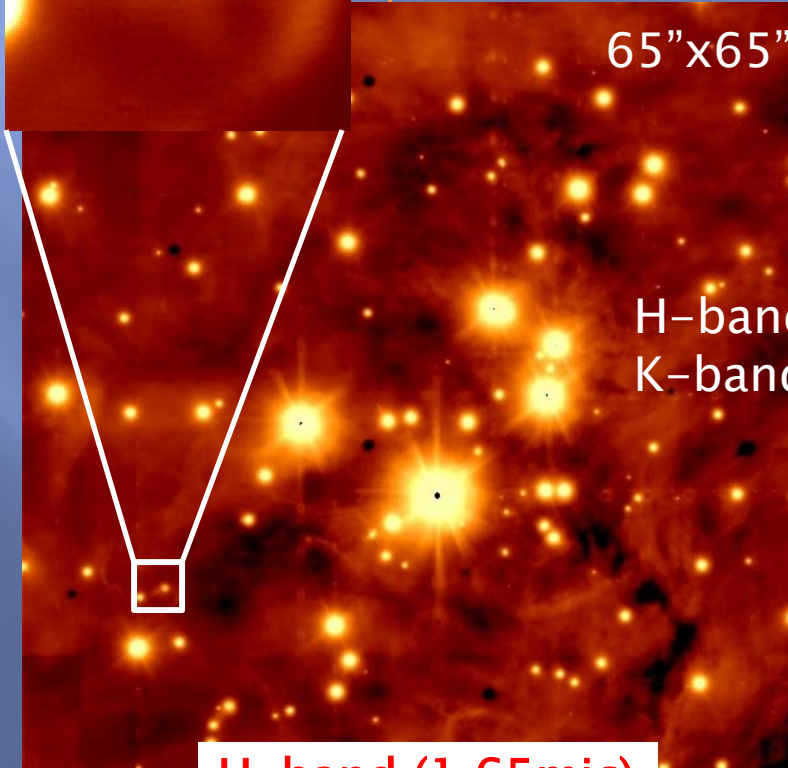
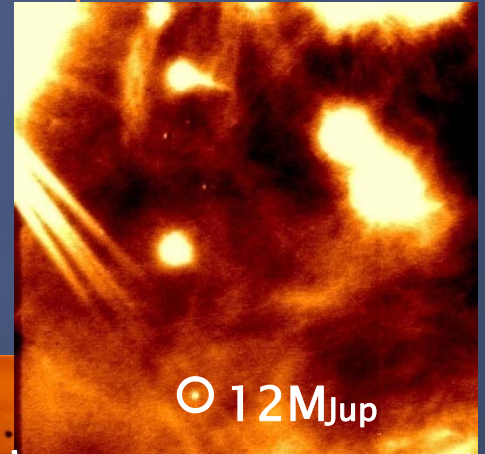
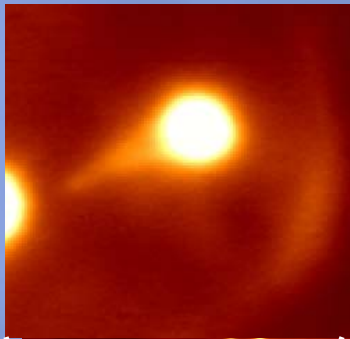
H-band det.limit: 21.0mag

K-band det.limit: 19.8mag

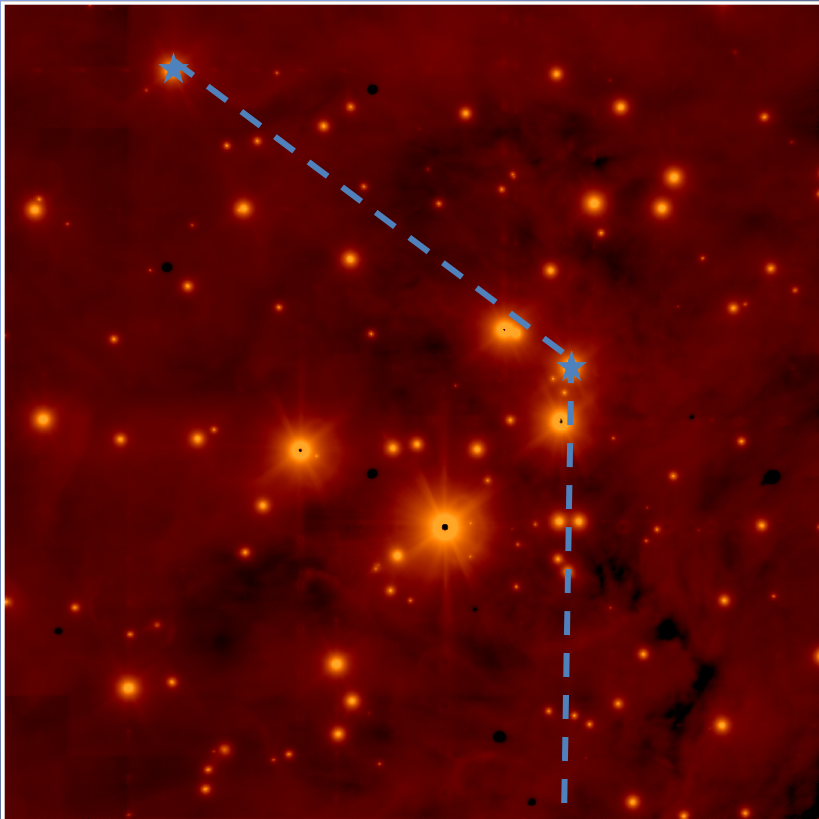
○ 12MJup

H-band (1.65mic)

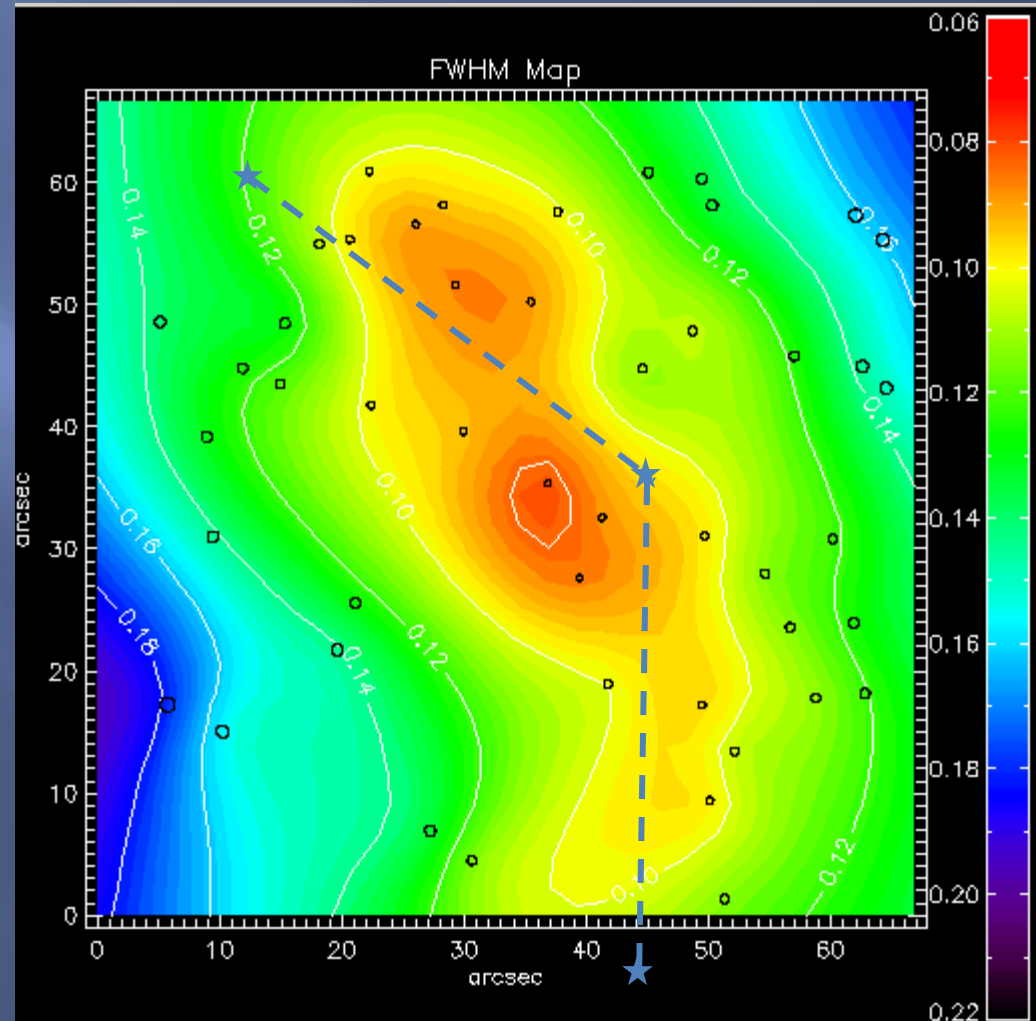
K-band (2.2mic)



MAD performance on the OTC



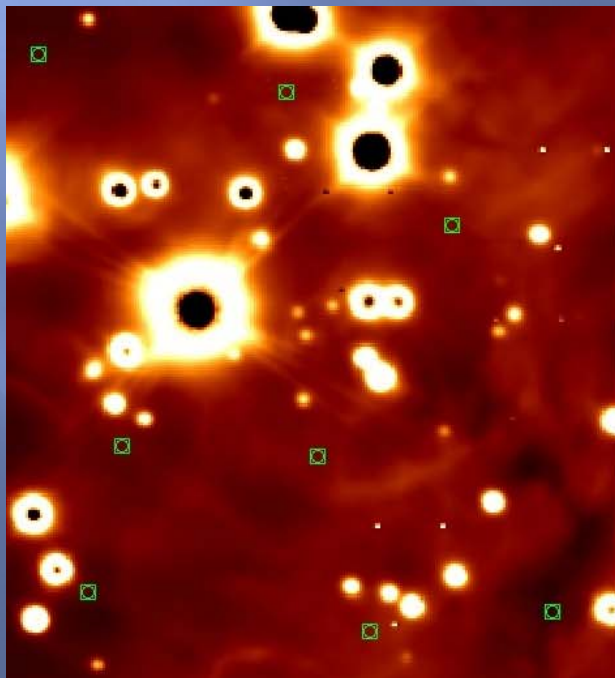
MAD H-band Orion trapezium image
Combination of 40 minutes of images
FWHM = 0.07" @ field center



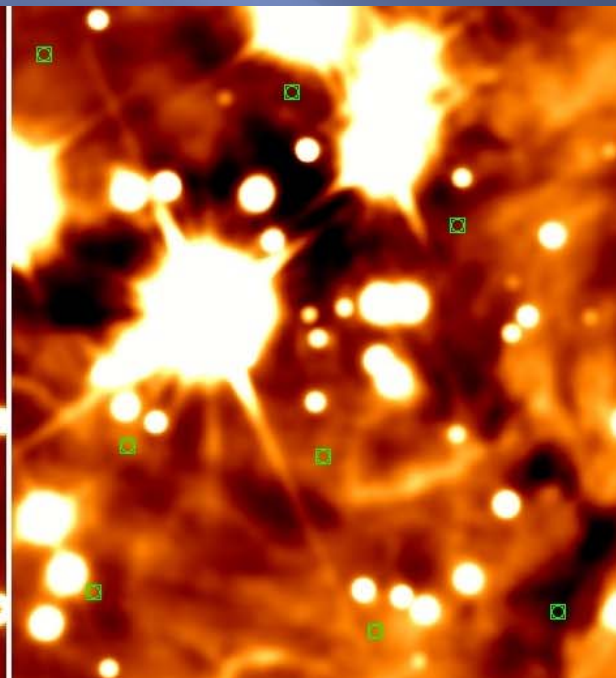
MAD performance on the OTC

The central Trapezium Cluster

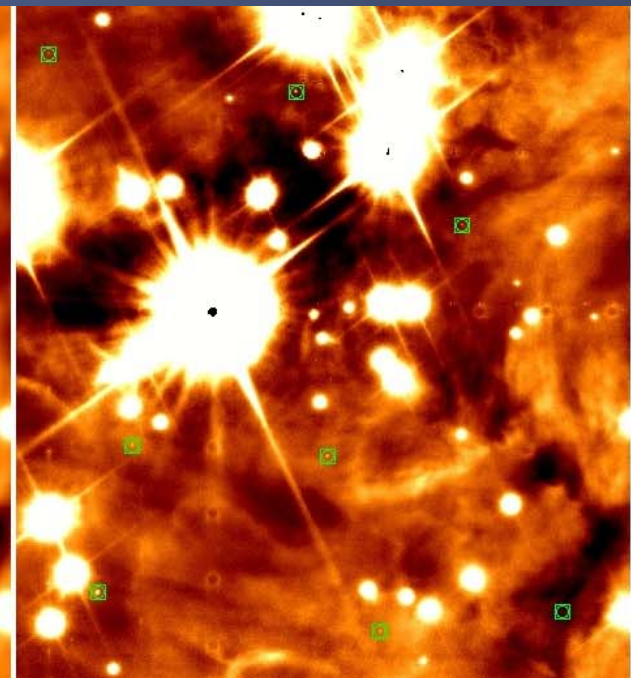
ISAAC/VLT/0.5"/15.min



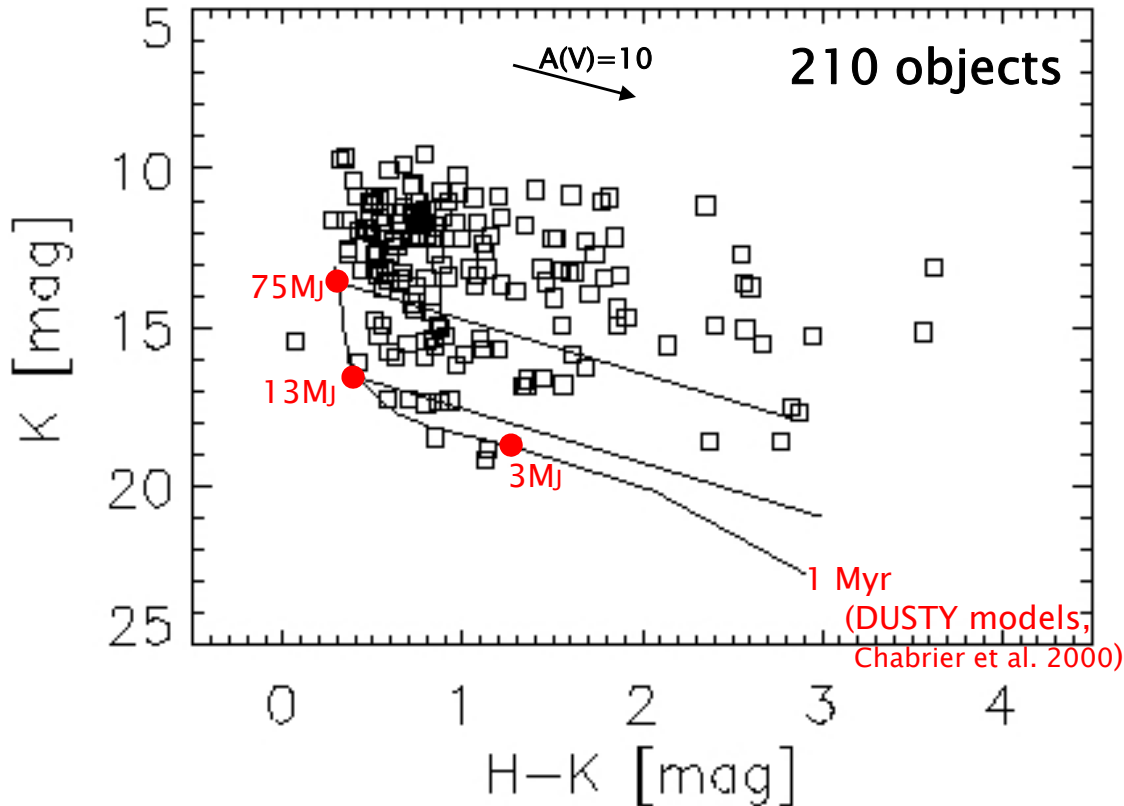
MAD/VLT smoothed to
ISAAC resolution



MAD/VLT/0.06"



Brown Dwarfs and Planetary Mass Objects (PMOs)



All the PMO candidates are new detections
Plus some of the BD candidates

Sub-stellar IMF
in Trapezium Cluster Center:

$$N(\text{BD})/N(\text{PMO}) = 3.0$$

in Trapezium Cluster periphery:
(Lucas et al. 2005, MNRAS 361)

$$N(\text{BD})/N(\text{PMO}) = 3.2$$

Close Binaries

with Component Separations $< 1''$ ($\sim 450\text{AU}$)

Total number of binaries detected:

$$N_{\text{binaries}} = 20 \text{ (19 known, 1 new)}$$

→ Binary Frequency: $\sim 8.5\%$

In agreement with previous findings

(Prosser et al. 1994, Petr et al. 1998, Simon et al. 1999
Köhler et al. 2006)

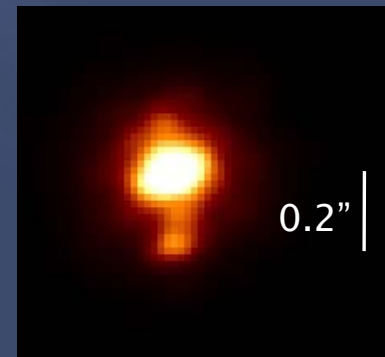
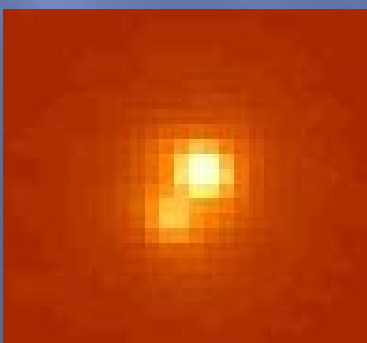
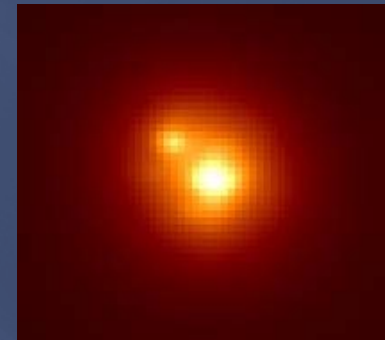
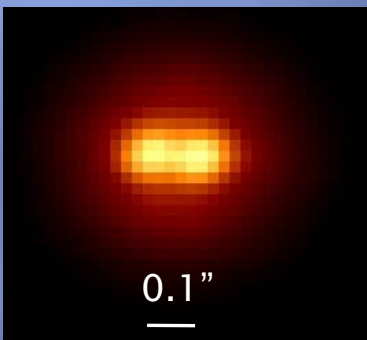
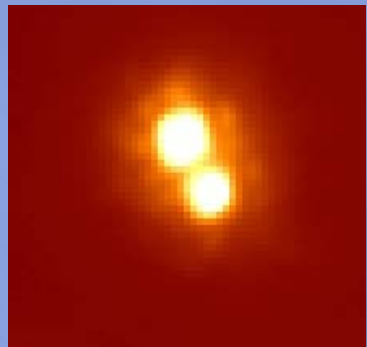
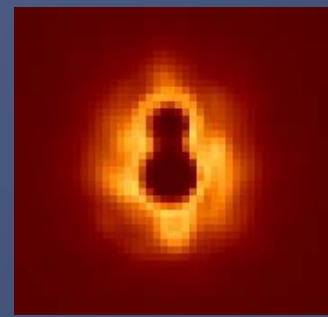
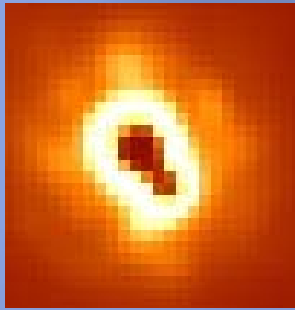
Brown Dwarf Binaries:

ONLY 1 BD binary

Companions to Orion Brown Dwarfs
are very rare?

→ Same conclusion as for the
outer region of the OTC

(Lucas, Roche, Tamura, 2005, MNRAS 361)



Summary

Multi-Conjugate Adaptive Optics concept was successfully demonstrated for the central Orion Trapezium Cluster

Several (~10) planetary-mass “candidates” have been detected, but still the MF appears declining quickly

Just one candidate brown-dwarf binary
→ very low brown-dwarf binary frequency