

RoPACS

Rocky Planets Around Cool Stars

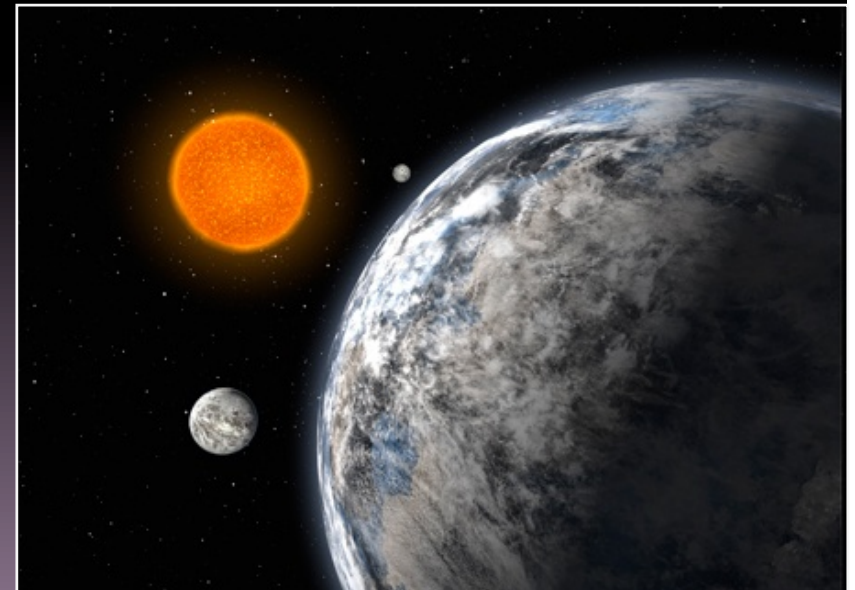


A Marie Curie Initial Training Network

Degenerate companions and extra-solar planets

May 2010
Munich

Joana Gomes



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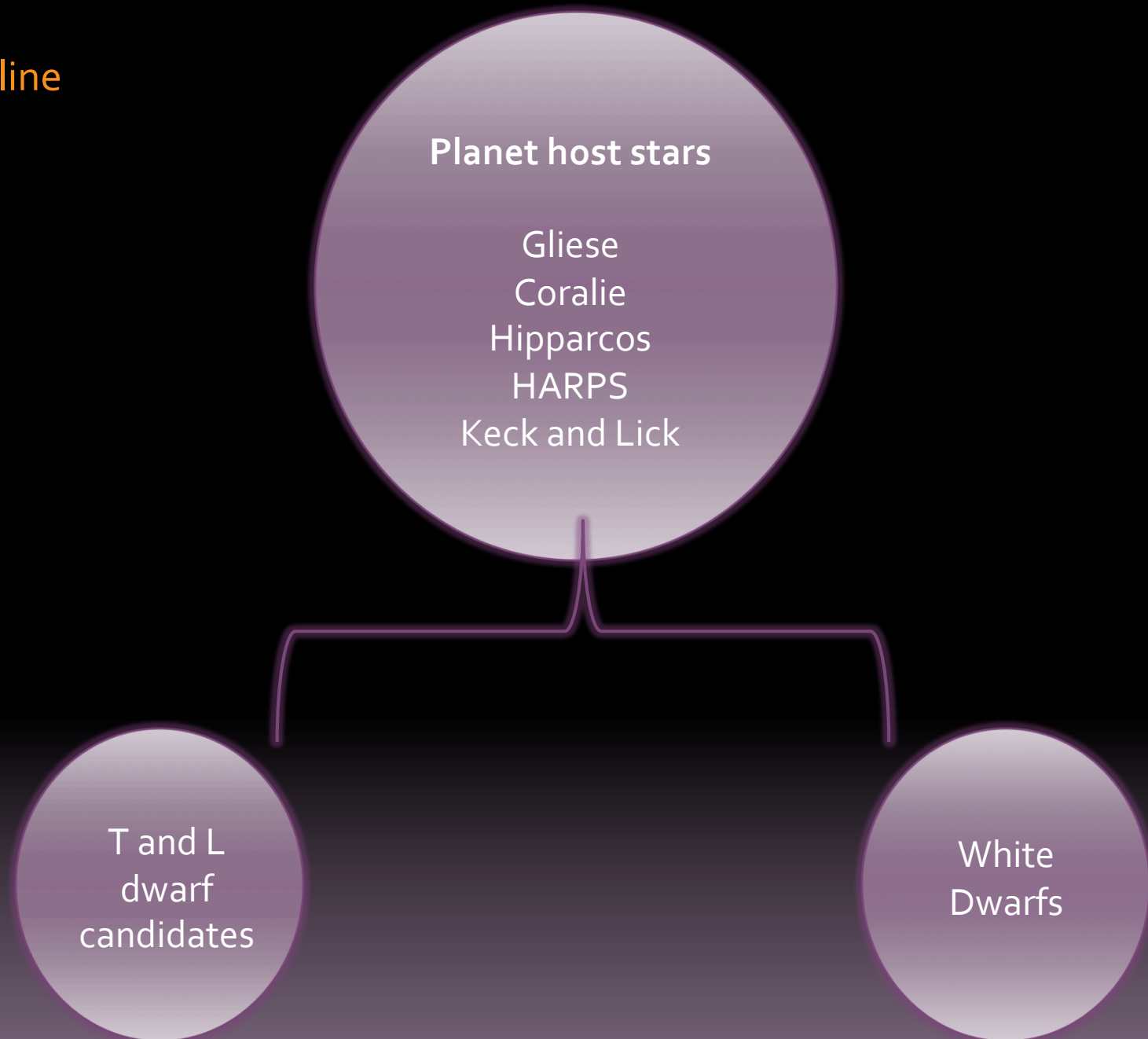
*Degenerate
companion
and
extrasolar
planets*

L/T dwarfs

White
dwarfs



Outline



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Ultracool dwarfs – The T and L dwarfs search

L dwarfs

All sky survey using 2MASS

- Avoid galactic plane $-15 < b < 15$
- Remove reddened regions, the SMC and the LMC

-Total of 28 020 candidates

Inferior limit	Color	Superior limit
0.500	J - H	1.600
0.400	H - Ks	1.100
1.075	J - Ks	2.80



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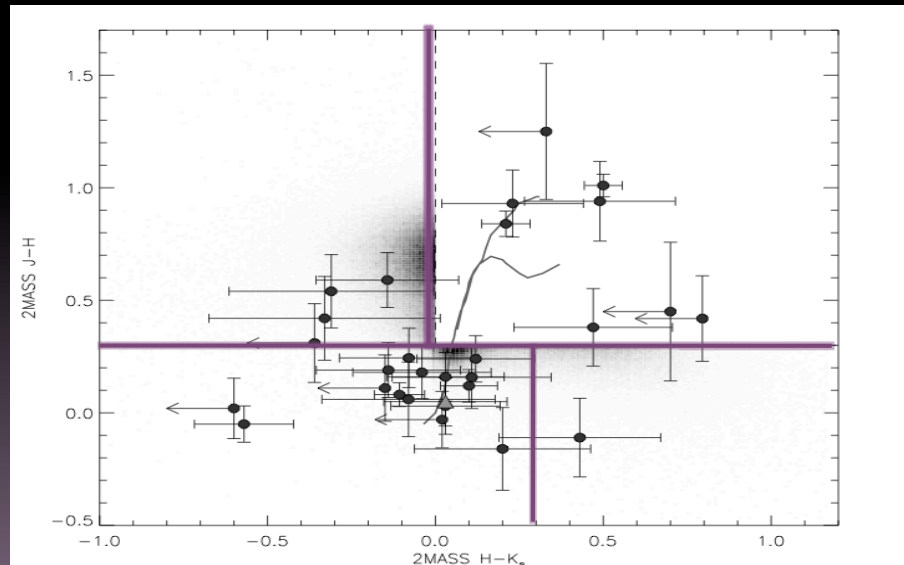
White
dwarfs



T dwarfs search

All sky 2MASS survey, using $J < 16$ and these color cuts:

Region	Colors	Total candidates
1	$J - H < 0.3 \ \& \ H - K < 0.3$	49 965
2	$J - H < 0.3 \ \& \ H - K > 0.3$	30 805
3	$J - H > 0.3 \ \& \ H - K < 0.0$	134 087



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-Spatial selection – eliminate regions too crowded, close to the galactic plane and the Magellanic clouds;

- Crossmatch with SuperCOSMOS to look for detections within a radius of $4''$;

Detections in
SuperCOSMOS

Non detections in
SuperCOSMOS

Color cut using $i - J > 4$

- Check for bright detections
in the J but, but not visible in
the B band

Check visually

Check for Sloan colours



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- Check for solar system bodies – Burgasser et al. 2002, Burgasser et al. 2003
- Check the DwarfArchive.

Sample 1 – 18 out of 29 T dwarfs with the color cuts used

Sample 2 – 2 out of 5 T dwarfs

Sample 3 – No matches for any of the 6 T dwarfs

The ones that are not in the sample – excluded in the first criteria, had magnitude $J > 16$, or different flags in 2MASS

- Double check in 2MASS to look for high proper motion stars, artifacts and false detections.



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Final results	J band	SuperCOSMOS	Sloan
List 1 = 61	$J < 15$	No	No
List 2 = 2	J detection	No	$i - z > 2$
List 3 = 4	J detection	Yes $i - J > 4$	No
List 4 = 157	$J > 15$	No	No

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Looking for binaries

Matching:

-Separation smaller than $10'$;

-Using the planet host star's distance, calculate a separation in AU and chose those with $\text{sep} < 20\,000\text{ AU}$;

-Check for distances, using a photometric distance for the T dwarf.



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Crossmatch between all these candidates and the list of planet host stars from Hipparcos, Gliese, Coralie, Harps and Keck and Lick.

T dwarfs + PH stars = **4 MATCHING PAIRS**



2 interesting pairs

1 strange shape – galaxy?

1 possible solar system object – not detected in DENIS

-Main sequence star - not in encyclopedia;

-T dwarf – not in the Dwarf Archive



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L dwarfs

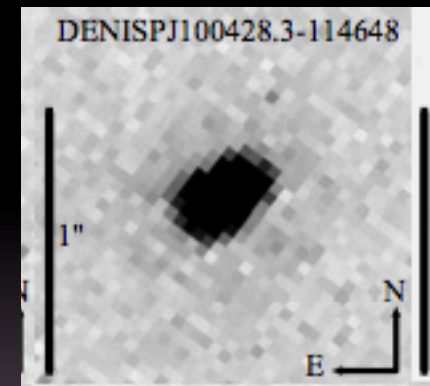
-572 pairs with separation $< 10'$;

-All of these pairs were at a separation smaller than 20 000 AU, assuming the star's distance.

Keck and Lick PH stars

1 INTERESTING PAIR!!!

-L dwarf is classified as an unresolved binary, with a dM9.5 and a dLo.5, at a distance of 46 pc – DENIS J100428.3-114646



Buoy et al. 2003

-Wide companion – Variable of BY Dra type, at 23.28 pc (parallax distance) K2 V_k



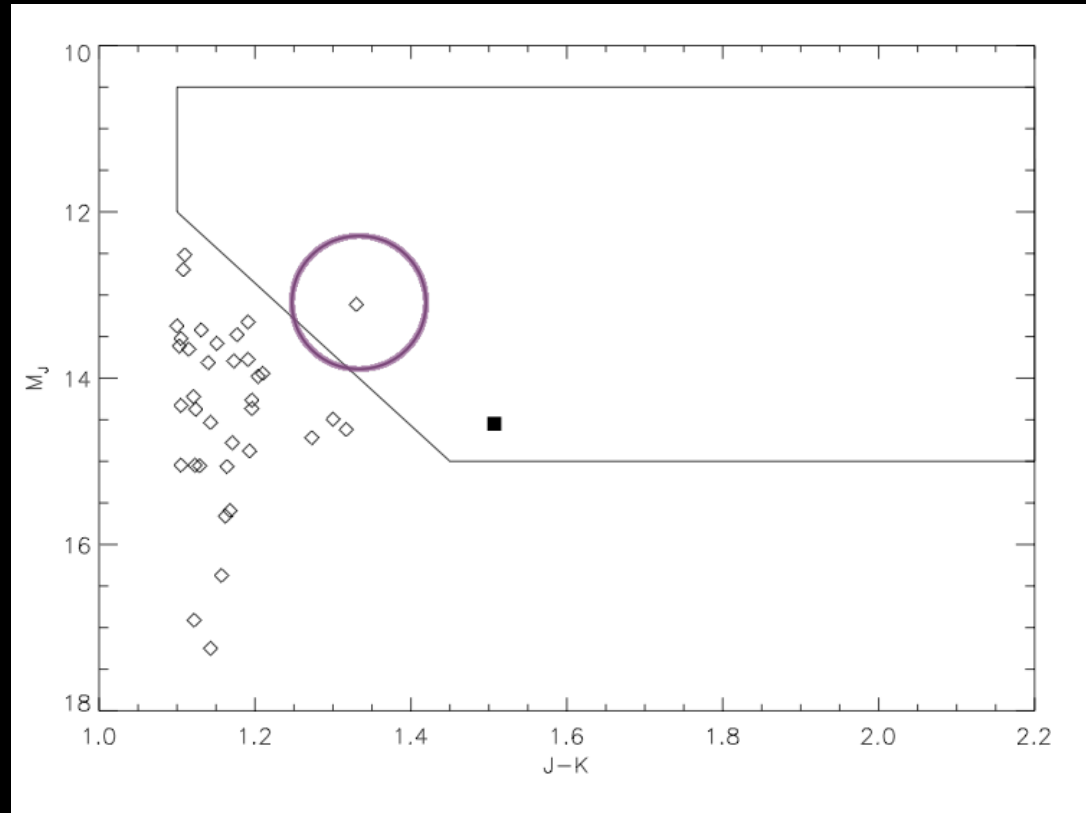
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Keck and Lick



Color-magnitude plot of the Keck
and Lick detection

- L dwarfs from the archive and known to be in binaries
- L dwarfs from the archive
- ◇ L dwarf candidates



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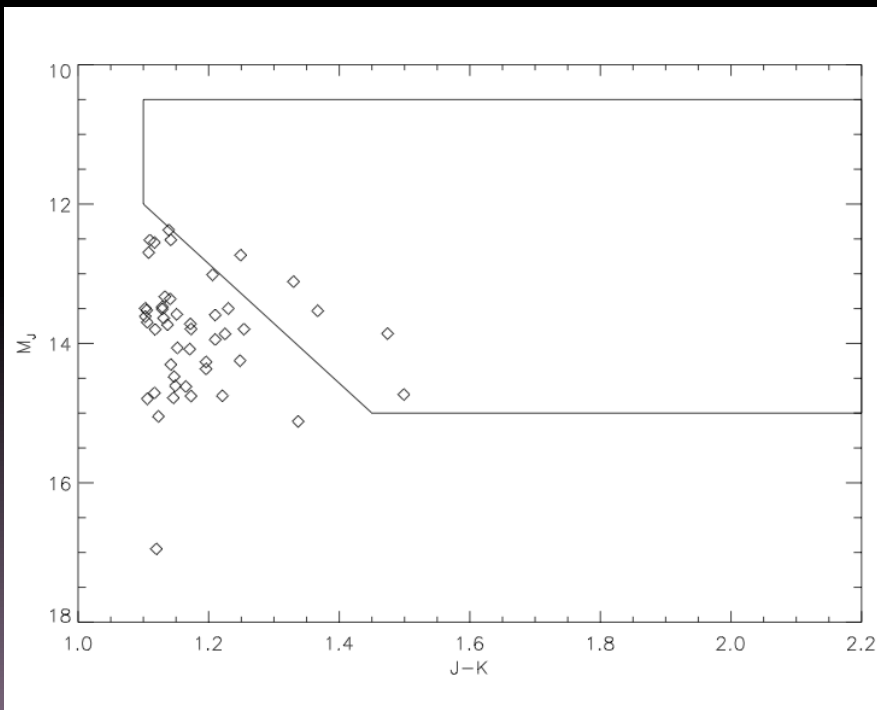
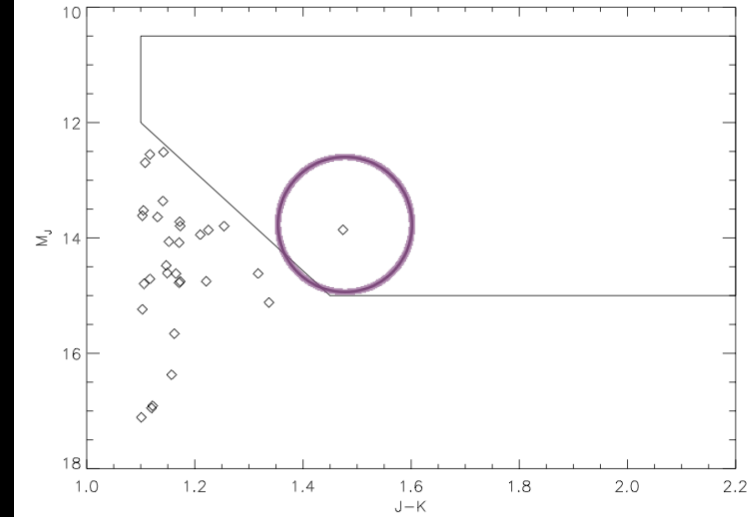
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HARPS

1 INTERESTING PAIR

- Low mass star M8 D
- Wide companion – High proper motion K7V



CORALIE

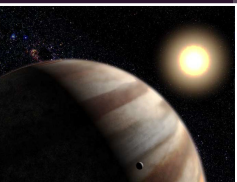
- 2 candidates already
matched with other PH stars
- 3 unknown L dwarfs

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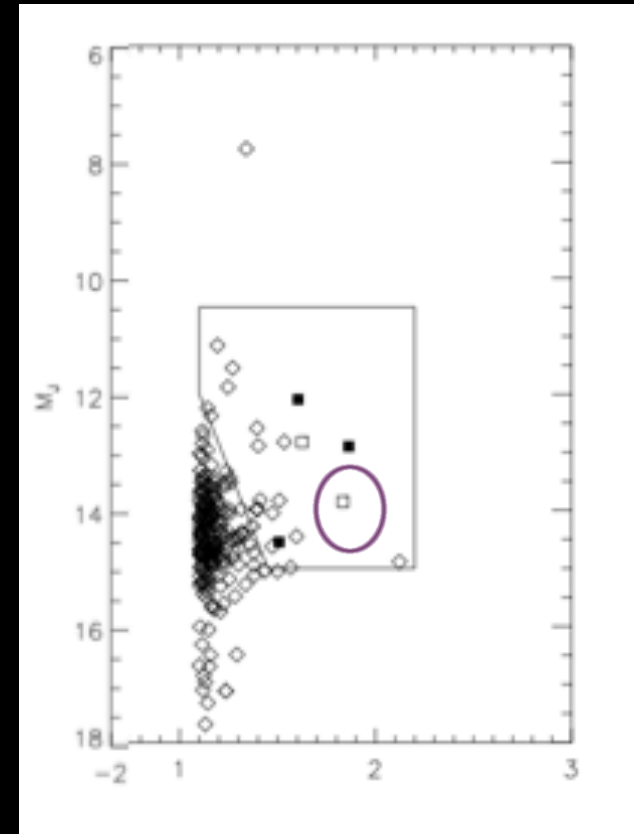
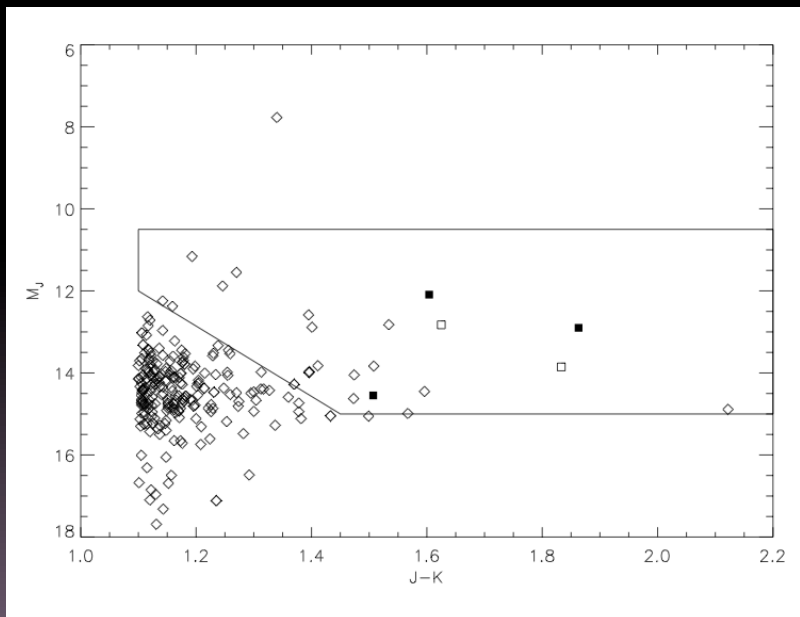
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GLIESE

- 5 known pairs
- 19 unknown candidates



Hipparcos

- 5 known pairs
- 13 unknown candidates

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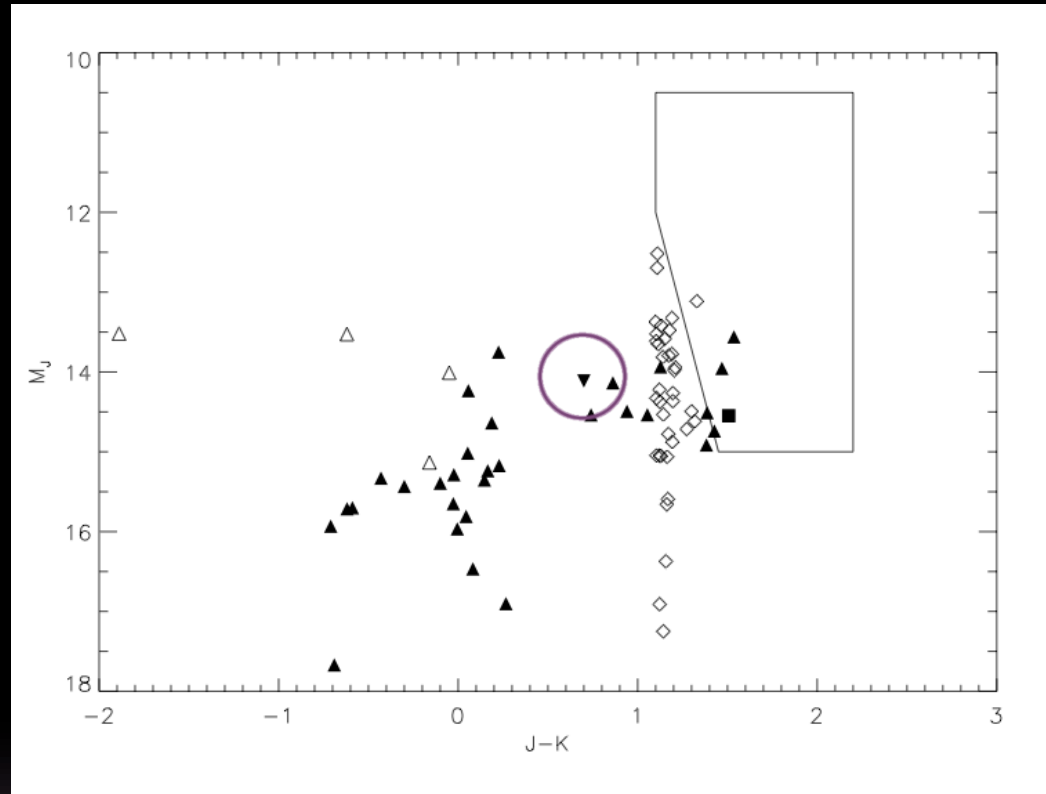
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- ▲ Known T dwarfs
- △ T candidates
- ▼ Eps Indi Ba, Bb
- ◇ L candidates

L and T candidates



Future work

-More multiepoch images from 2MASS, DENIS, Sloan and SuperCOSMOS



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PH stars + Potential White Dwarfs

- 1515 candidates – check for common proper motion

Proper motion and errors – Sloan

-59 possible common proper motion binaries

-Check visually using SIMBAD

-Exclude repeated candidates, white dwarf binaries and high proper motion stars



18 possible candidates
within $\sigma < 3$

20 possible candidates within
 $\sigma < 5$

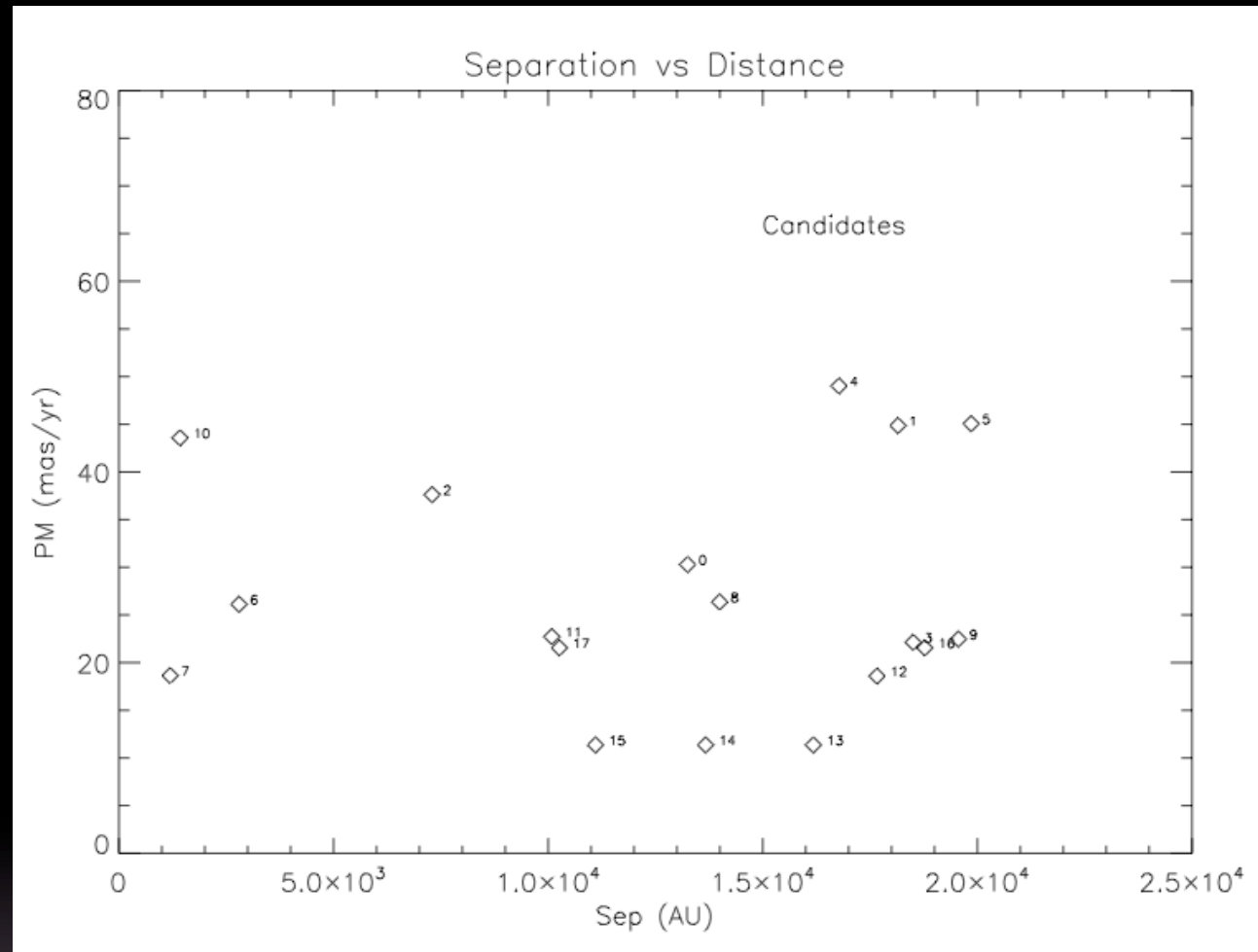


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Separation vs Distance for the 18 candidates

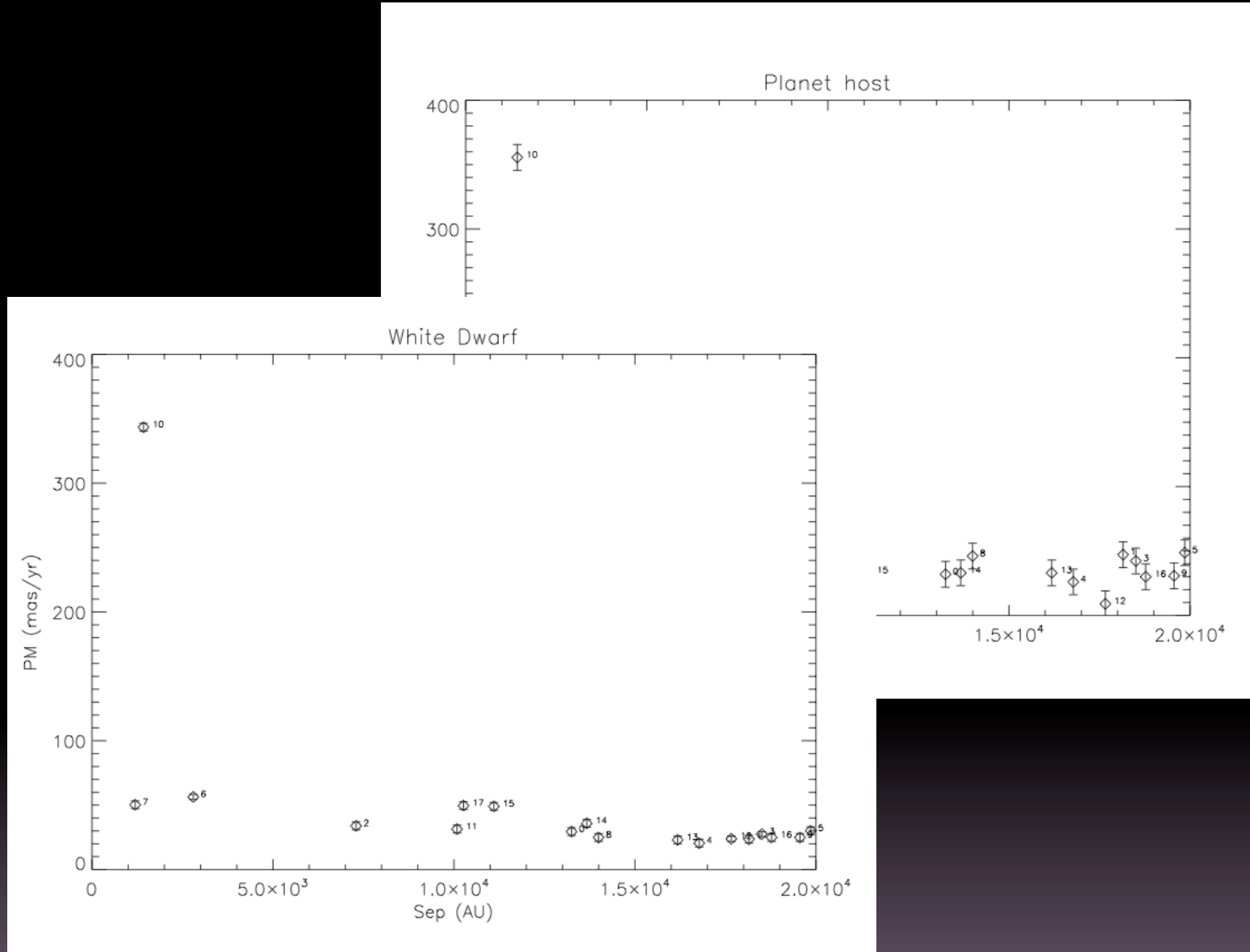


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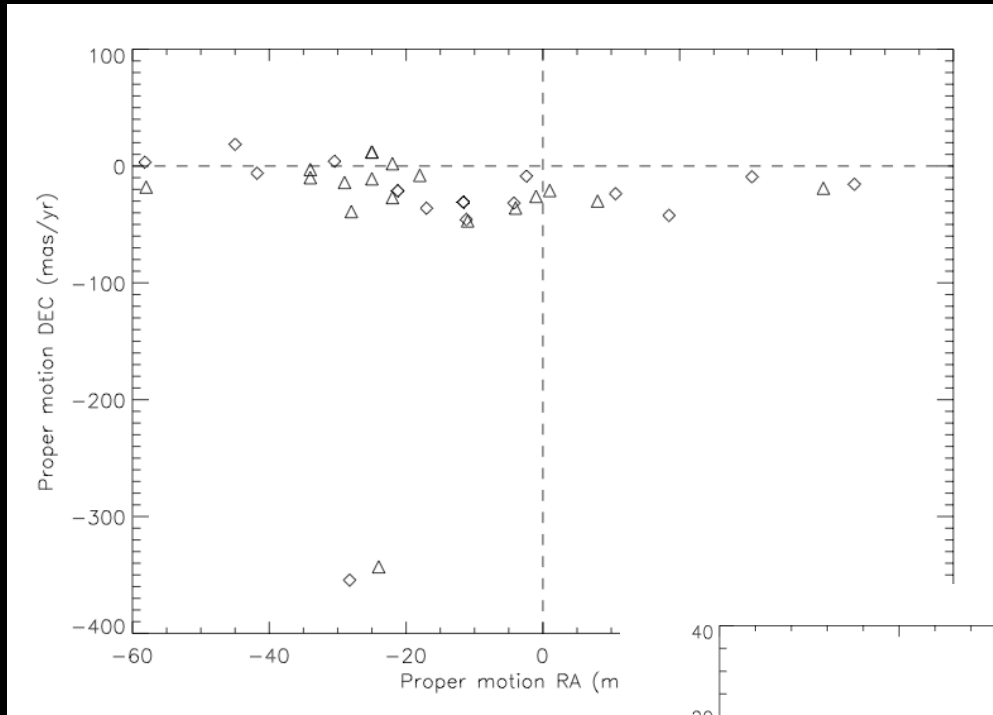
Proper motion vs Separation

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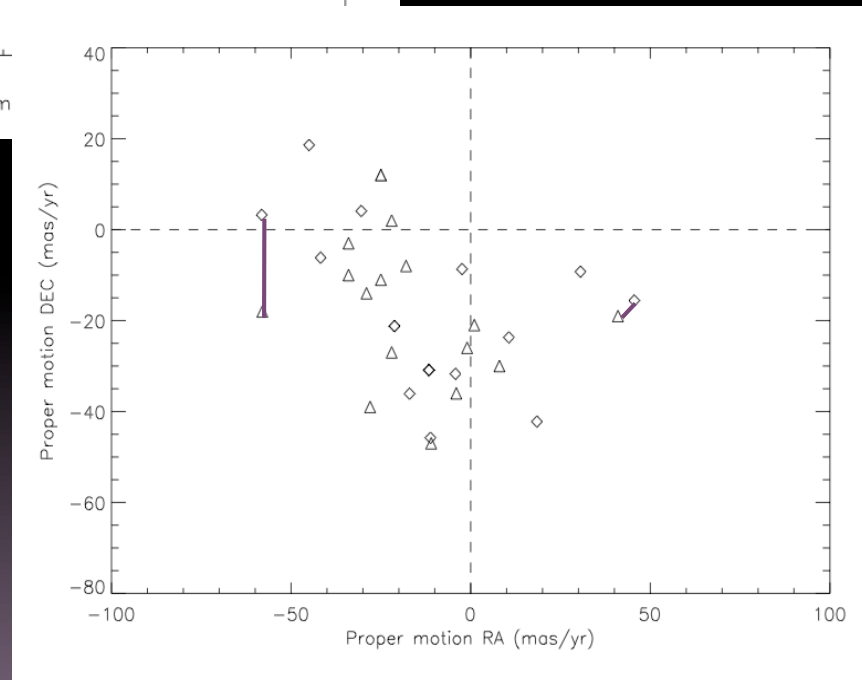
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Vector diagram

- ▲ White dwarf
- ◆ Main sequence star



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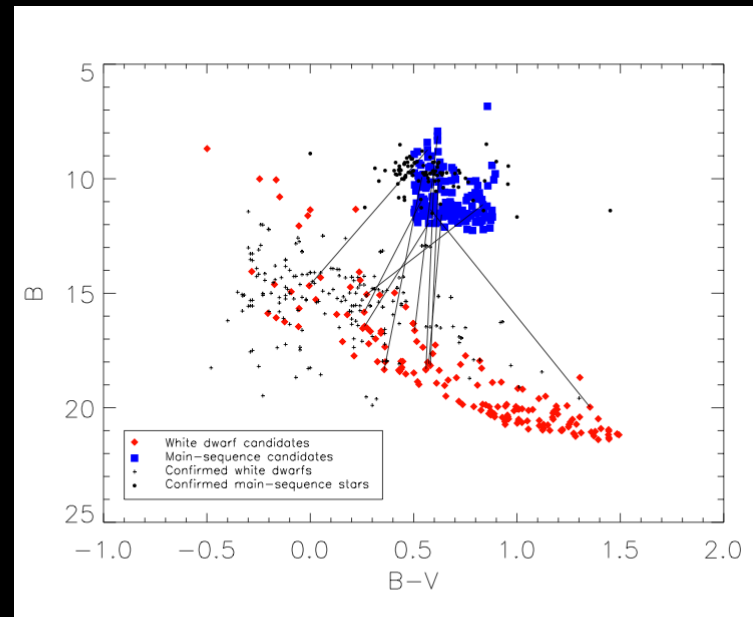
**White
dwarfs**

Tycho and SuperCOSMOS White dwarfs

Extend our sample to more SuperCOSMOS white dwarf stars and Tycho main sequence star.

-Study the possibility that DZ white dwarfs are contaminated by circumstellar matter – planetesimal remains.

Determine ages from the WD cooling age and therefore determine precise ages for the companions.



Colour-magnitude diagram. In blue, main sequence stars. In red, white dwarfs.



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