University of Hertfordshire

Understanding planetary systems: faint companions

Joana Gomes

Supervisors: David Pinfield, Hugh Jones, Ben Burningham
Collaborators: Avril Day-Jones, Silvia Catalan, Ralf Napiwotzki, James Jenkins

Outline

- Introduction to the project
- Work done so far
- Telescope time awarded
- Future work

Main goals of this project

- Search for and study benchmark ultracool companions

  Brown dwarf companions with well constrained properties will be useful to provide testbeds for giant planet and also brown dwarf atmospheric physics

- White dwarf companions to main sequence stars

  This will allow us to investigate the ultimate fate of planetary systems. A new hypothesis states that the metal lines in DZ white dwarfs atmospheres might be due to the accretion of remnants from planetary systems.

- White dwarfs as age constraining companions to planet hosts

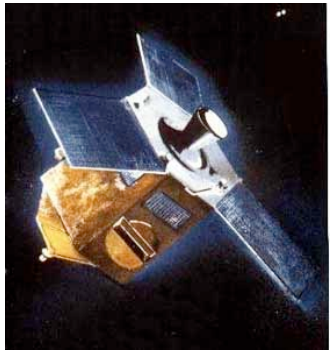
  Using the cooling age of white dwarfs it is possible to estimate the age of its companion and therefore place constraints in the age of the system.

- Sub-stellar companions to main sequence stars

  Study binaries with main sequence stars and brown dwarfs in order to analyze the possible effects on planet formation.

Work done this year

- Searching for faint companions to main sequence stars

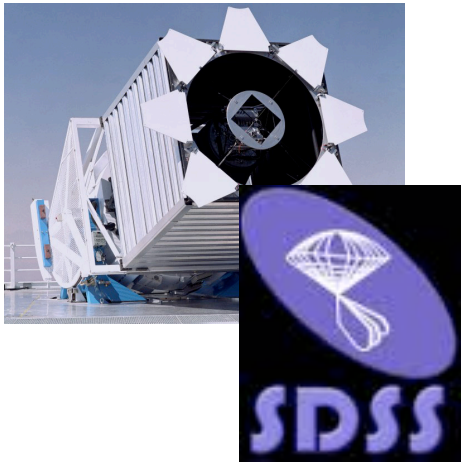


Search for L and T dwarfs using color cuts with the infrared bands J, H and K

Main sequence stars from Hipparcos and Gliese catalogues F, G, K stars

- 2 common proper motion binaries with T dwarfs
- 3 common proper motion binaries with L dwarfs – publish paper about these

- Searching for white dwarf and main sequence star systems

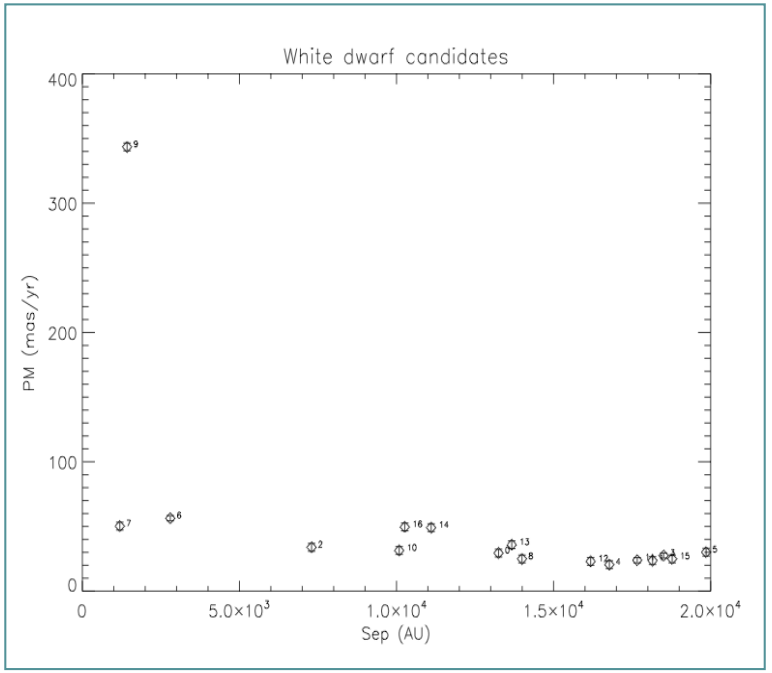


White dwarfs selected based on color cuts and reduced proper motion diagrams

+

Main sequence stars
Hipparcos, Gliese, HARPS, Coralie, Keck and Lick

36 binary candidates



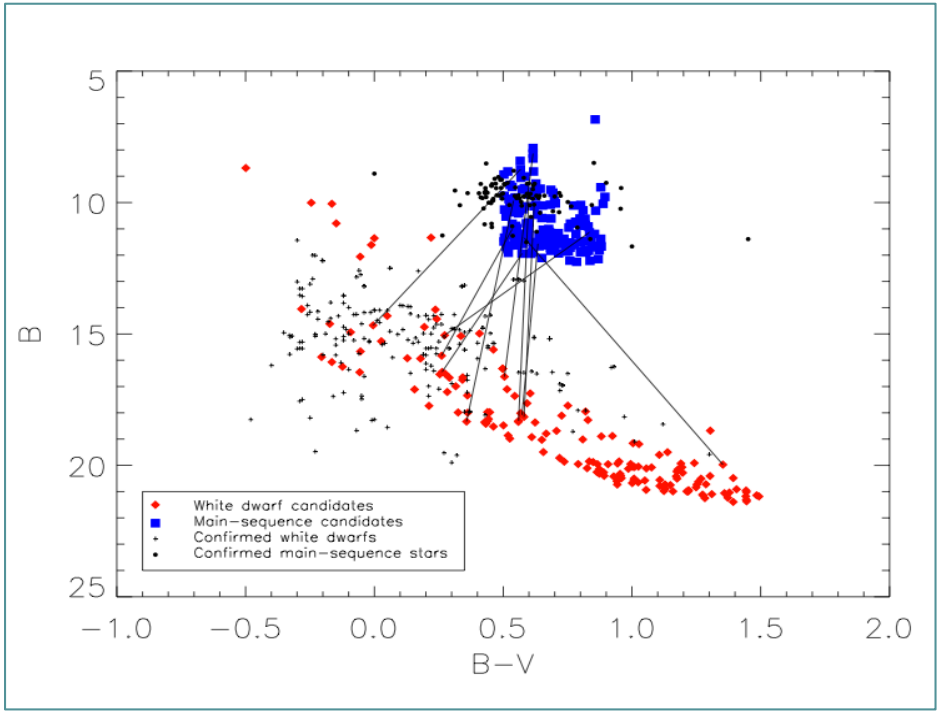
SuperCOSMOS Sky Survey

White dwarfs from the SuperCOSMOS catalogue

Tycho catalogue main sequence stars
$V < 12$

180 common proper motion candidates

40 of these white dwarfs were already observed with the IMAS telescope



Color-magnitude diagram of the white dwarf – main sequence star binary systems. The red filled diamonds are the white dwarfs and the blue squares the primary stars.

The binaries will be used to study the relation between spectral lines in DZ white dwarfs and the metallicity of the progenitor star.

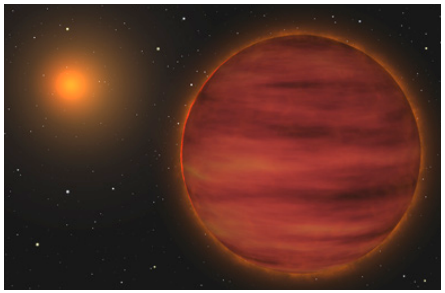
Estimate metallicities of the WD progenitor star by using the companion metallicities.

Hypothesis – White dwarfs were contaminated by circumstellar material of rocky exoplanet remnants

Telescope time

- 20 nights at 2m telescopes
  - FEROS – metallicites of main sequence stars in MS + WD binaries
  - INT + Terskol – common proper motion and photometric follow up of new ultracool candidate companions
- 6 nights at 4m telescopes
  - Common proper motion and photometric follow up of new ultracool candidate companions
- 11 nights at 6 – 8 m telescopes
  - VLT xshooter – spectroscopic observations for candidate ultracool dwarfs in binary systems
  - IMACS – white dwarf spectra for the MS + WD binaries

Future work

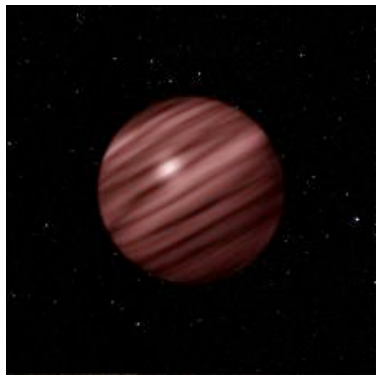


• Write and publish paper about the L dwarf + MS star binaries

•Follow up photometric observations to confirm the nature of the L and T dwarf candidates

• Reduce the images from Spartan and calculate proper motions for the new L and T dwarf candidates

• Begin to use UKIDSS and VISTA data to expand the search for ultracool companions to WD and MS stars



• Reduce the white dwarf spectra obtained at the IMACS telescope.

• Obtain metallicities for main sequence primaries. This will be done using literature and data from the FEROS spectroscopic observations.

• Use spectroscopic information to assess which of the white dwarfs have metal absorption lines in their atmospheres and analyze this sample in detail to study any DZ/progenitor metallicity trends.

• Write paper about the new sample of WD + MS stars.