FINDING T-DWARF COMPANIONS TO GAIA PRIMARY STARS

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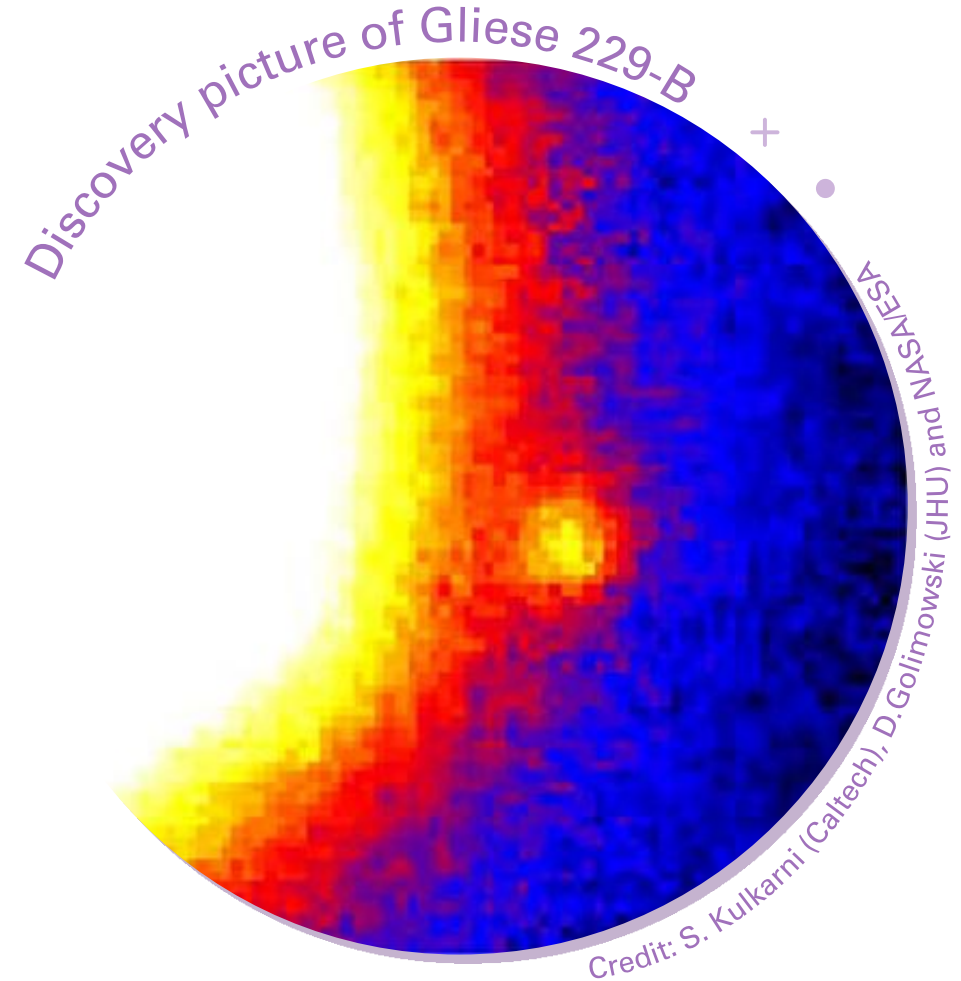University of Hertfordshire
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What are T-Dwarfs?

- Brown dwarfs can have spectral types M to Y

- T-dwarfs are second-coolest spectral classification

- Temperatures typically below 1300K

- NIR spectra characterised by methane absorption at 2μm

Artist's impression of a T-dwarf

Credit: NASA/JPL-Caltech

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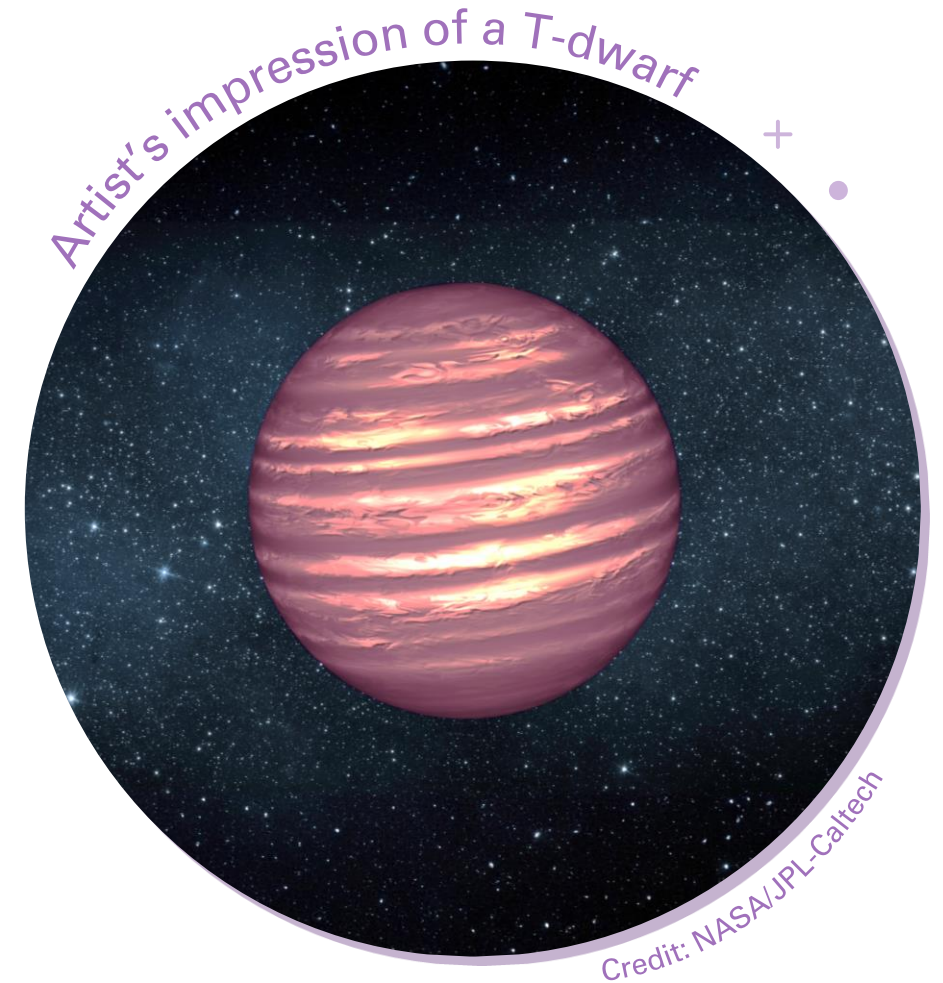
Why Study T-Dwarfs?

- The first T-dwarf was discovered in 1994

- The physics of T-dwarf atmospheres is an active area of research
  - Clouds, condensates, mixing

Discovery picture of Gliese 229-B

Credit: S. Kulkarni (Caltech), D.Golimowski (JHU) and NASA/ESA

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The Problem™

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- To be able to determine the properties of a T-dwarf, we need to know some of the properties of the T-dwarf...
  - Age, mass and composition depend on effective temperature, surface gravity and metallicity

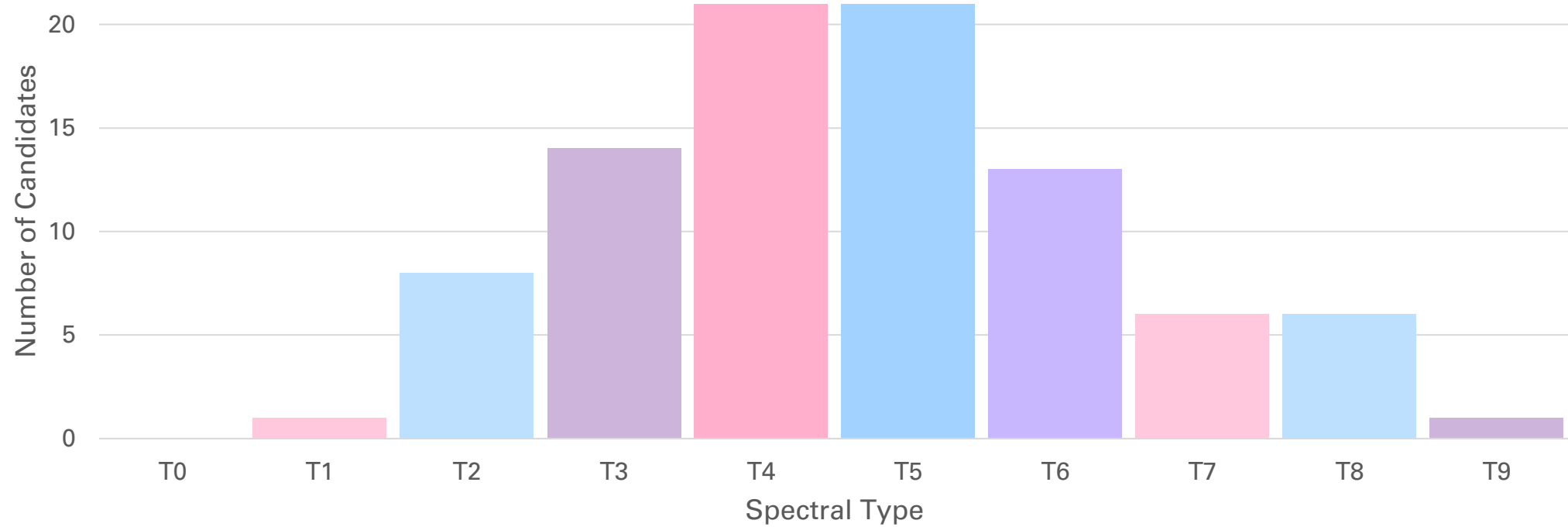University of Hertfordshire UH

Companions to the Rescue!

- Infer the properties of companion brown dwarfs from their primaries

- Stars are easier to determine properties of, and a lot already have published ages etc

- Assume common formation of a brown dwarf with its primary star

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Finding Potential Companions

- Find potential T-dwarfs using VHS and DES

- Applied colour, magnitude and distance cuts to eliminate non-brown dwarf objects

- Potential primaries identified in Gaia DR3 and CatWISE
  - Out to 1 degree away from T-dwarf candidate

- Remove non-common proper motion primary/brown dwarf pairs

- Total: 91 potential T-dwarf companions

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Spectral Types

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False Alarm Probabilities

- Number of line-of-sight associations in parameter space of each candidate

- Values < 0.05 -- deem to be confirmed companions

- 6 confirmed companions so far

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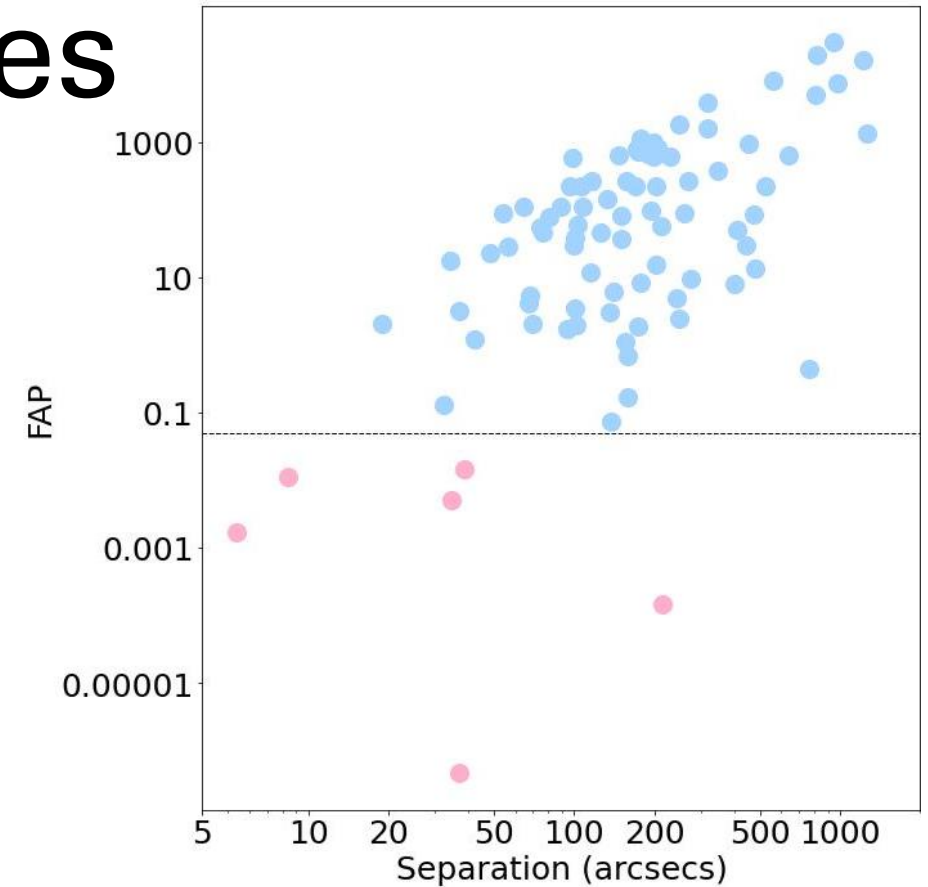
Observations

- 2 nights of observations using FourStar and FIRE on the Baade Magellan telescope in Chile

- FourStar observations of 52 candidates, including confirmed companions

- FIRE observations of the 6 confirmed companions

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Future Work

Finish up reduction of observations

Measure updated proper motions and calculate new false alarm probabilities

Use properties of primary stars to determine properties of confirmed companion T-dwarfs

Extend this method to other spectral types

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Conclusions

- Benchmark T-dwarfs are scarce due to their faintness and lack of well-established relations between their properties

- Using companion brown dwarfs can help by inferring properties from the primary

- We found potential primaries using VHS, DES, Gaia and CatWISE

- Total 91 potential companions, 6 of which we consider confirmed companions

- Observations needed to confirm other companions and to derive properties from spectra

- Hopefully extend to other spectral types in the future

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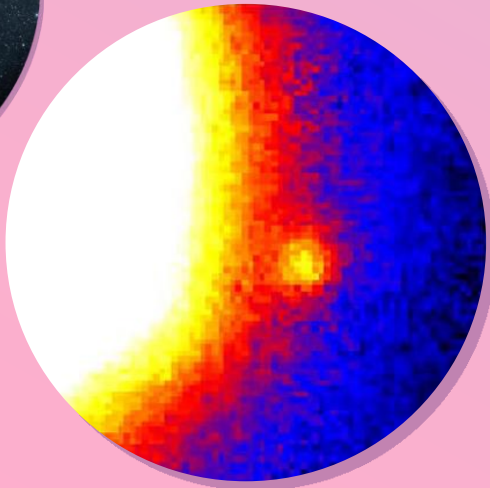
THANK YOU ☺

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