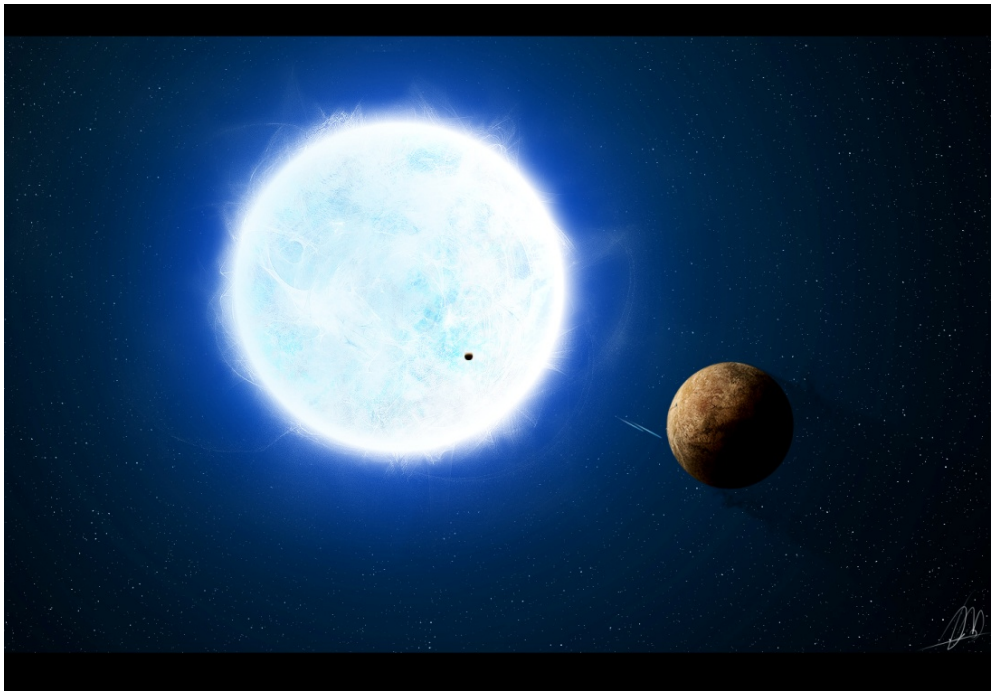
A substellar cuckoo?



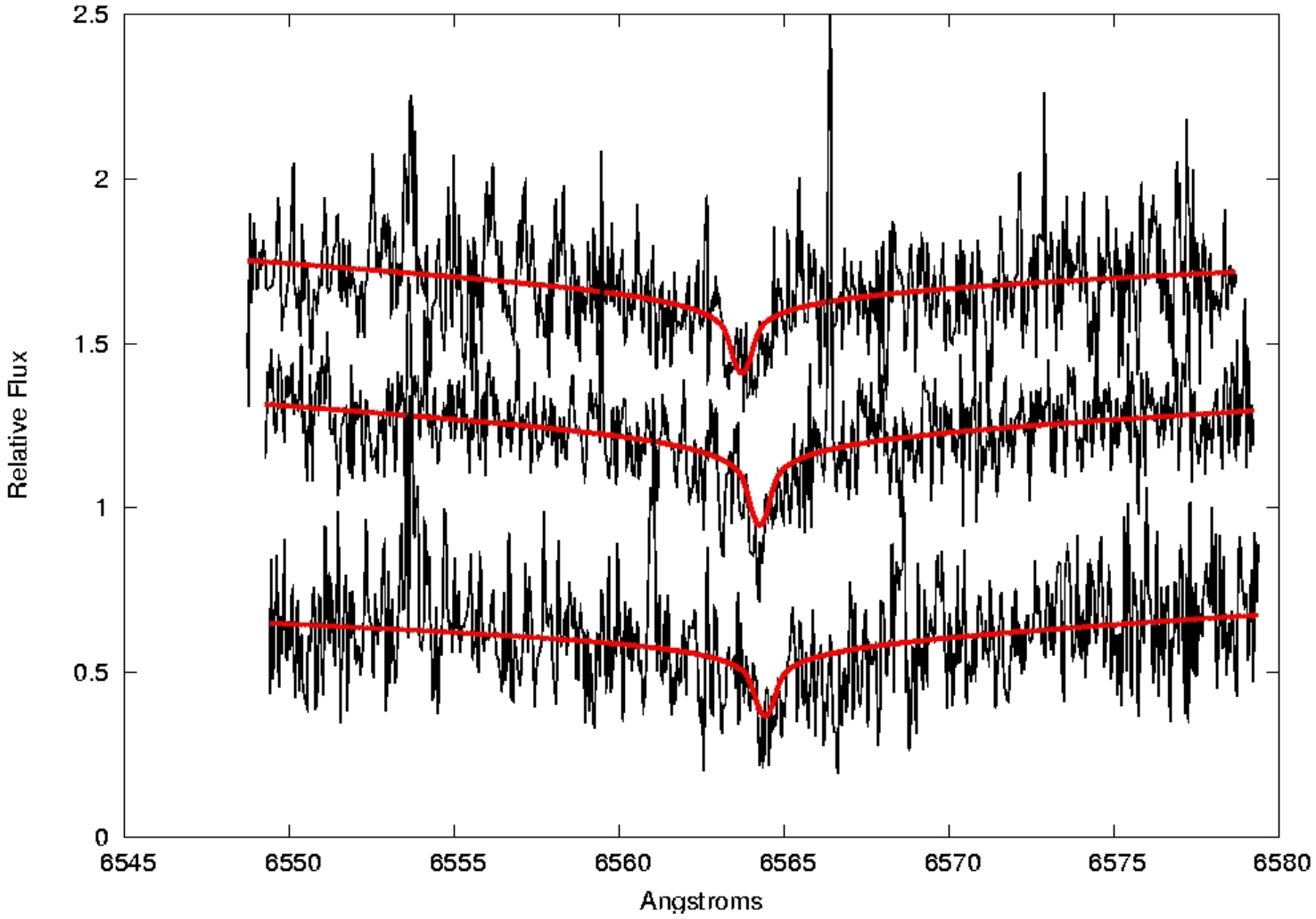
S.L. Casewell, M. R. Burleigh, G. A. Wynn, R. D. Alexander, R. Napiwotzki
K. A. Lawrie, P. D. Dobbie, R. F. Jameson, S. T. Hodgkin

Praesepe

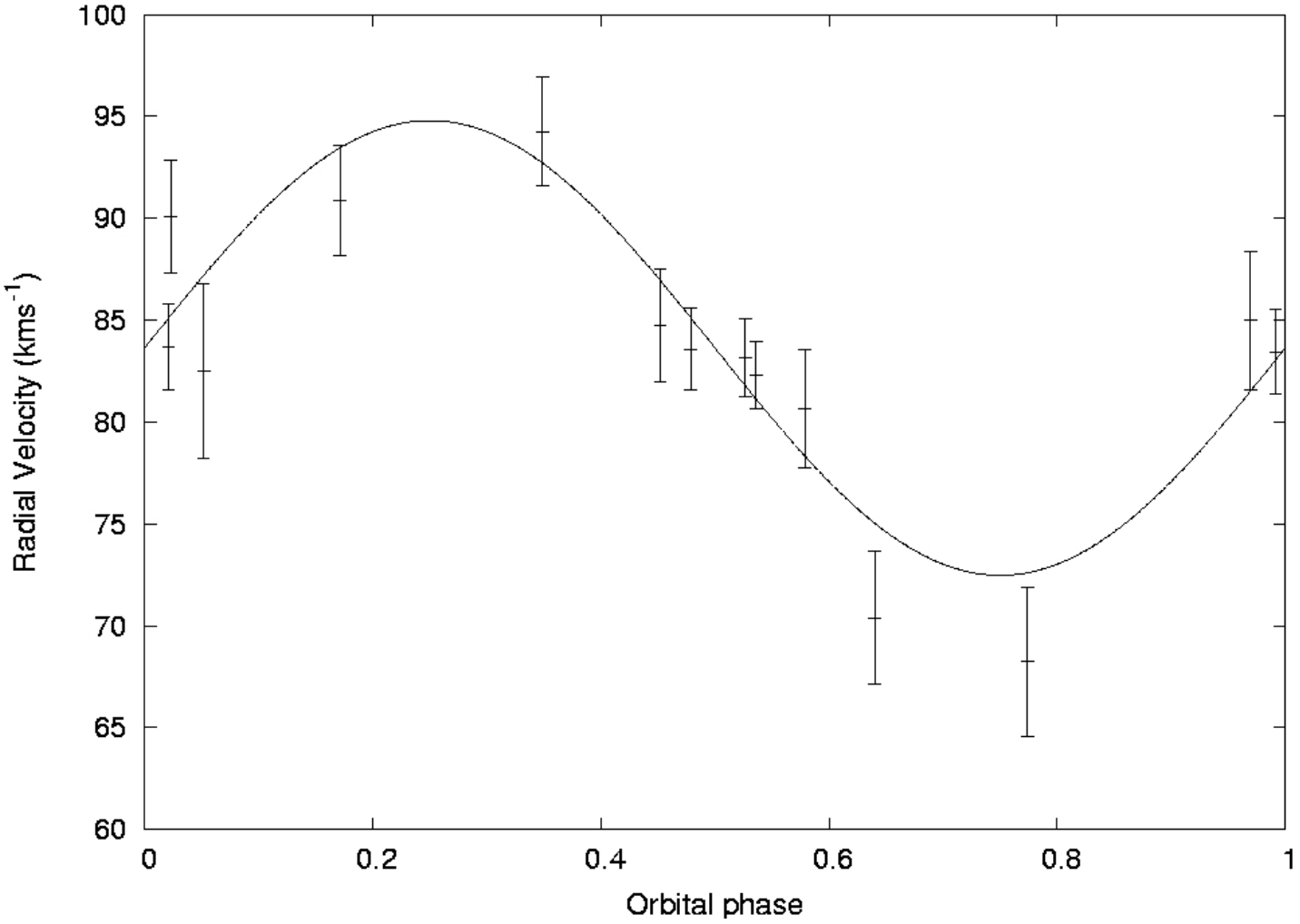
- 625 Myr
- 177 pc
- 10 White dwarf members
- 1 magnetic
- ~15000 K
- ~0.8 $M_{\odot}$

A substellar cuckoo?

Radial Velocity



Period



4.2 hrs
11.3 km/s
M>25Mjup

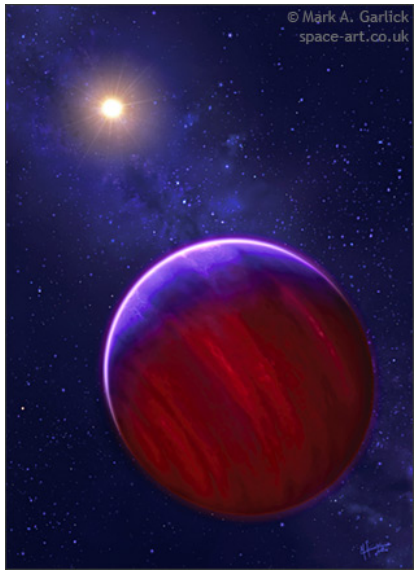
A substellar cuckoo?

White Dwarf + ?

- Period 4.2 hours
- Velocity semi-amplitude 11.3 km/s
- Msin i 25M_{Jup}
- Separation 0.006 AU

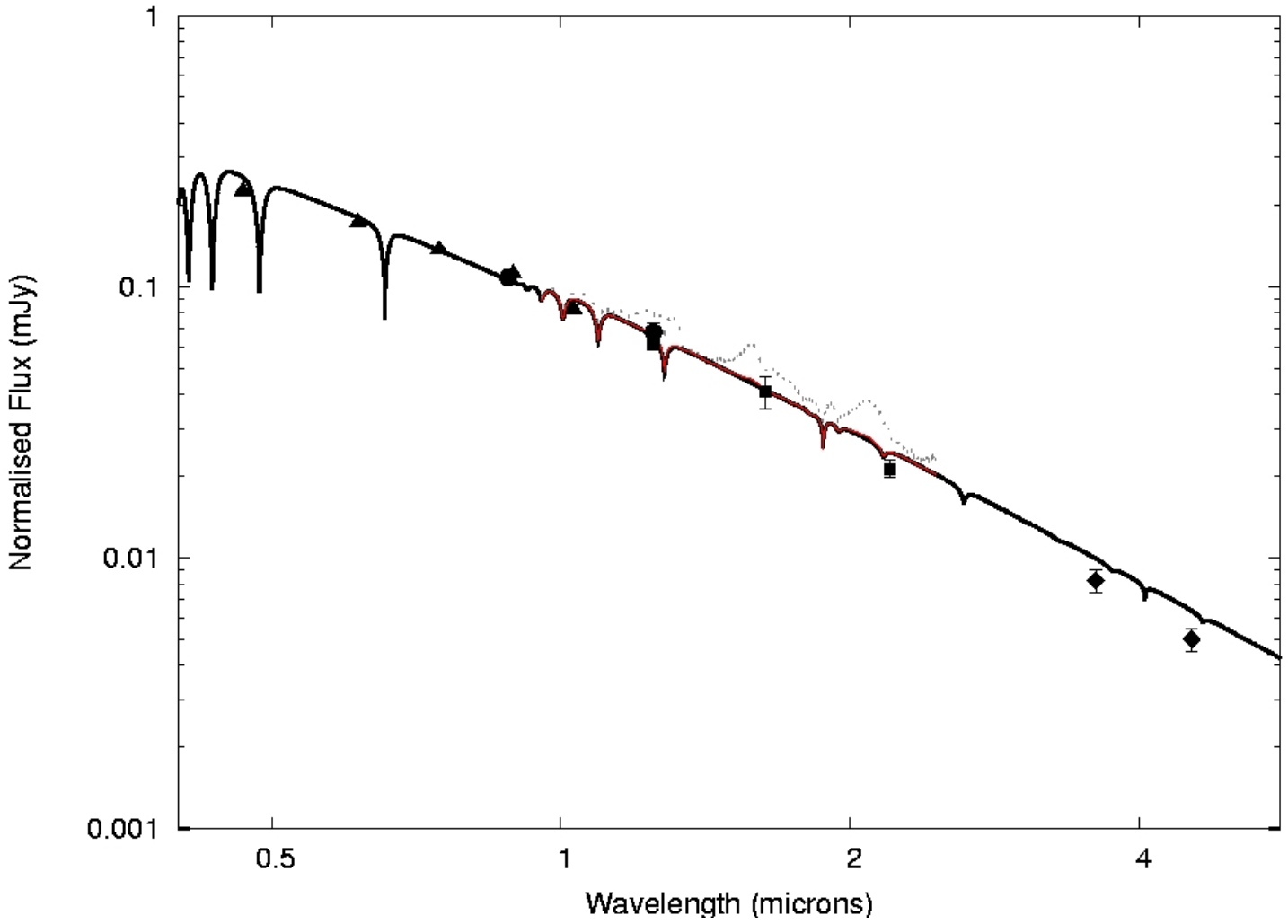
- Mass 0.8 $M_{\odot}$
- M_{prog} 3.5 $M_{\odot}$
- Cooling time 313 Myr

What about photometry?

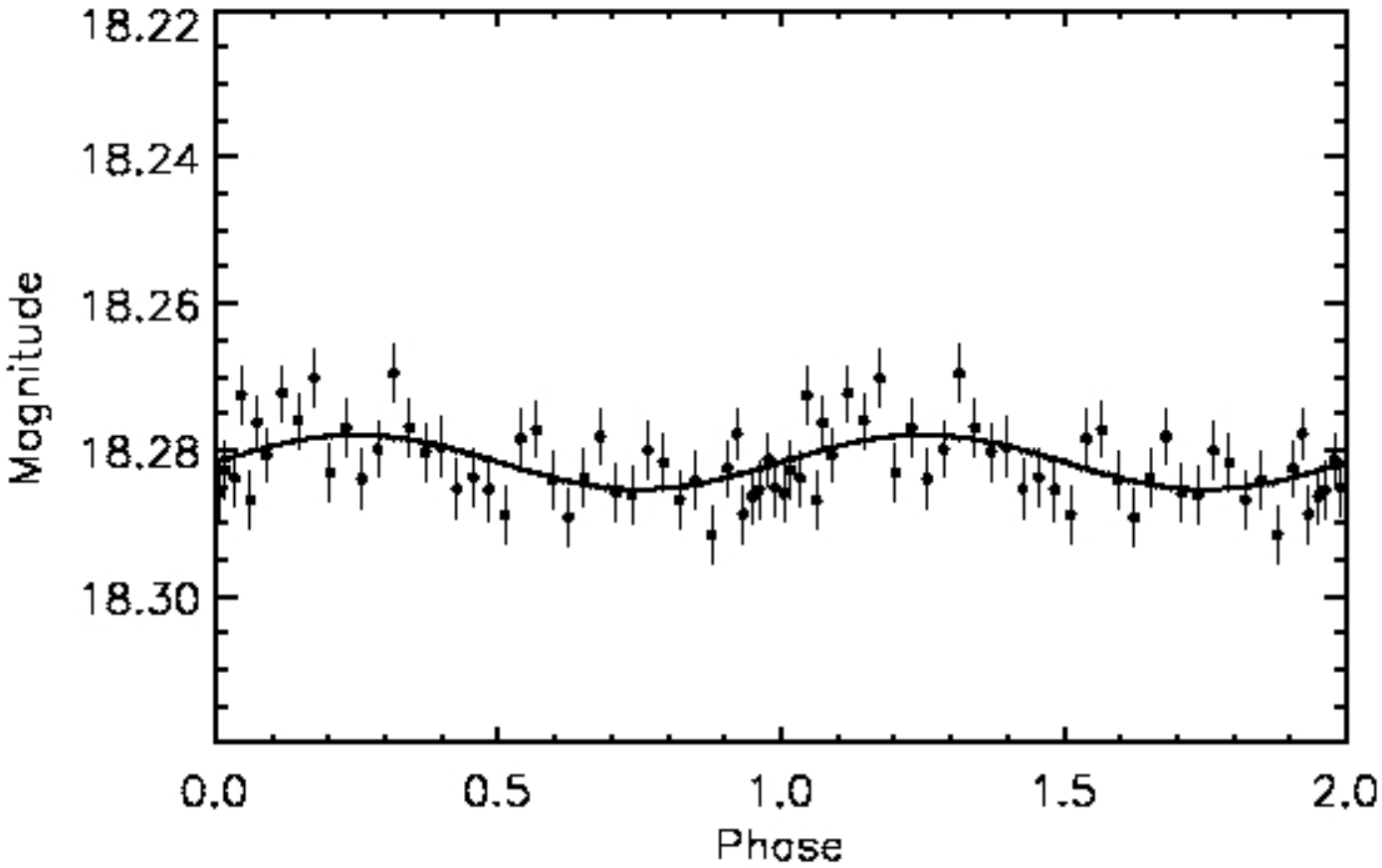


Excess?

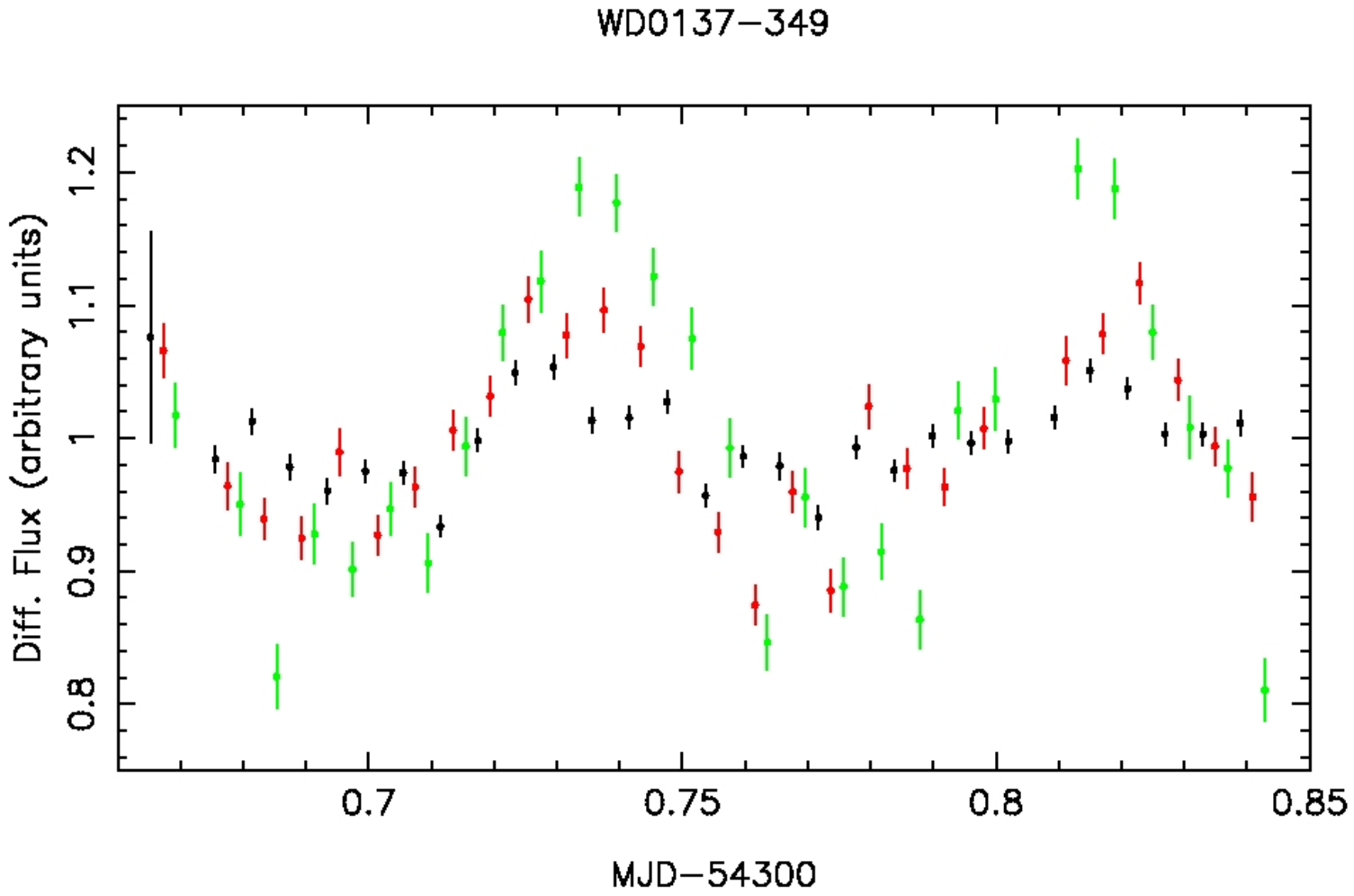
Max Mass 30 M_{Jup}



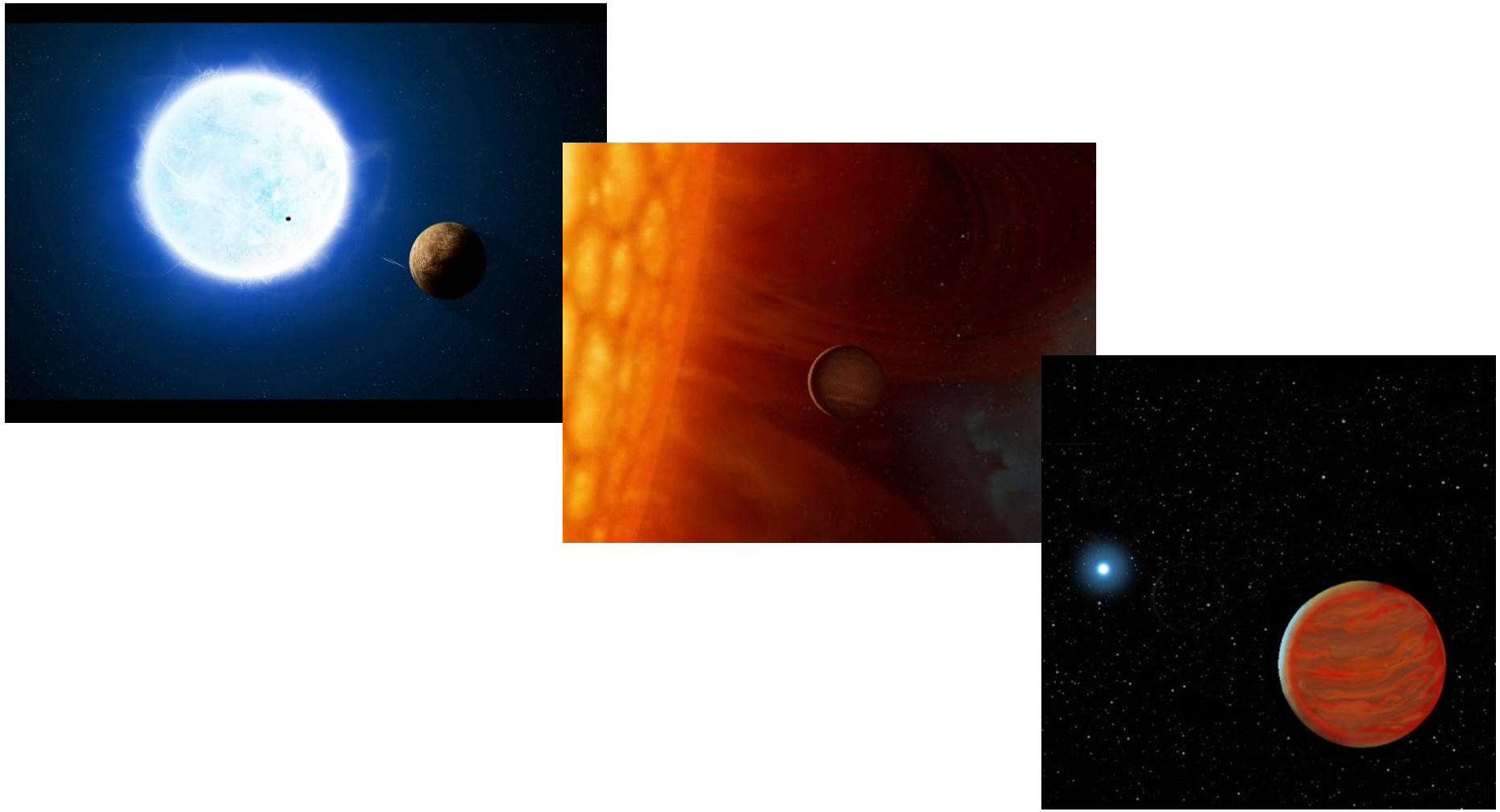
Heating?



Heating?


WD0137−349
Diff. Flux (arbitrary units)
0.8
0.9
1
1.1
1.2
0.7
0.75
0.8
0.85
MJD−54300

Evolution



AGB Phase

- Orbit is too close for T dwarf to have formed in situ – must have migrated
- This system has gone through AGB phase – WD mass = 0.8 $M_{\odot}$, B9 star
- Only 2 known WDs with close BD companions that have survived CE evolution
- Progenitor mass is at upper end of mass range to give core of 0.8 M
- CE occurred at the end of AGB evolution, and caused star to eject envelope
- Initial separation was probably ~2AU

Formation?

Planetary

- Disk formation
- Core accretion?
- Gravitational instability?

Binary

- Binary route unknown, but
- High mass ratio binaries rare

Formation?

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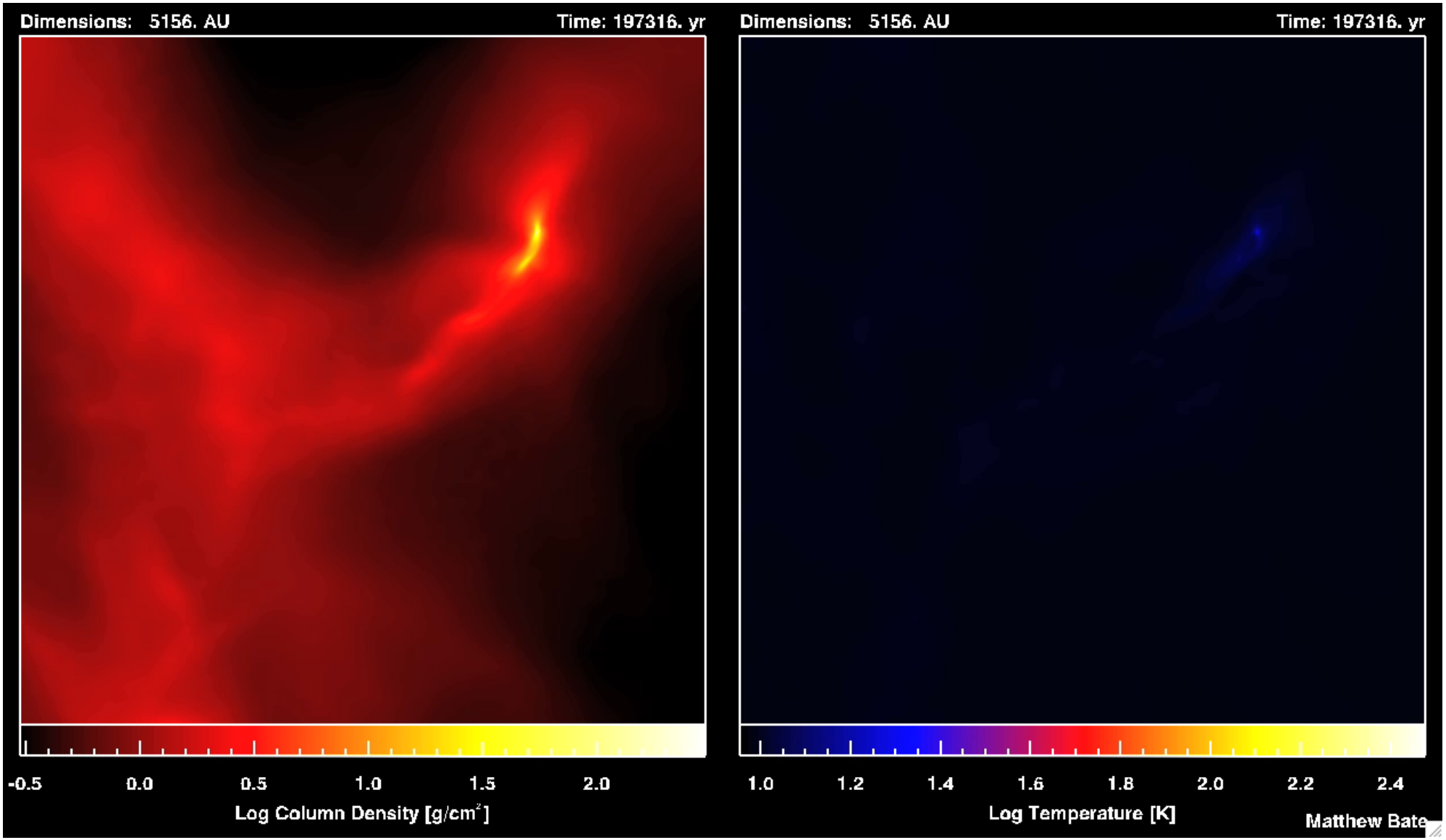
Capture

- By White dwarf?
- By B star?



A substellar cuckoo?

Conclusions

- Binary system of 0.8 $M_{\odot}$ DA white dwarf + 25-30 M_{Jup} T dwarf
- CE evolution occurred at end of AGB, ejecting envelope
- T dwarf migrates inwards
- Formation is likely to be capture early in the life of the cluster
- T dwarf ejected from binary, and captured by B star
- First object of this type to have a known formation mechanism