Uncovering Faint Companions of WISE Brown Dwarfs

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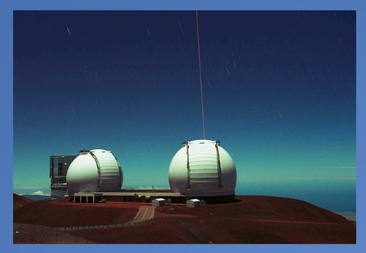
and the WISE Brown Dwarf Team

WISE has uncovered brown dwarfs with effective temperatures ~400K, bringing us ever closer to finding objects with Jupiter-like atmospheres (T=128K). Being so cold, these brown dwarfs are intrinsically faint and necessarily close, making them the best targets in which to search for faint companions. Because the components in a binary are coeval and have the same metallicity, binaries provide critical constraints when comparing brown dwarf observations to model atmosphere results. We have been using the Hubble Space Telescope and W.M. Keck Telescope to obtain high resolution images of WISE-discovered brown dwarfs with spectral types T8 and later (T<700K) in order to search for fainter and colder companions. In this poster I discuss the HST and Keck observing programs and provide some of the preliminary results from the survey.

Keck Telescope Observations

- 49 Objects imaged with NIRC2 AO (NGS and LGS)
- Program PIs: Gelino, Beichman, Wright
- All objects observed with *H* filter (suspected binaries observed with *J* and *K*)
- Both Narrow (10 mas/pix) and Wide cameras (40 mas/pix) used
- Exposure times typically 30 minutes (*H* ~23 mag)
- Four binaries resolved

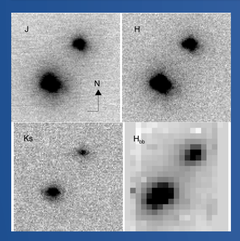


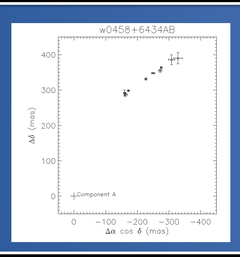
Hubble Space Telescope Observations

- 37 Objects imaged with WFC3/IR
- One dedicated program (PI:Gelino)
  - 13 objects (F110W & F160W)
- Other objects from programs to support grism observations (PIs: Cushing & Kirkpatrick)
  - Filters (F105W, F110W, F125W, F140W, F160W)
  - Multiple epochs for some objects
- One resolved binary

Results

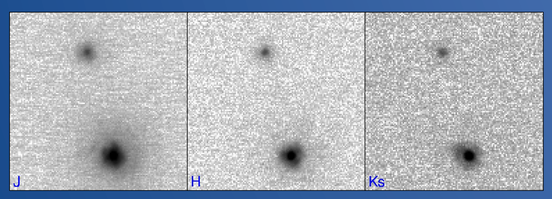
WISE 0458+6434AB





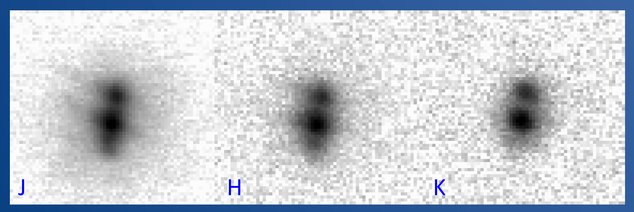
- Brightness differences ~1mag (Gelino et al. 2011)
- Separation decreasing at a rate of ~45mas/yr
- Resolved spectral types: T8.5 & T9.5 (Burgasser et al. 2012)
- Distance = 14 pc (Dupuy & Kraus 2013)

WISE 1217+1626AB

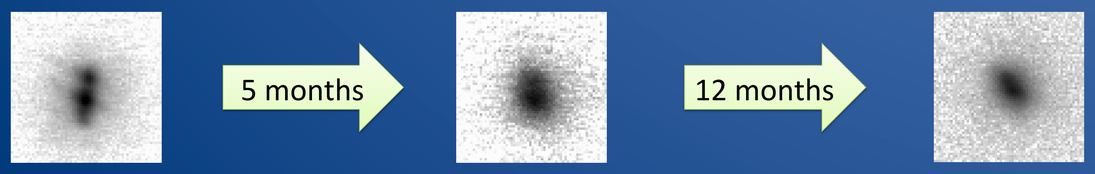


- Independently discovered by Liu et al. (2012)
- Resolved spectral types: T8.5+Y0 (Leggett et al. 2014)
- Brightness differences ≈2.2 mag
- Separation ≈ 760mas
- Distance = 10 pc (Dupuy & Kraus 2013)

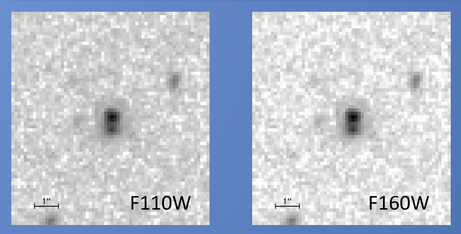
NEW BINARY!!



- Estimated types: T8 + T8.5(?)
- Brightness differences ~0.5 mag
- Separation ~90mas
- Orbital motion is shown over 3 epochs

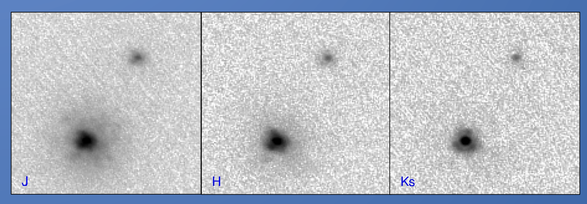


NEW BINARY!!



- Estimated types : T9 + T9-T9.5(?)
- Separation ~500mas in WFC3/IR imaging
- Brightness differences ~1 mag
- Need another epoch to confirm common proper motion
- Distance = 9 pc (Tinney et al. 2014)

WISE 1711+3500AB



- Independently discovered by Liu et al. (2012)
- Estimated types are T8 and T9.5
- Brightness differences≈2.8 mag
- Separation ≈ 780 mas
- Distance ~18pc

Spectral Type	Keck Targets	HST Targets	Total Unique Objects	Binaries	Binary Fraction (%)
T8	19	9	28	2	7^{+8}_{-2}
T8.5	9	1	10	1	10^{+16}_{-3}
T9	9	8	16	2	13^{+12}_{-4}
T9.5	3	2	3	0	<36
Y0	7	9	11	0	<14
Y0.5	0	2	2	0	<45
Y1	1	4	4	0	<30
>Y1	1	2	2	0	<45
Totals	49	37	76	5	7^{+4}_{-2}

These fractions are less than those for earlier types (L0-T8 ~20%; Burgasser et al. 2006). This could point to either a less efficient binary formation mechanism at very low masses or a difficulty in finding these very faint companions.