The Properties of Young Brown Dwarfs

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What’s a Brown Dwarf?

M Dwarf
75 $M_{\text{Jup}}$
2,700 K

L Dwarf
65 $M_{\text{Jup}}$
1,700 K

T Dwarf
30 $M_{\text{Jup}}$
900 K

Jupiter
180 K

The Sun
1050 $M_{\text{Jup}}$
5,800 K

Artist Rendition by R. Hurt
What is a Brown Dwarf?

- Not enough mass to sustain proton-proton Nuclear Fusion in its core like the sun.
- Gravitational Potential energy from the gas coalescing to form brown dwarf becomes heat.
- Gas pressure supports the brown dwarf.
- As the gas cools it emits light (mostly infrared).
- Much dimmer than the sun or other stars.
What study Brown Dwarfs?

• Limits of conditions for fusion.
• Theory suggest there should be large numbers of the objects – how do we find them?
• Do they develop like stars with planetary systems?
  – How many?
  – What range of sizes?
Our primary observatory.
Where to Look?
Search Method

• Observe same area of sky 5 – 10 years apart with wide surveys.
• Look for movement!
• Process includes writing software to resize and align images.
• Then scan the images (automatically and manually) for noticeable differences.
• This process is partially complete.
Follow Up

- Use other telescopes to observe the candidate objects at different wavelengths to determine their temperatures
- If the objects are cool enough follow up with spectroscopic observations (from ground and space based telescopes)
Spectra – Confirmed Brown Dwarf!

Dashed line is M-dwarf of same spectral type. Arrow indicates presence of lithium.
Goals

• Find young brown dwarfs based on photometric temperature.
• Look for excess in Infrared (5 -10 μm) spectrum to indicate dust in a disk surrounding the brown dwarf.
• Determine composition, size and dynamics of disk.
• Hope to find system(s) with planet formation in disk.
DANGER! – CAUTION!
DO NOT FEED THE ASTRONOMER!