Atmospheric Properties of Brown Dwarfs

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Abstract:

- We present near-infrared spectra of 80 L dwarfs.
- We fit these data to synthetic spectra with a range of effective temperatures, gravities, and grain sedimentation efficiencies.
- From this comparison, we investigate the range of physical properties spanned by the L dwarf spectral class.

Introduction:

- Brown Dwarfs form in a way similar to stars; however their low mass makes it impossible for them to sustain nuclear fusion and therefore they cool with time.
- The L dwarf class is comprised of both low-mass stars and brown dwarfs.
- The atmospheres of L dwarfs are dominated by condensate clouds.
- The goal of this poster is to study the properties of these clouds (sedimentation efficiency) and the physical properties of L dwarfs (effective temperature and gravity).

Spectral Models:

- Models created by Marley and Saumon.
- Re-sampled to R=250
- Effective temperatures between 1200 - 2400K
- Sedimentation Efficiencies (f_{sed}) of 1, 2, 3, with 1 indicating the thickest clouds.
- Log(g) of 4, 4,5, 5, 5.5.
- The models do not include absorption due to FeH, which dominates the H-band around 1.6-1.7 microns. As a result, the H-band was not used to find the best fit model.
- Effective temperature coarsely grid in 100K strides so the resultant temperatures are rough.

Near-Infrared L Dwarf Spectra:

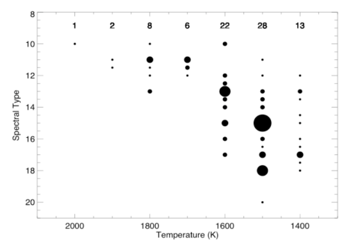
- Examples of the spectra are shown in Figure 1.
- Obtained with the SpeX spectrograph on the IRTF telescope.
- Spectra cover 0.8-2.5 microns at R=250.
- 80 targets with spectral types based on optical spectra.

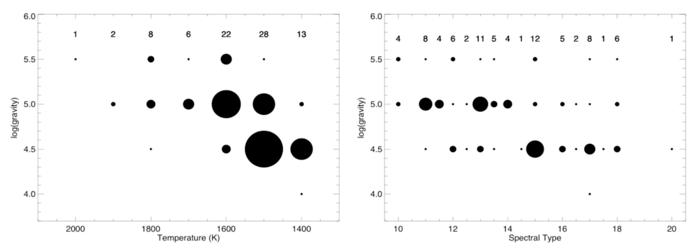
Best Fit:

- We found the best fit model with the minimum total difference for each spectrum by subtracting the fluxes and then dividing by the model's flux.
- They are normalized to the J band around 1.2-1.3 microns.
- In general, the fits are quite good. See Figure 1.

Results:

- In Figure 2 we show the comparison of the best-fit parameters for all 80 L dwarf spectra. The size of the symbol corresponds to the number of objects occupying that data point and the number at the top of each plot represents the quantity of objects in each column.
- As expected, there is a general trend of decreasing effective temperature with spectral type.





- L dwarfs span a range of gravities with most having log(g) = 4.5 or 5. We find 11 objects with a a slightly higher gravity of 5.5 and only one object with a low gravity of 4.0.
- Most of the L dwarfs appear to be cloudy. The majority of them with f_{sed}=1 and very few with f_{sed}=3.

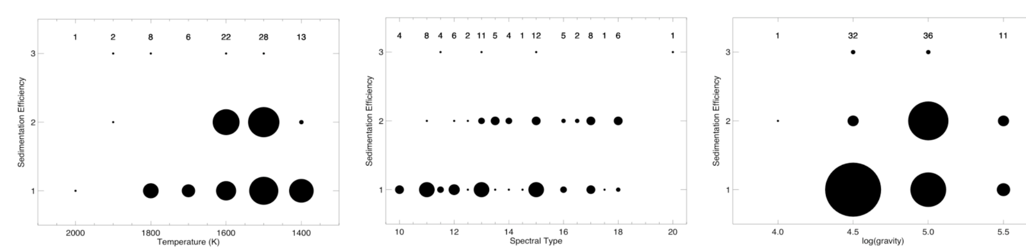


Figure 2: Comparison of the best-fit parameters for all 80 L dwarf spectra. The size of the symbol corresponds to the number of objects occupying that data point. The number of objects in each column is labeled at the top of each plot.

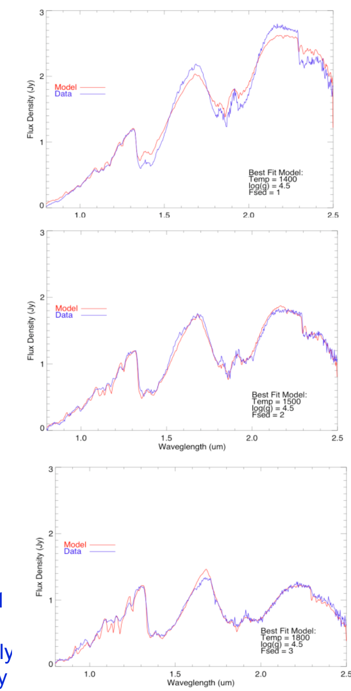


Figure 1: Example of the best fit model spectrum (*red*) for three different observed L dwarfs (*blue*).

Future Work:

- Use finer temperature grid.
- Investigate difference between low-gravity and cloud effects.
- Include metallicity parameter.
- Add T dwarfs to analysis.

Acknowledgements:

This work is supported in part by the New York NASA Space Grant Program. KLC is supported by an NSF Astronomy and Astrophysics Postdoctoral Fellowship under award AST-040148.