Examining Cloud, Metallicity, and Gravity signatures in Brown Dwarfs

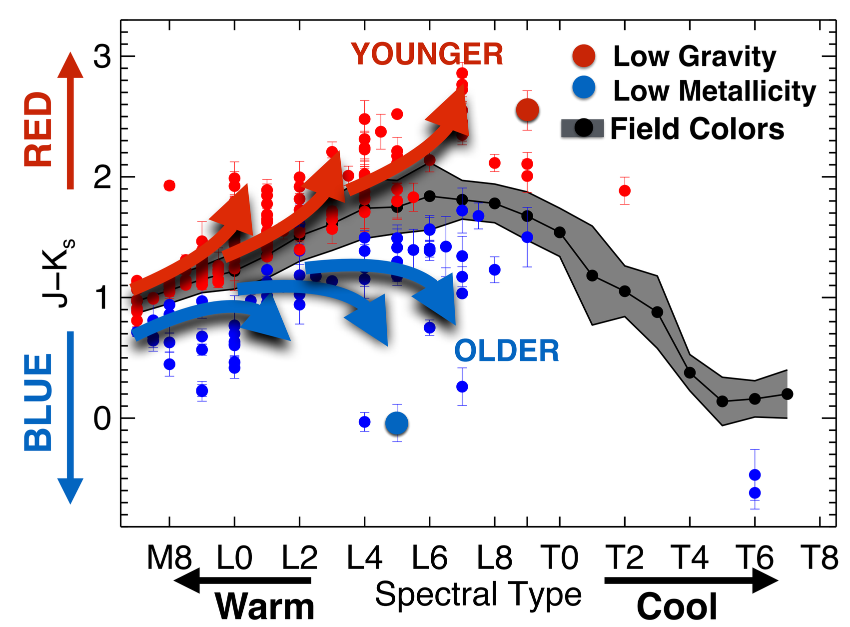
Eileen Gonzales [1, 2, 3], Jacqueline Faherty [3], Kelle Cruz [2, 3]

@EGonzales788

1. The Graduate Center, City University of New York
2. Hunter, The City University of New York
3. American Museum of Natural History

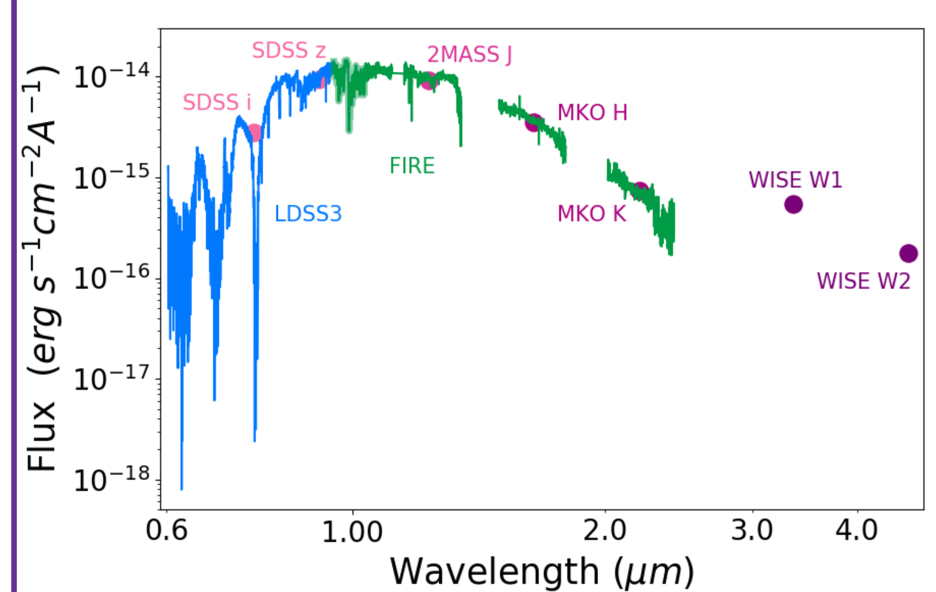
The nearby solar neighborhood is littered with low mass, low temperature objects called brown dwarfs. This population of ultracool objects do not have enough mass to sustain stable hydrogen burning so they never enter the main sequence and simply cool through time. Brown dwarfs span effective temperatures in the range 250 to 3000K. They also have age dependent observable properties. Young brown dwarfs appear to have redder near infrared colors than field age sources, while old objects tend to have bluer colors. Over the past several years, the research group entitled "Brown Dwarfs in New York City" (BDNYC) has been collecting optical, near and mid-infrared spectra, as well as photometry for sources that have well defined distances. In this poster, I will compare the distance calibrated spectral energy distributions of a sample of old, young, and field age brown dwarfs of the same effective temperature. In so doing, I will discern observables linked to gravity, atmosphere, metallicity and age effects.

YOUNG OBJECTS ARE RED, OLD OBJECTS ARE BLUE



- Field gravity objects with mean colors of each subtype as black points and the grey as the standard deviation at each bin.
- Red are low gravity/young
- Blue are low metallicity/old

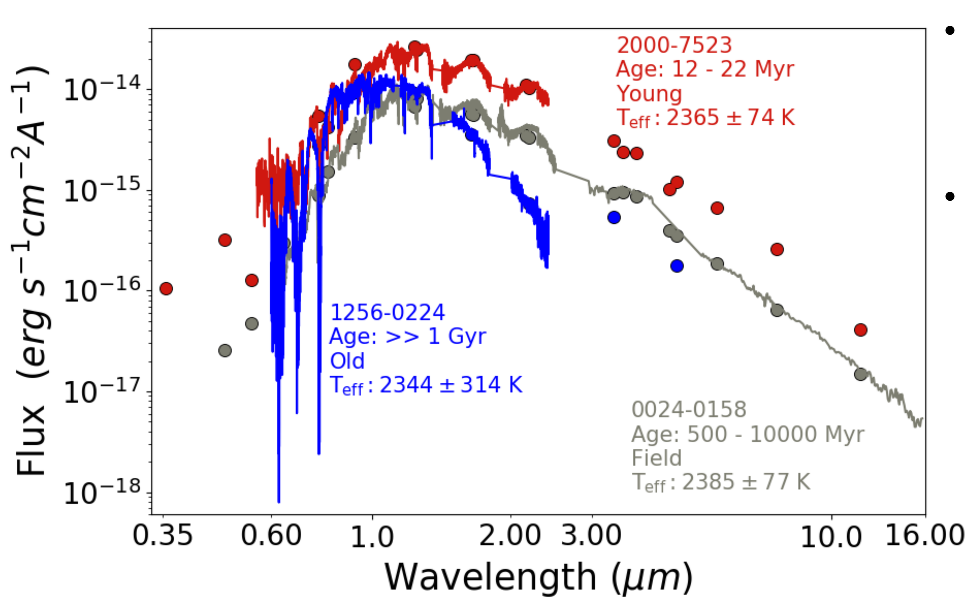
CONSTRUCTING SPECTRAL ENERGY DISTRIBUTIONS



- SED is constructed from spectra and photometric points using the technique of Filippazzo+ 2015 and a parallax from Schillbach+ 2009.
- From these SEDs we integrate and solve for L_{bol} and T_{eff} assuming a radius as described in Filippazzo+ 2015 that relies on age estimates and evolutionary models.

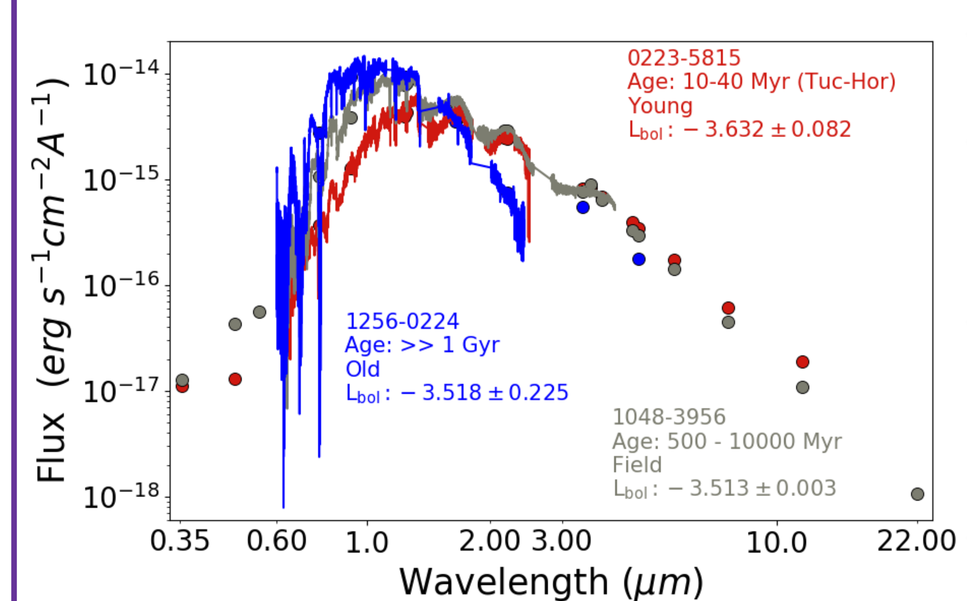
Optical- Burgasser+ 2009a, NIR- Gonzales+ in prep.

COMPARING SED SHAPES OF BROWN DWARFS OF SAME T_{eff}



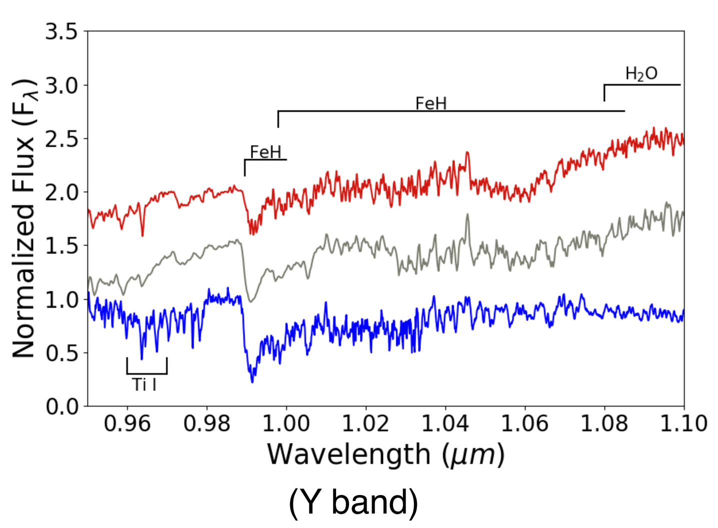
- Red object has an increase of flux in NIR and MIR compared to the field
- Blue object has a sharp decrease in flux in the NIR and MIR compared to the field

COMPARING SED SHAPE OF BROWN DWARFS OF SAME L_{bol}

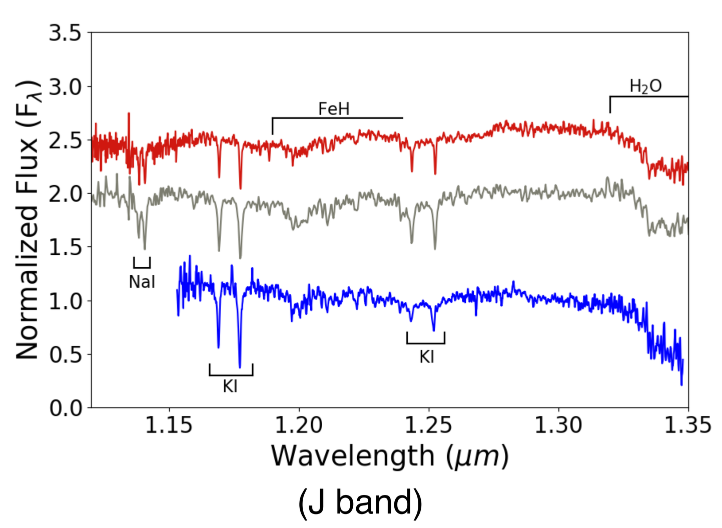


- Young source: Under luminous through NIR
- Old source: Over luminous through J band, drops drastically to under luminous through the MIR.
- Thick clouds in atmospheres of young brown dwarfs (and giant exoplanets) absorb at shorter wavelengths and then radiate energy out at longer wavelengths.
- Low metallicity subdwarfs are likely cloudless (Faherty+ 2012).

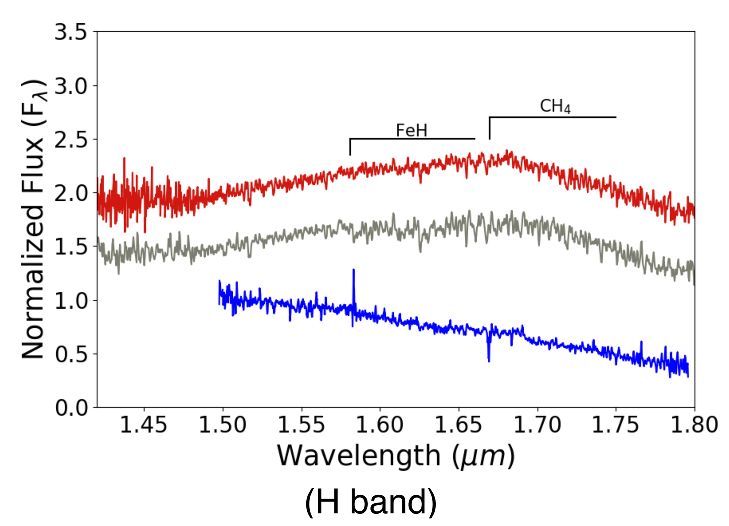
SIGNATURES OF CLOUDS, GRAVITY, AND METALLICITY IN YOUNG AND OLD BROWN DWARFS OF SAME T_{eff}



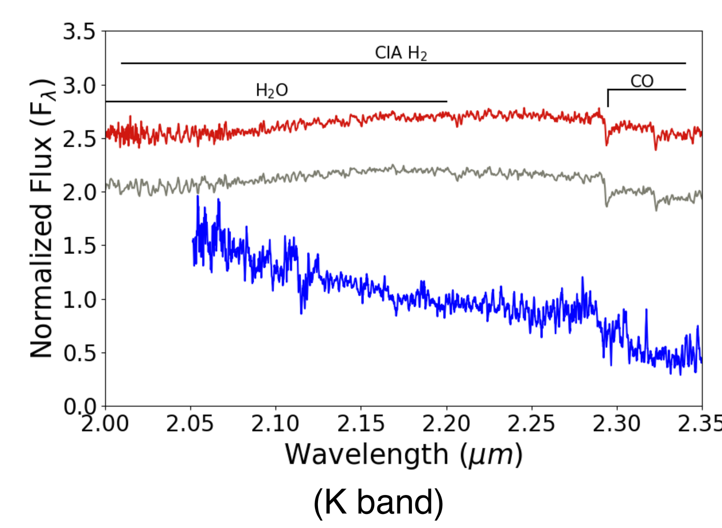
(Y band)



(J band)

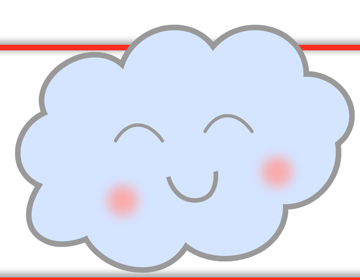


(H band)

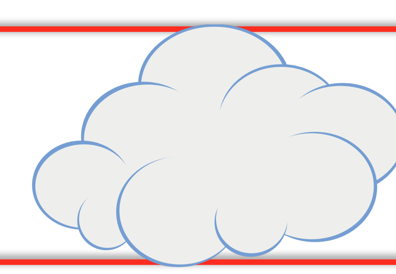


(K band)

- **FeH:** indicator of **atmospheric** phenomenon, **clouds**
- FeH is enhanced in low metallicity objects.
- **KI** and **NaI** alkali line absorption are **gravity** sensitive.
- Low metallicity have deeper KI lines.
- **Gravity** impacts the **shape** of the **H band.**
- **Collision induced H_2** sculpts both the **H** and **K band shapes**.



CLOUD EFFECTS DRIVE MAJOR CHANGES IN THE SPECTRA OF BROWN DWARFS AND GIANT EXOPLANETS.



This work has been supported by the NIGMS RISE program at Hunter College.