



@EGonzales788

# Examining Cloud, Metallicity, and Gravity signatures in Brown Dwarfs

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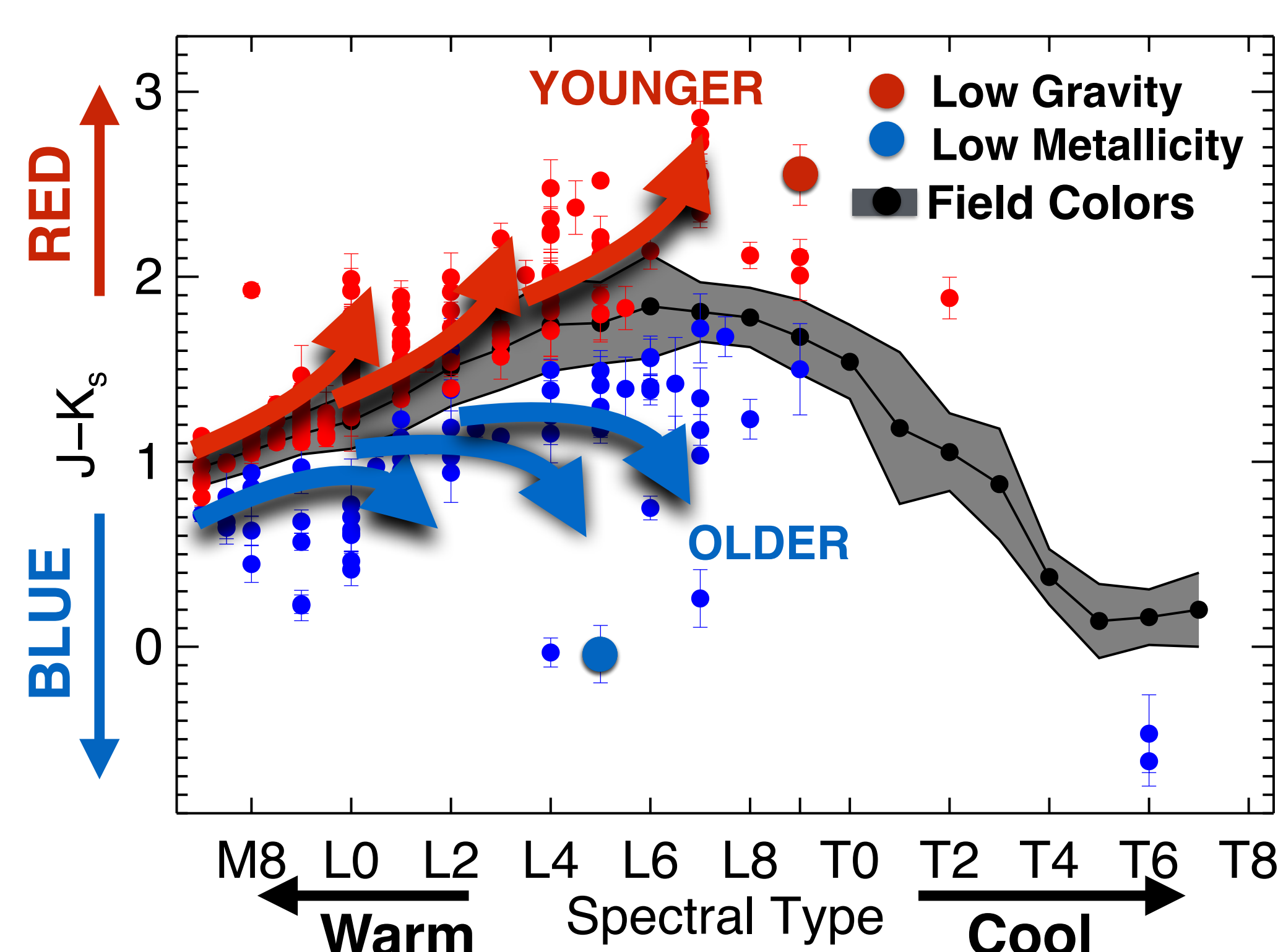
The nearby solar neighborhood is littered with low mass, low temperature objects called brown dwarfs. This population of ultracool objects do not have enough mass to sustain stable hydrogen burning so they never enter the main sequence and simply cool through time. Brown dwarfs span effective temperatures 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.

1.

2. **HUNTER**  
The City University of New York

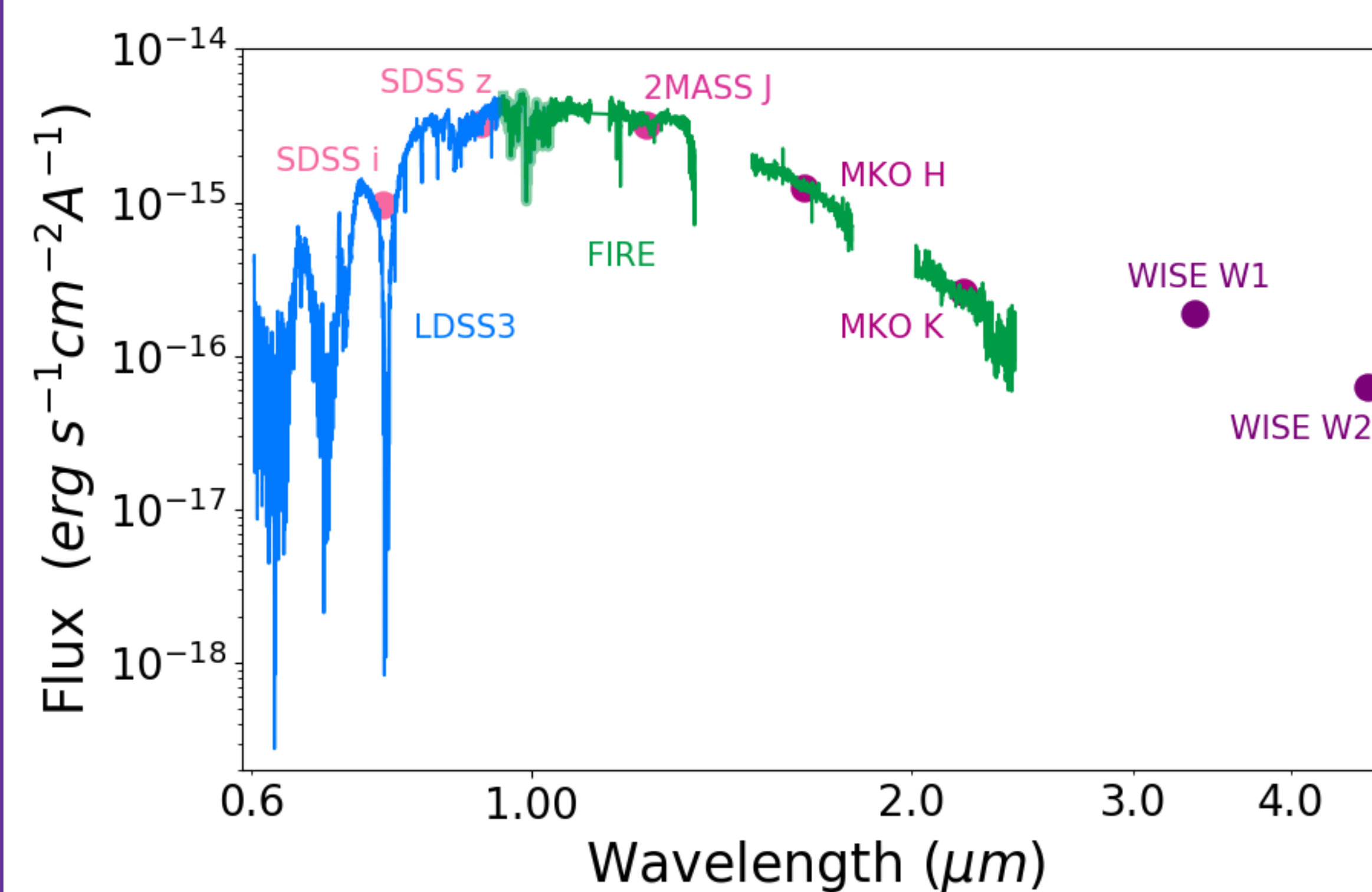
3. **AMERICAN MUSEUM OF NATURAL HISTORY**

## 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

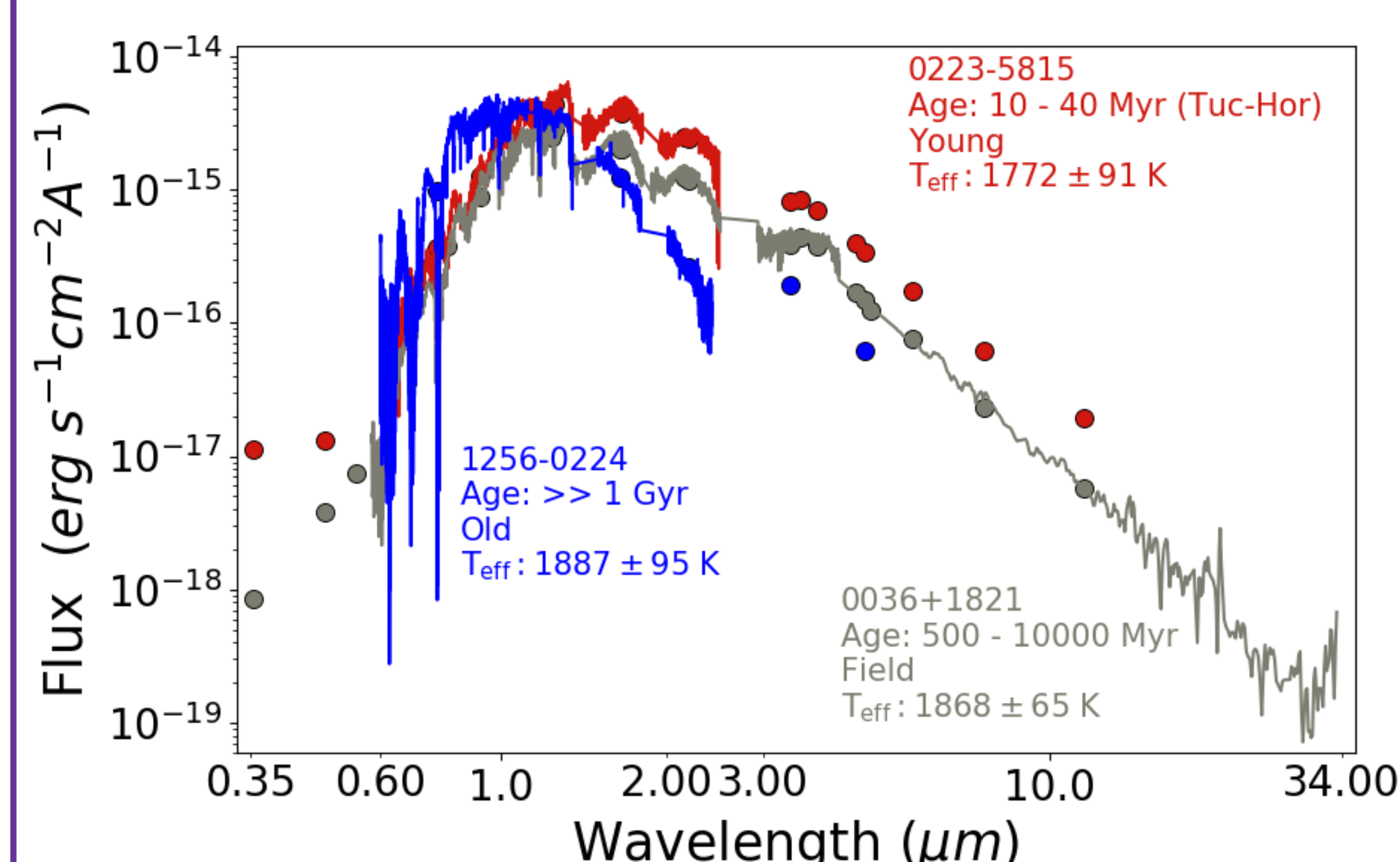
## CONSTRUCTING SPECTRAL ENERGY DISTRIBUTIONS



- 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.

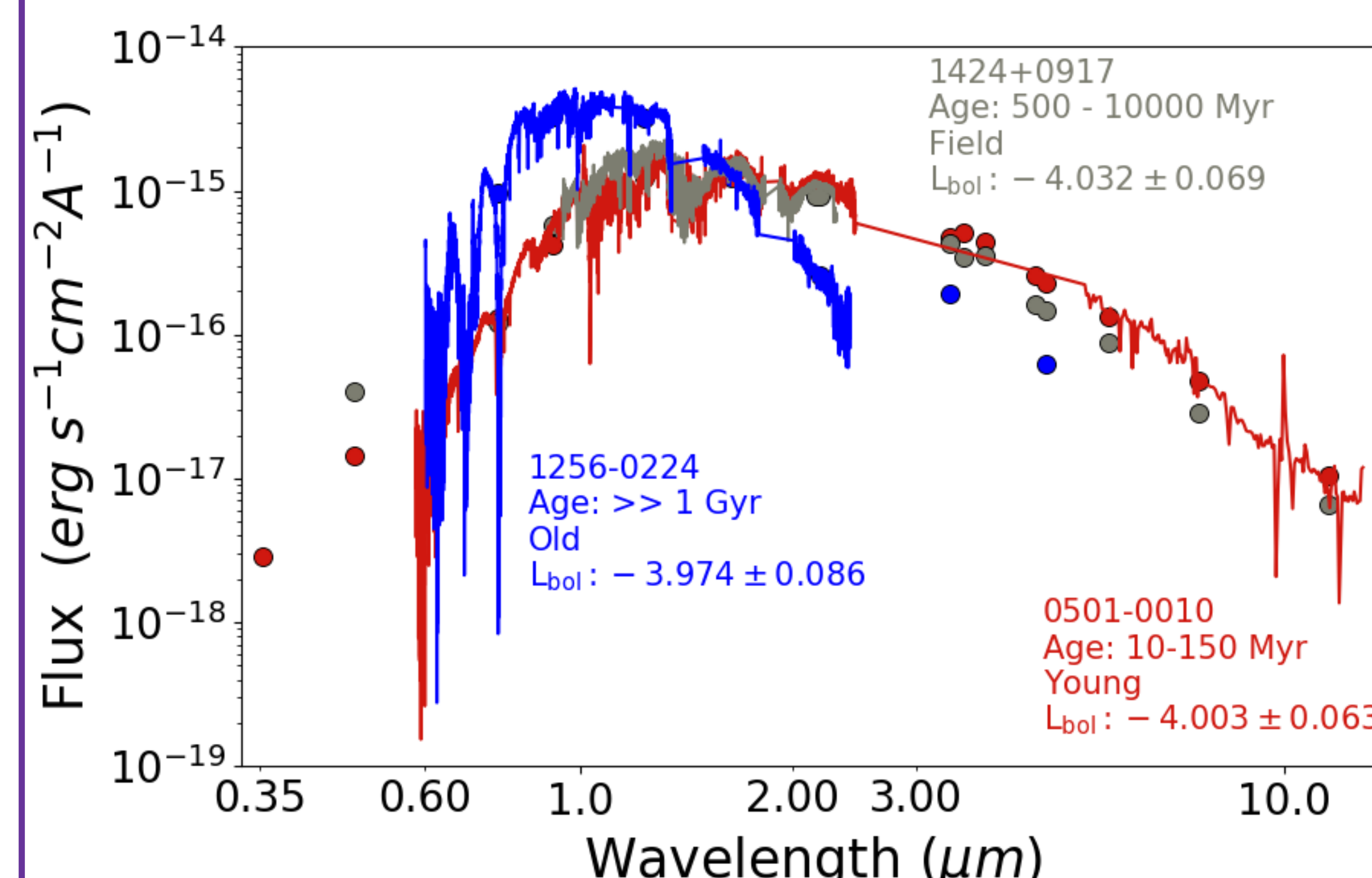
Optical- Burgasser+ 2009a, NIR- Gonzales+ in prep.

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



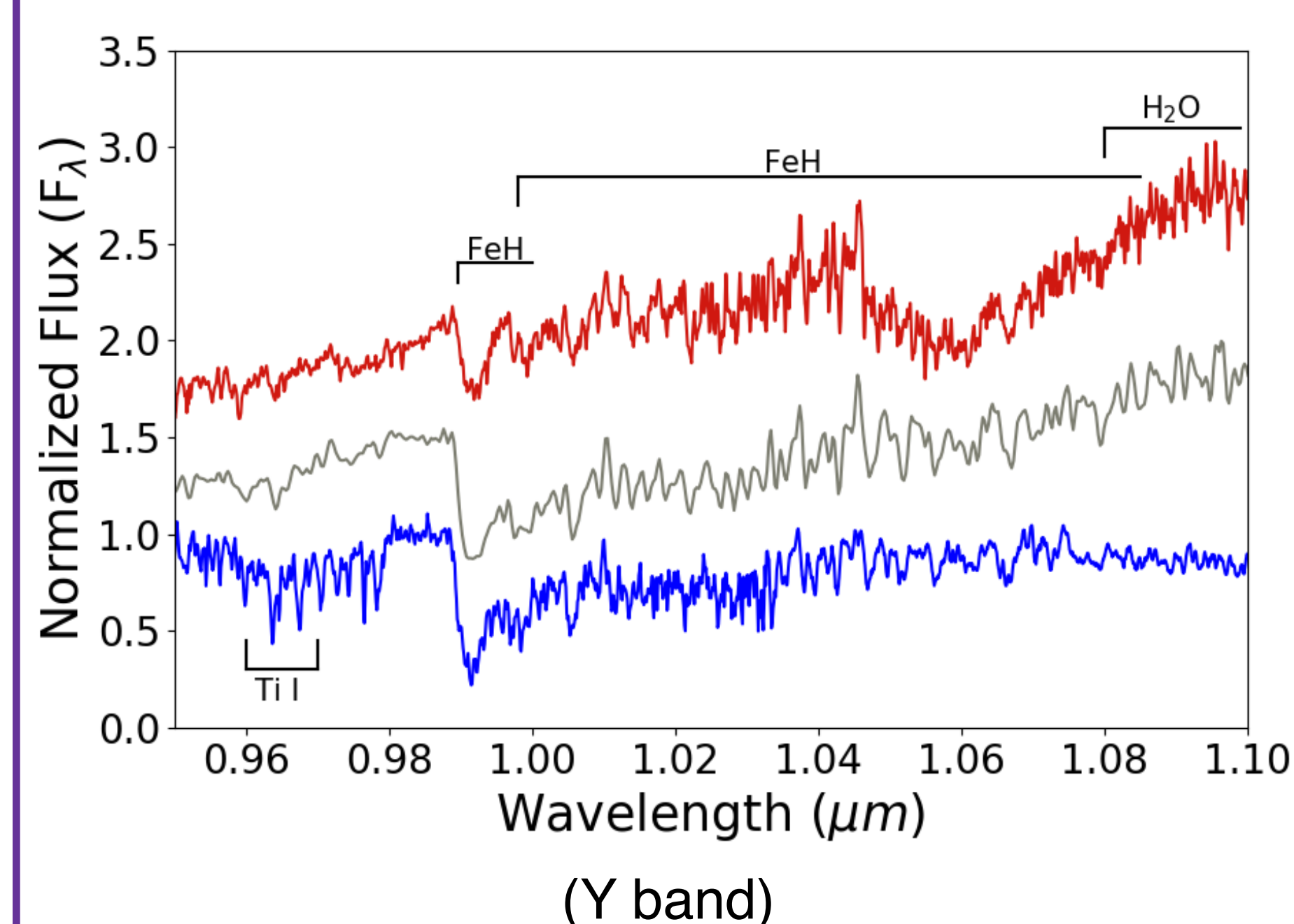
- Red object has an increase of flux in NIR and MIR compared to the field
- Blue object has a sharp decrease in flux in the NIR and MIR compared to the field

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

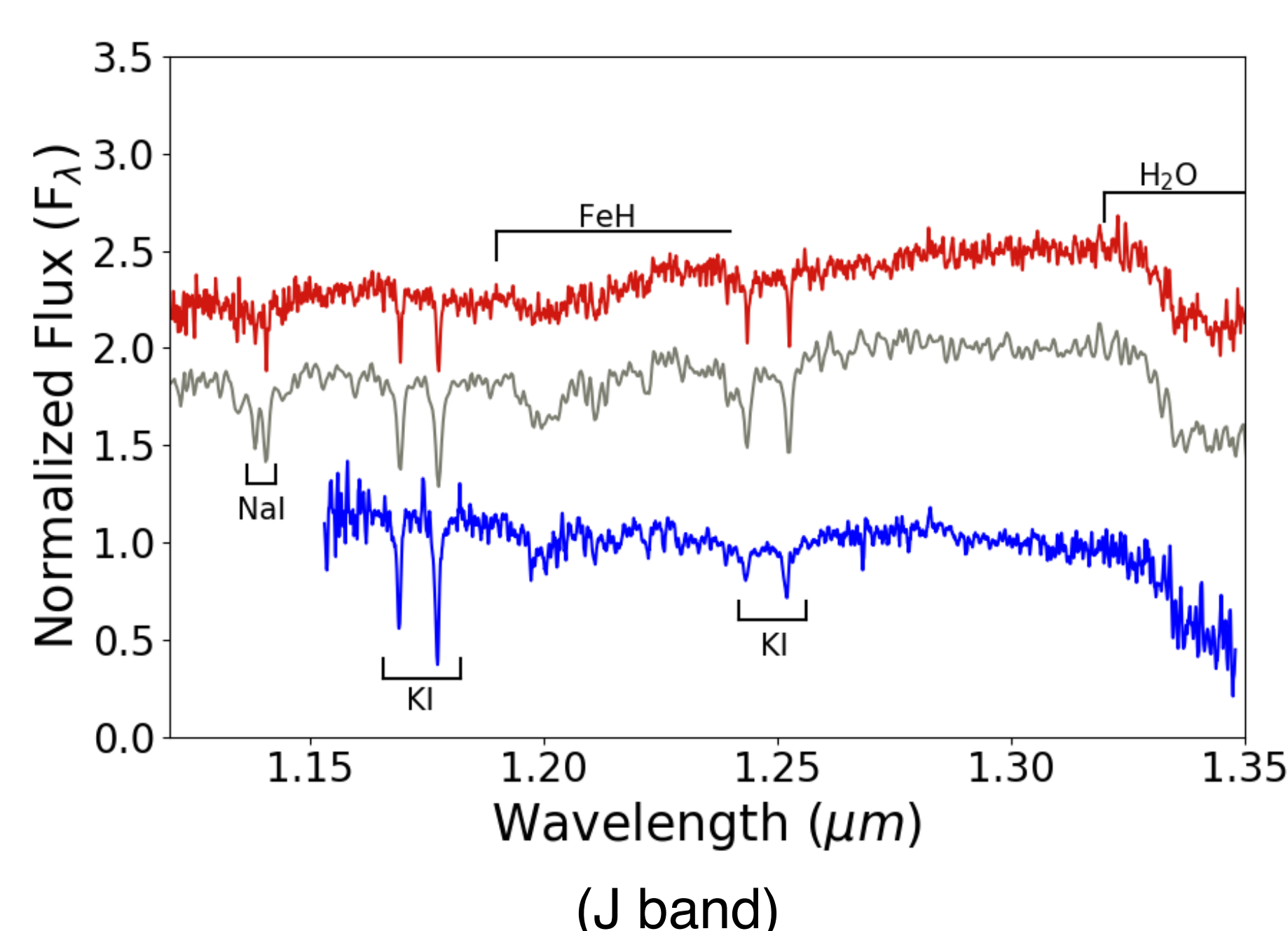


- Young source: Slightly over luminous in MIR
- Old source: Over luminous through J band, drops drastically to under luminous through the MIR.
- Thick clouds in atmospheres of young brown dwarfs (and giant exoplanets) absorb at shorter wavelengths and then radiate energy out at longer wavelengths.
-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

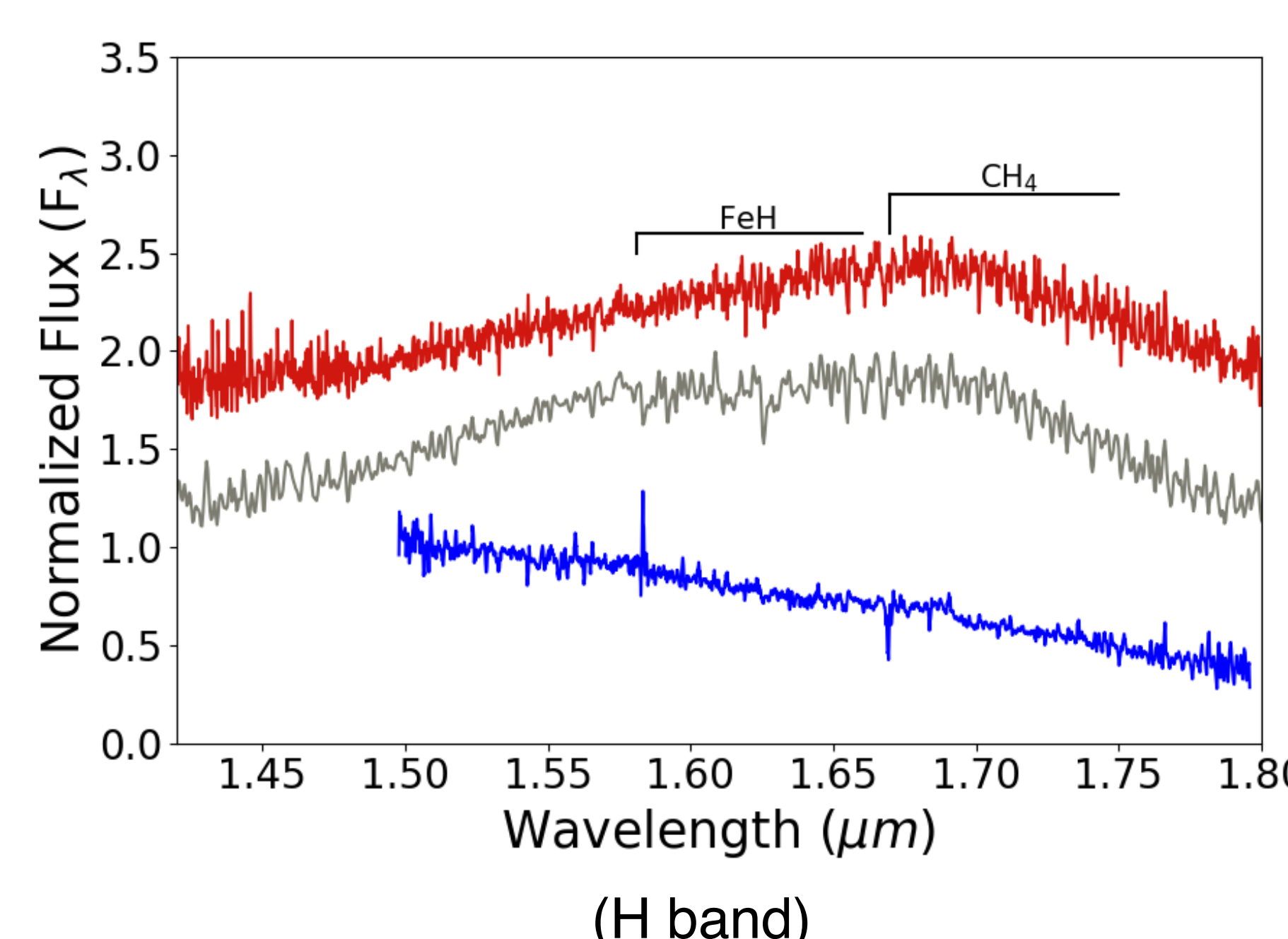
## SIGNATURES OF CLOUDS, GRAVITY, AND METALLICITY IN YOUNG AND OLD BROWN DWARFS OF SAME $T_{eff}$



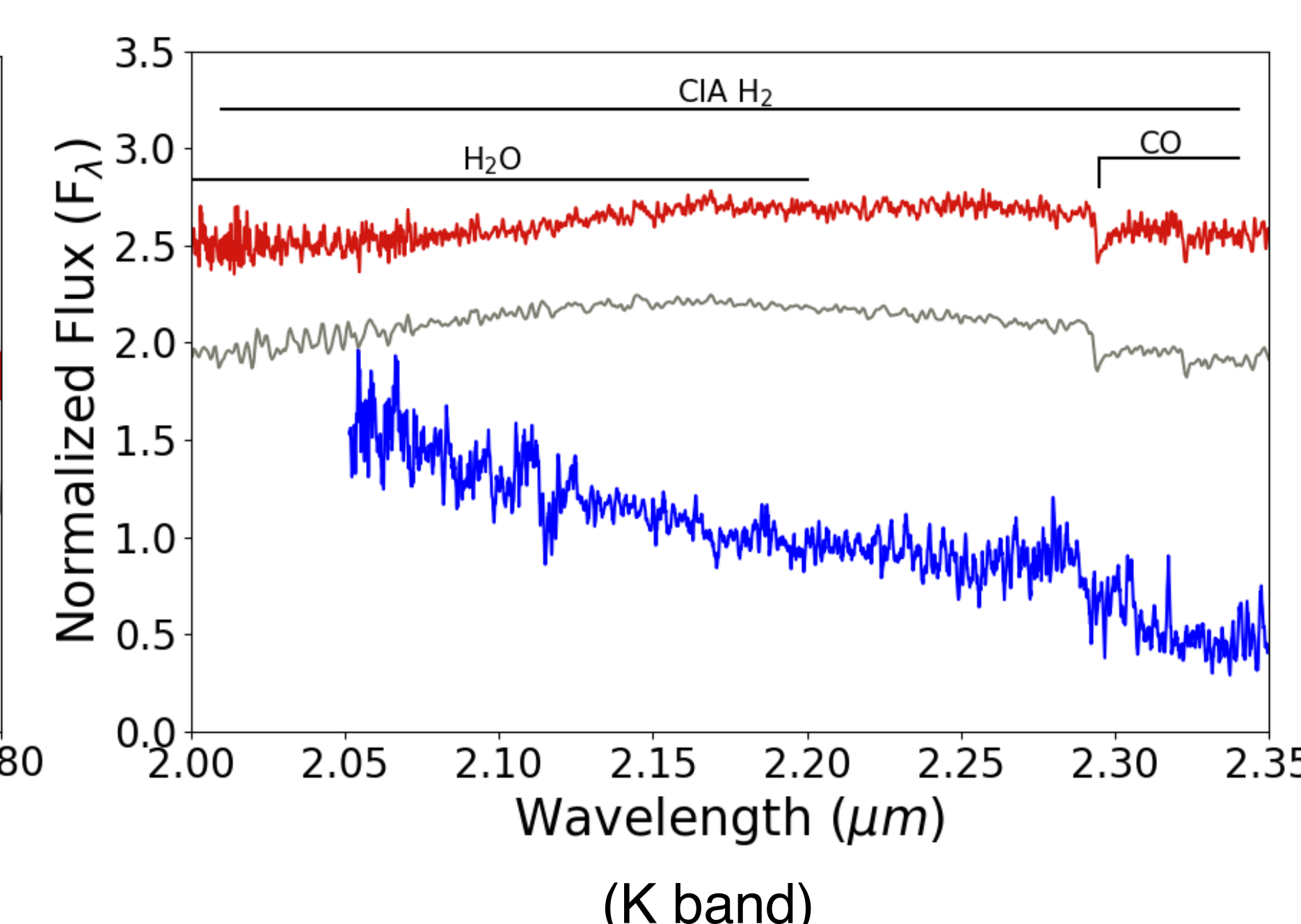
- FeH:** indicator of atmospheric phenomenon, clouds
- Enhanced in low metallicity objects



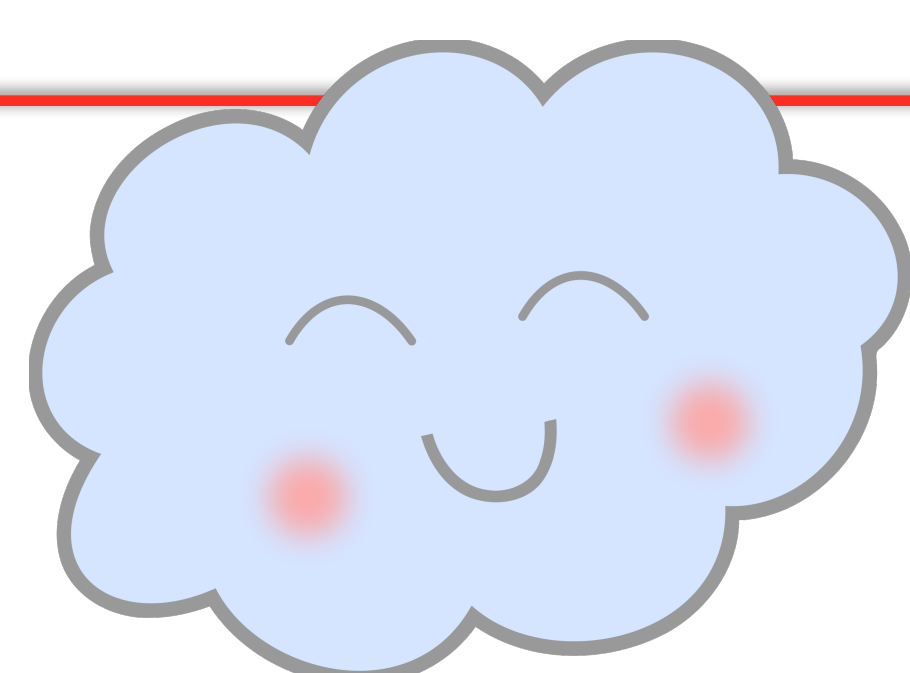
- KI and NaI alkali line absorption are gravity sensitive.
- Low metallicity have increased KI lines.



- 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.

