Optical Spectroscopy of Very Low Mass Stars

An Undergraduate Research Report

COOL STAR LAB

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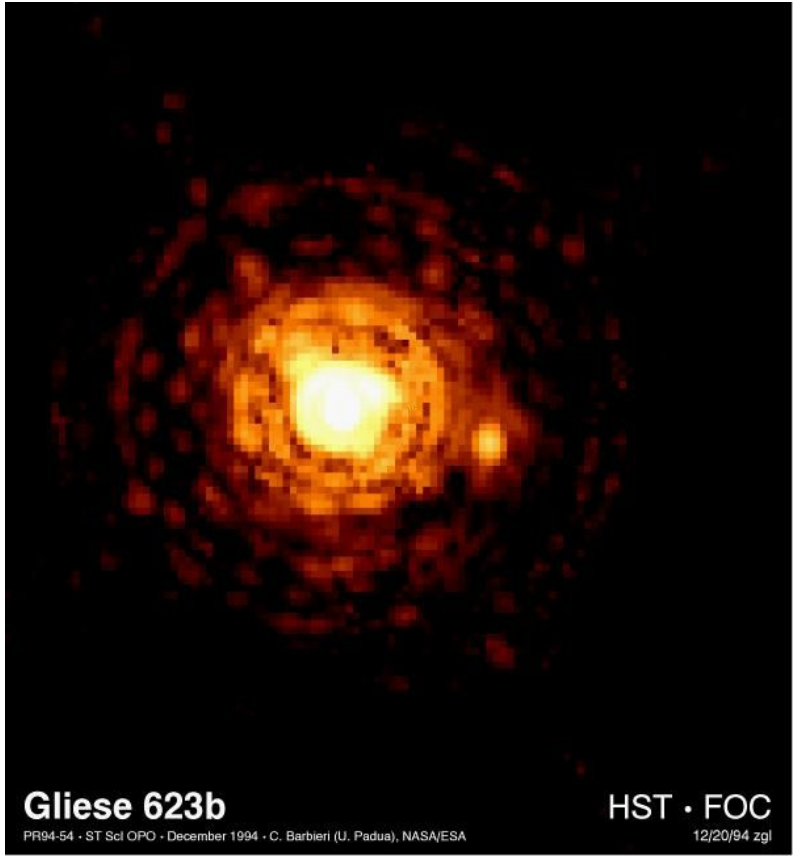
Agenda

- Introduce the Science Goals of this project
- Overview of Data and Analysis
- Preliminary Results

What are we looking at?

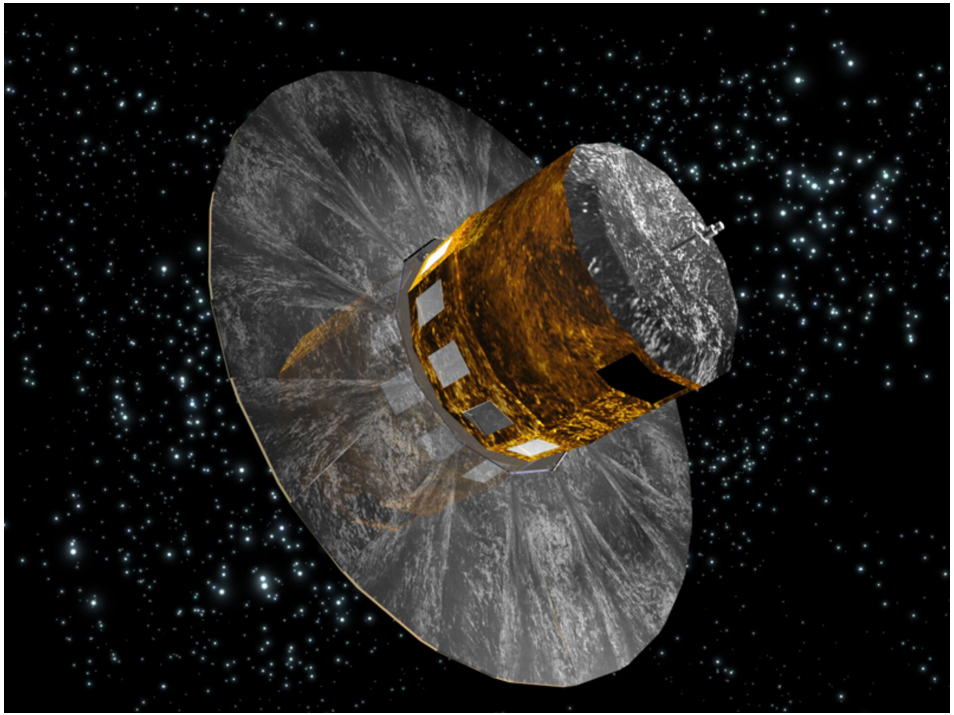
- Very Low Mass Stars and Substellar Objects
  - M type Main Sequence Stars
  - Brown Dwarfs
  - Typically <0.15 Solar Masses
- Most numerous, longest living objects in the Galaxy
- They encode galactic history in their kinematics and composition



https://www.spacetelescope.org/static/archives/images/original/opo9454a.jpg

How do we Find Them?

- All-sky surveys, such as 2MASS and SDSS discovered many dim, red objects
- We are interested in stars within 30 pc of the Sun, so we can use kinematics
- Closeby stars have either small parallax or high proper motion
- Look for dim, red things that move fast!
- Our targets are selected from *Gaia* and LaTE-MoVeRS



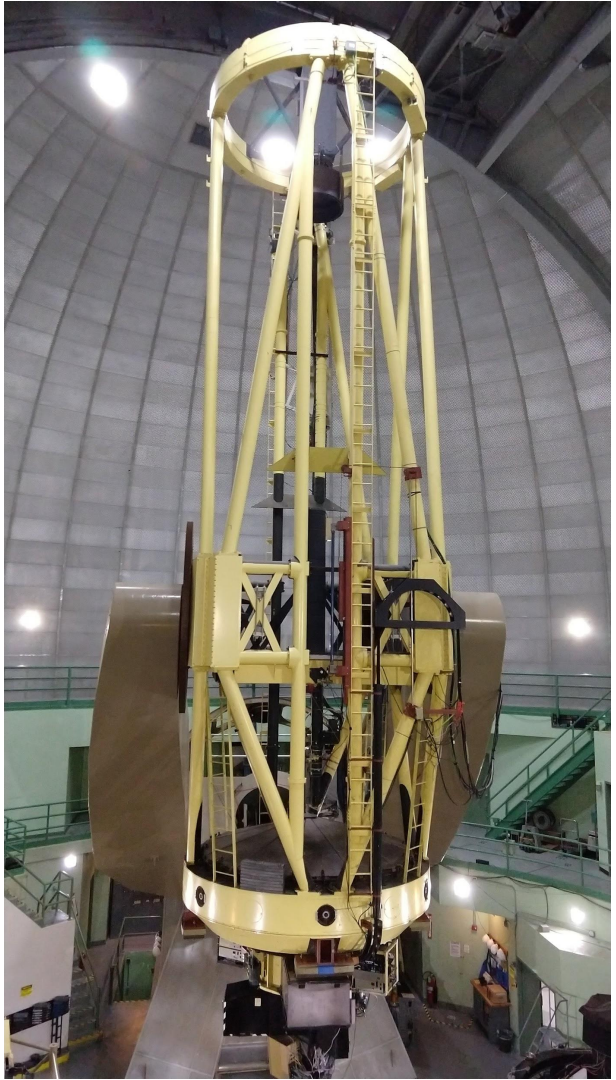
https://www.esa.int/var/esa/storage/images/esa_multimedia/images/2006/05/artist_s_impression_of_the_gaia_satellite/9272925-5-eng-GB/Artist_s_impression_of_the_Gaia_satellite_pillars.jpg

How did We Look at Them?

The Instrument...

The Shane 3-m telescope at Lick Observatory, Mt. Hamilton, CA

The Kast Double Spectrograph



What was my Role?

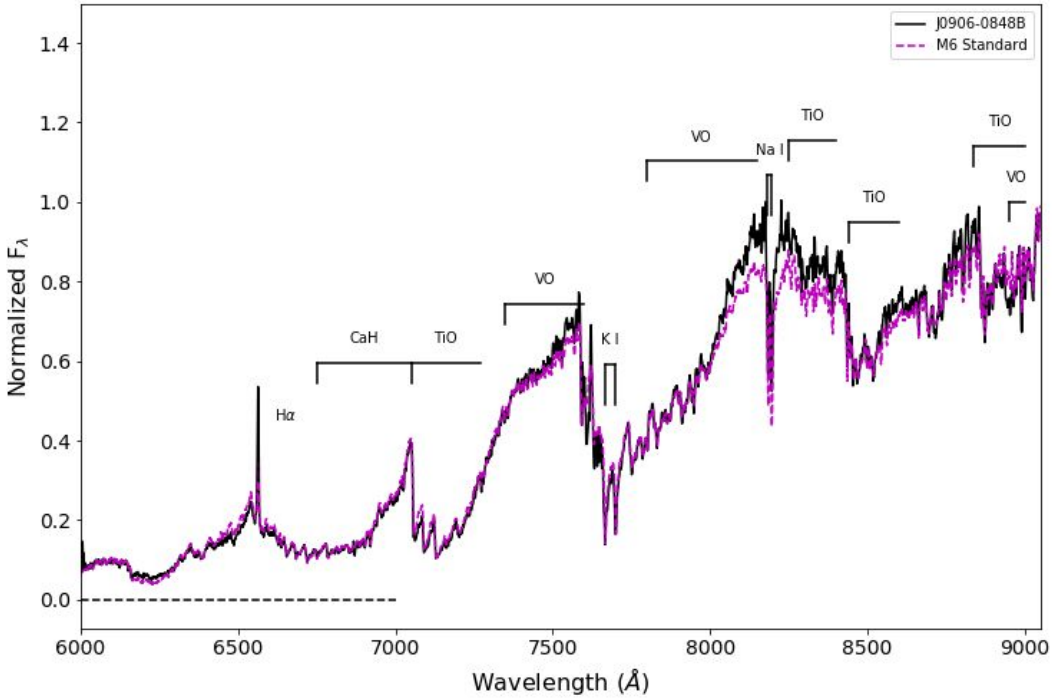
Data Reduction

Data Analysis

Data Analysis

Three major measurements:

- Standard Comparison
- Spectral Indices
- Equivalent Widths



Standard Comparison

- Spectral types are defined by spectral standards
- Previous astronomers chose what stars represent each type
- One way to obtain the spectral type of some star is direct comparison to standards via chi-squared testing

$$\chi^2 = \sum_i \frac{(f_i - AF_i)^2}{\sigma_i^2}$$

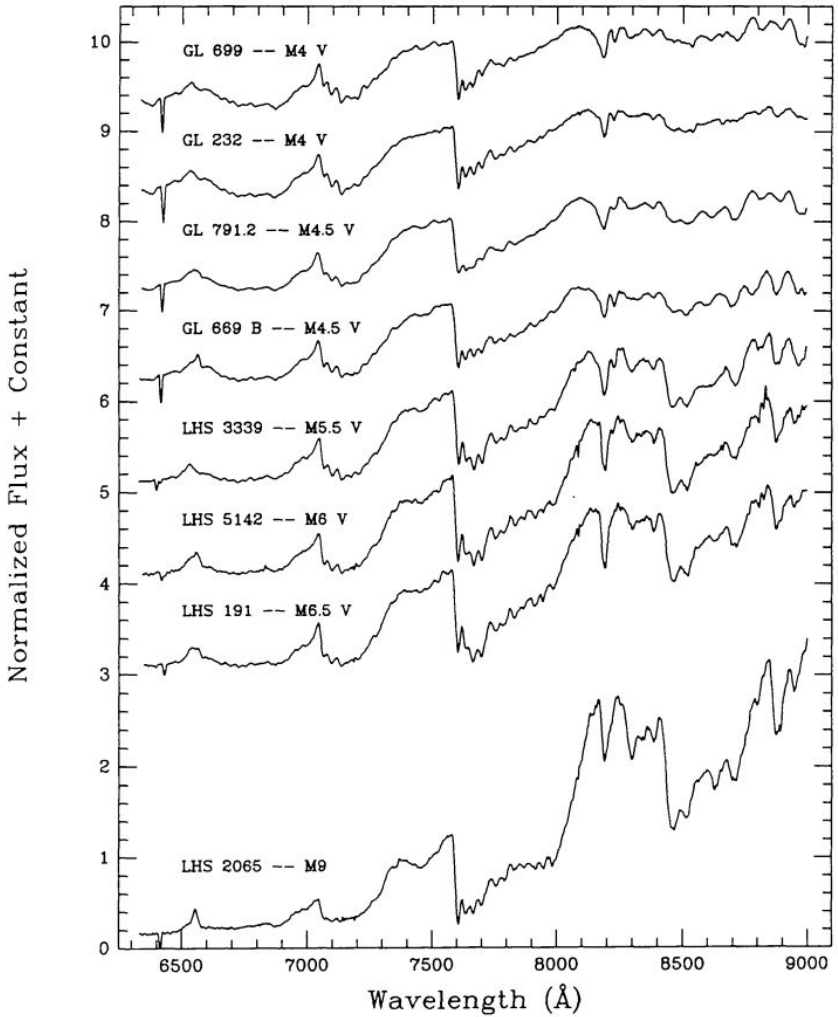
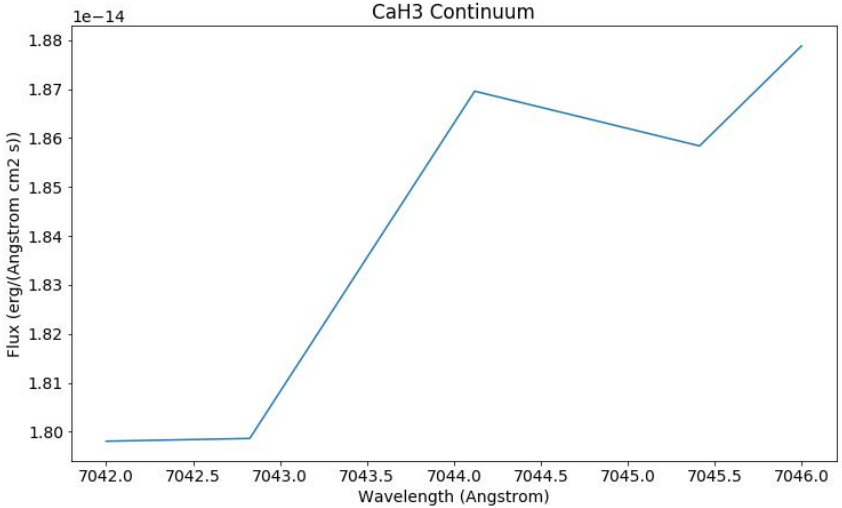
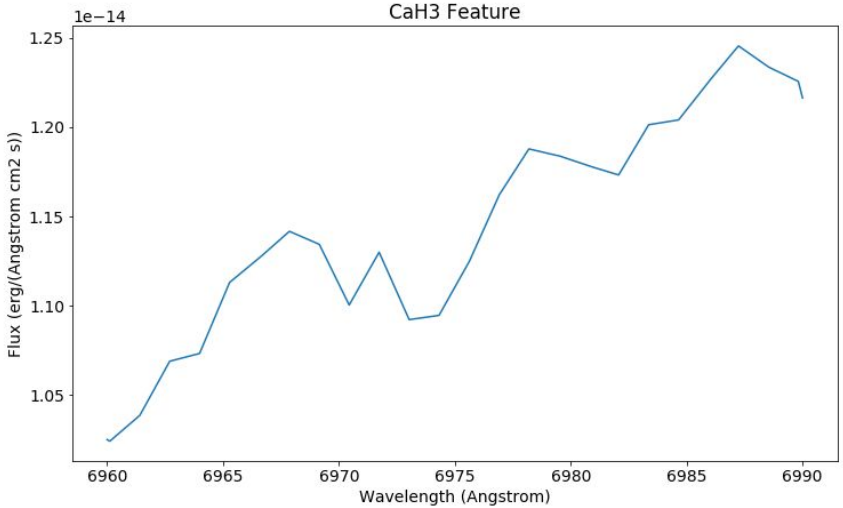


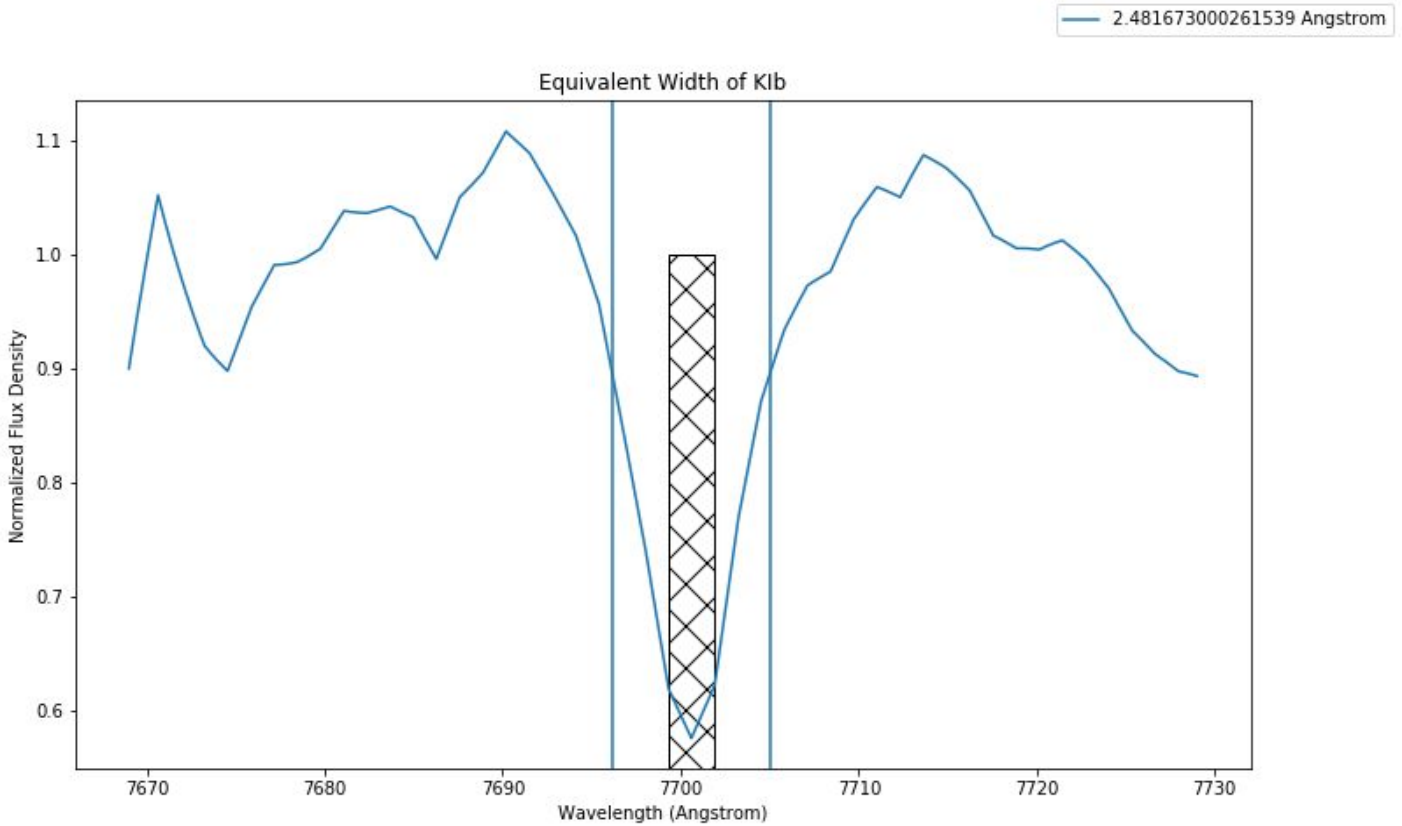
Fig. 2 from 1991ApJS...77..417K

Spectral Indices



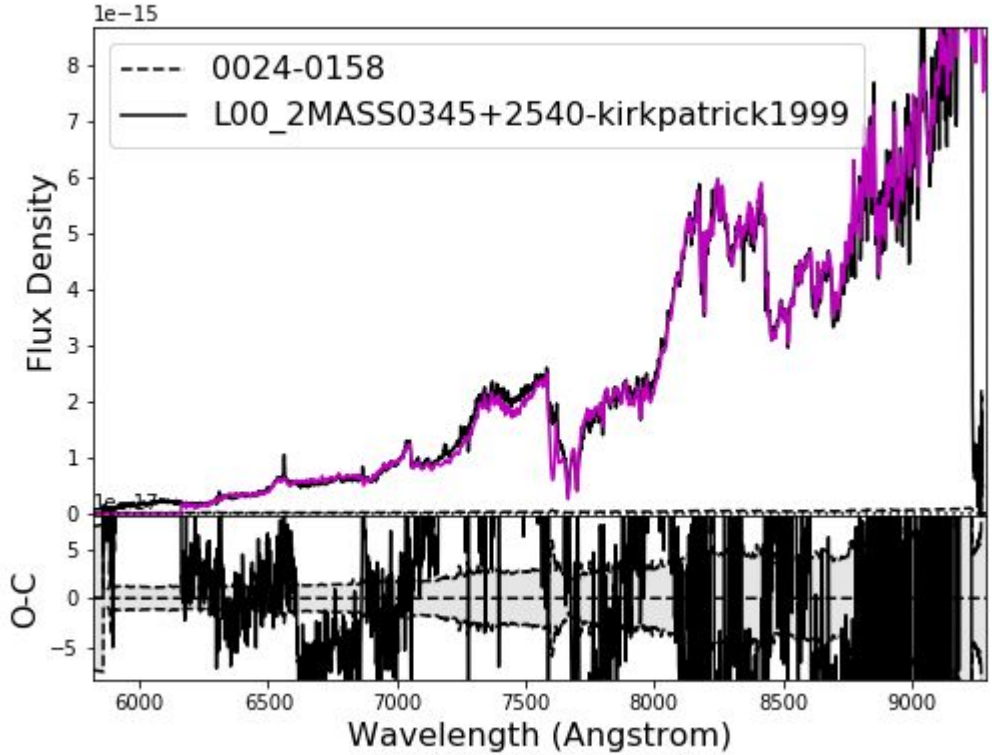


Equivalent Widths

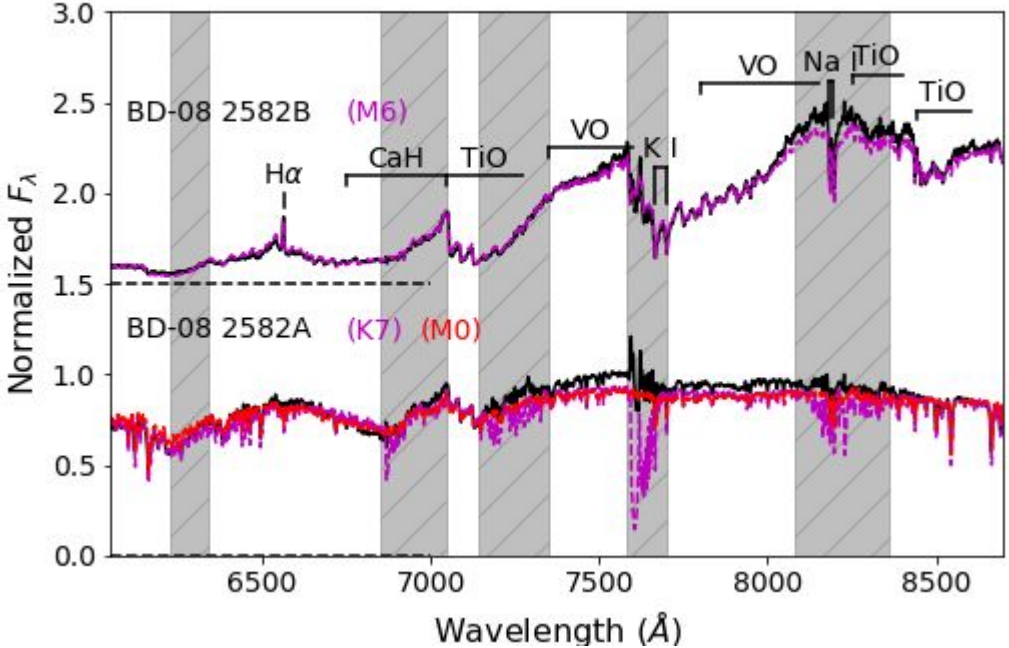


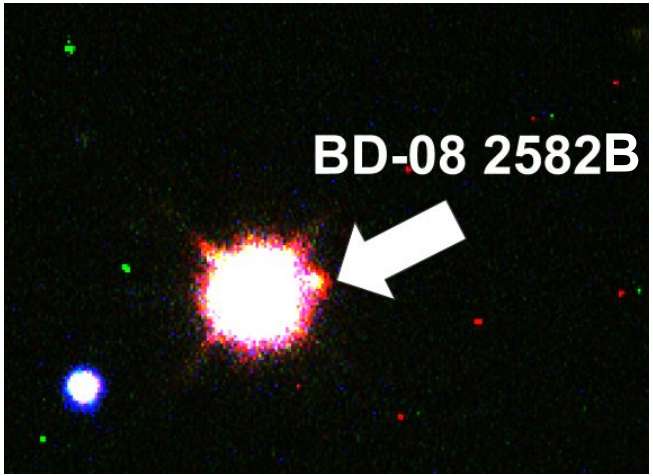
Preliminary Results?

Looking for “Oddballs”



Potentially Interesting Systems





Thank You!

Any Questions?