

ASTR 421

Stellar Observations and Theory

Lecture 02

Q/A

Prof. James Davenport (UW)

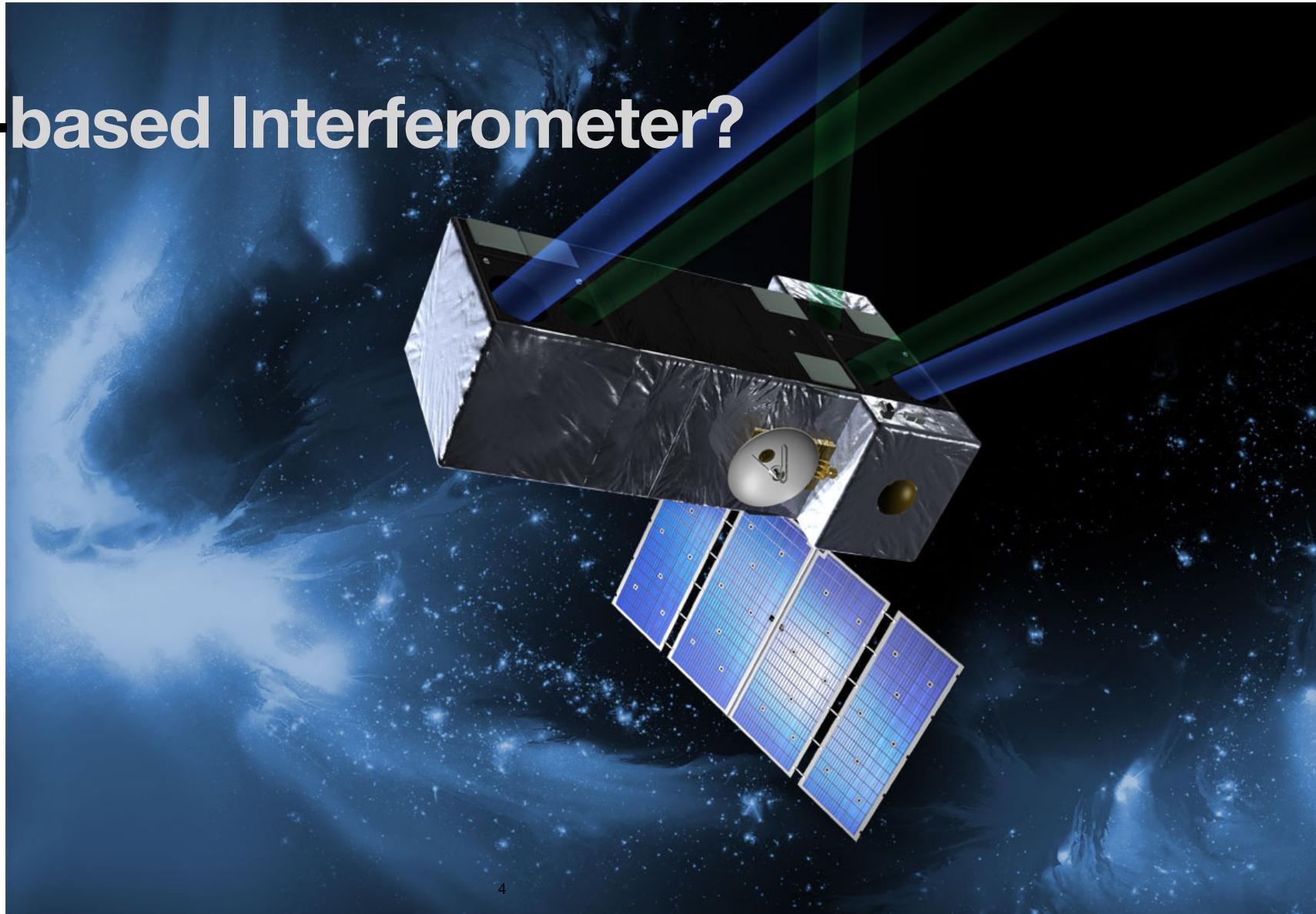
- First a little admin business:
 - **Canvas**: I'll be using it for posting grades, b/c that's the only legal way to do it, and privacy laws are important!
 - **HW1**: posted, due on Monday (11pm PST).
 - Reminder: Q/A due at 9AM... b/c it takes me a couple hours to get answers/discussion prepped for class.
- Lecture 3/4: recording together today
HW2 is posted already
- *How was Lecture 2? Any feedback is welcomed!!*

Coding/Technical stuff

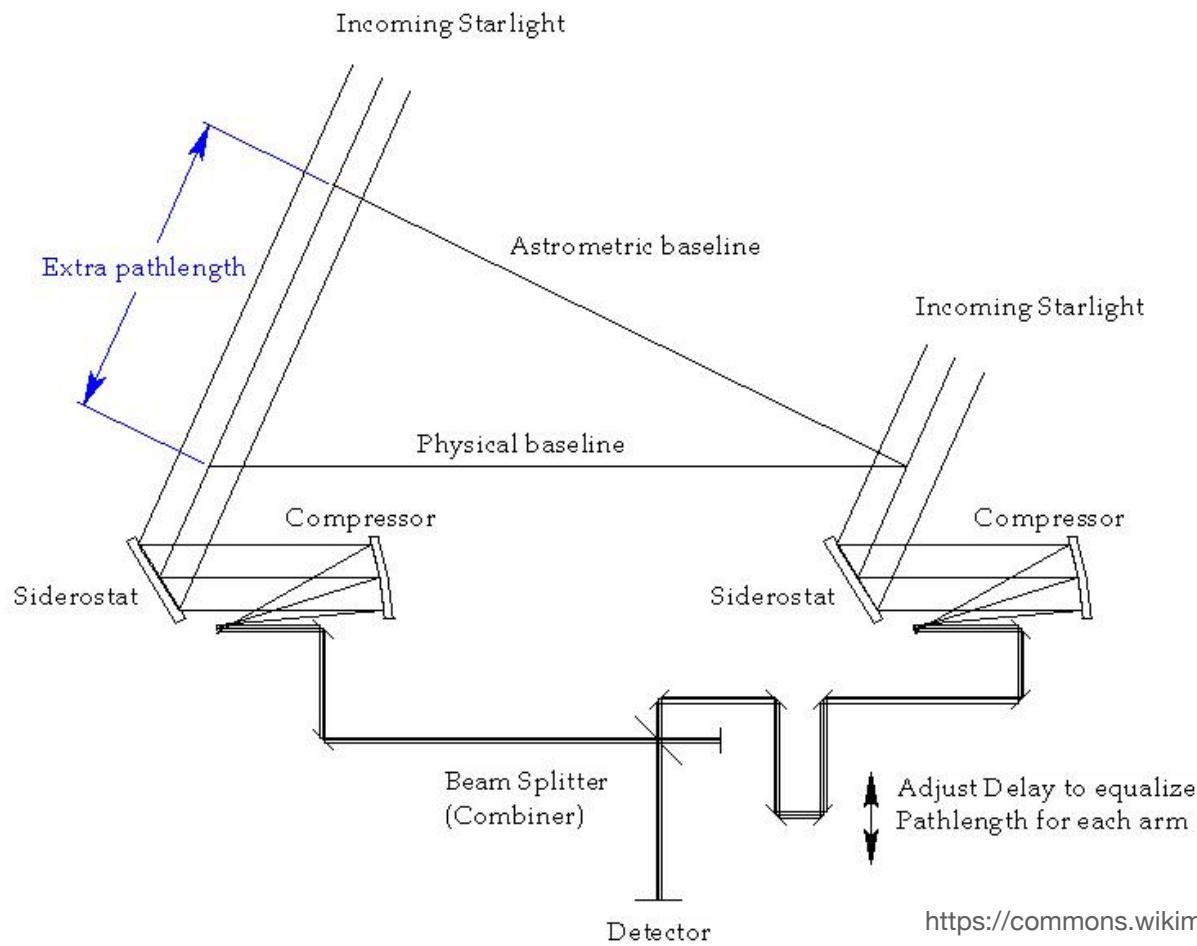
- Jupyter/Conda install...
 - **Jupyter**: no “Hub” for the course, but LMK if that’s problematic!
- Reading those files/isochrones... we’ll touch on that at the end today, but also Andy has thoughts!

Space-based Interferometer?

- Meet SIM
-



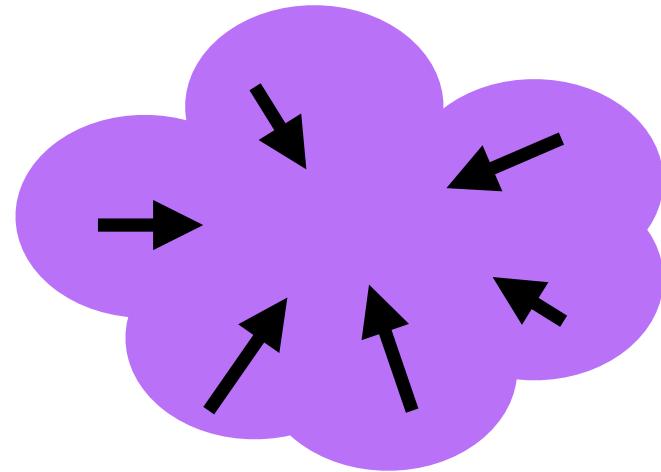
A Michelson Astrometric Interferometer



https://commons.wikimedia.org/wiki/File:Michelson_Astrometric_Interferometer_Diagram.JPG

Y Dwarfs!?

- They *form* like stars
- They're “free floating”



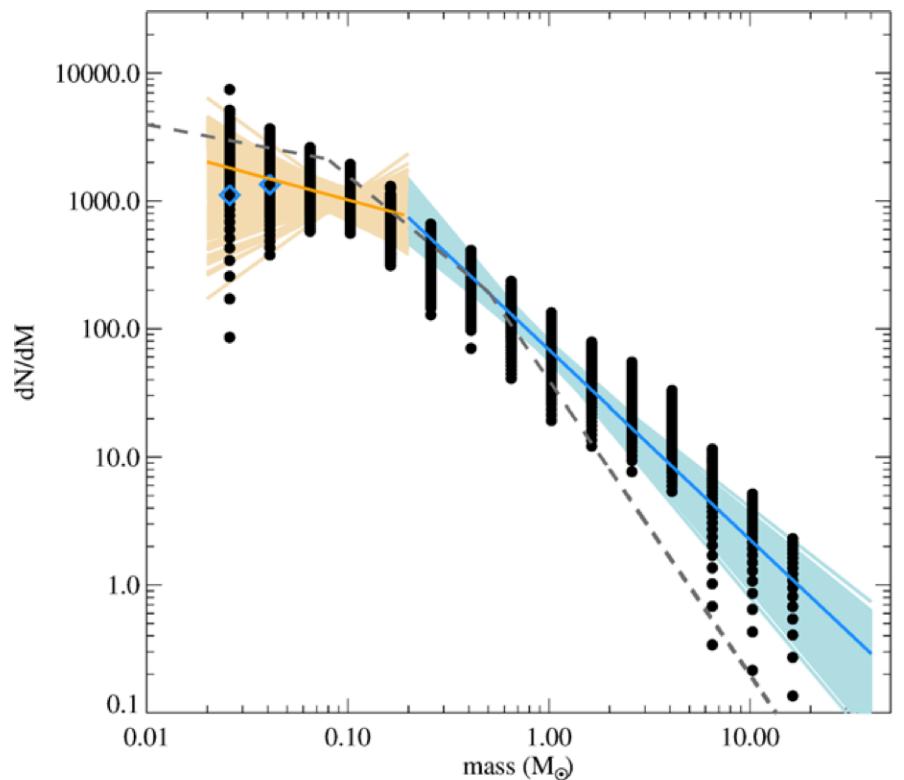
How many are there?!

- But they're *very* faint
- & w/o fusion, they cool over time



7

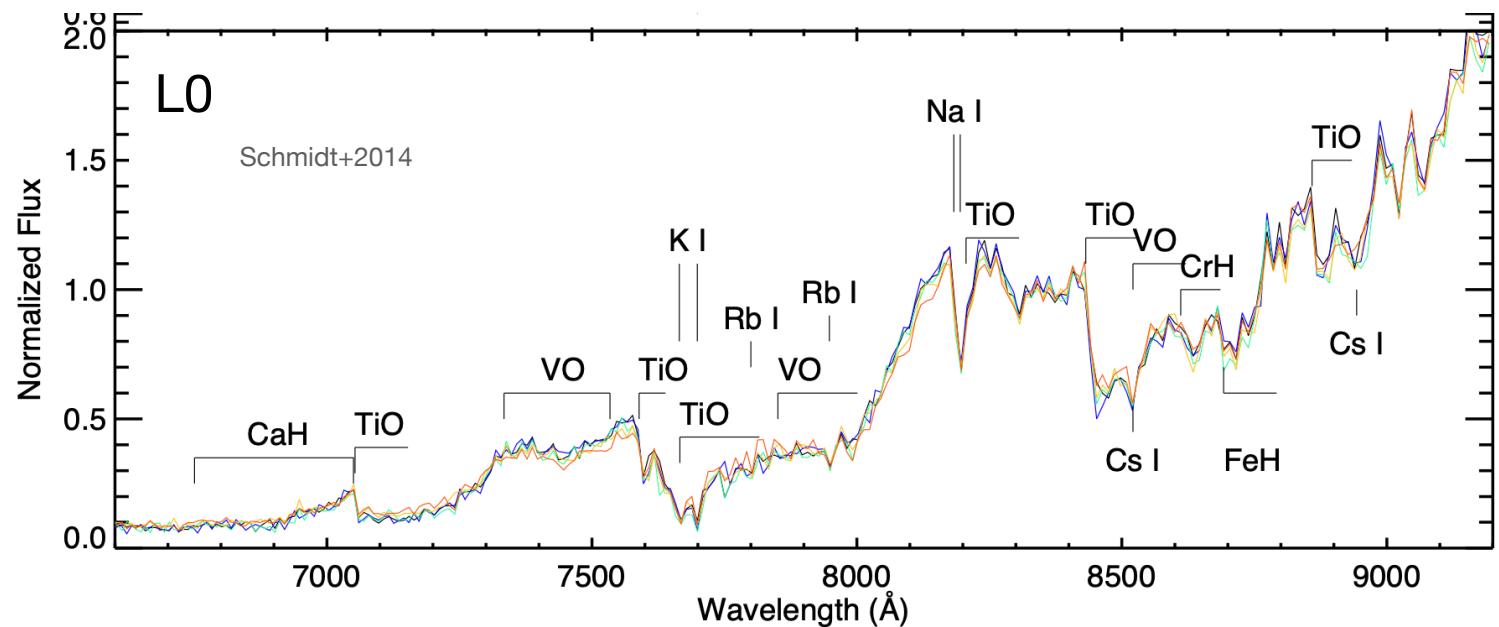
A LOT

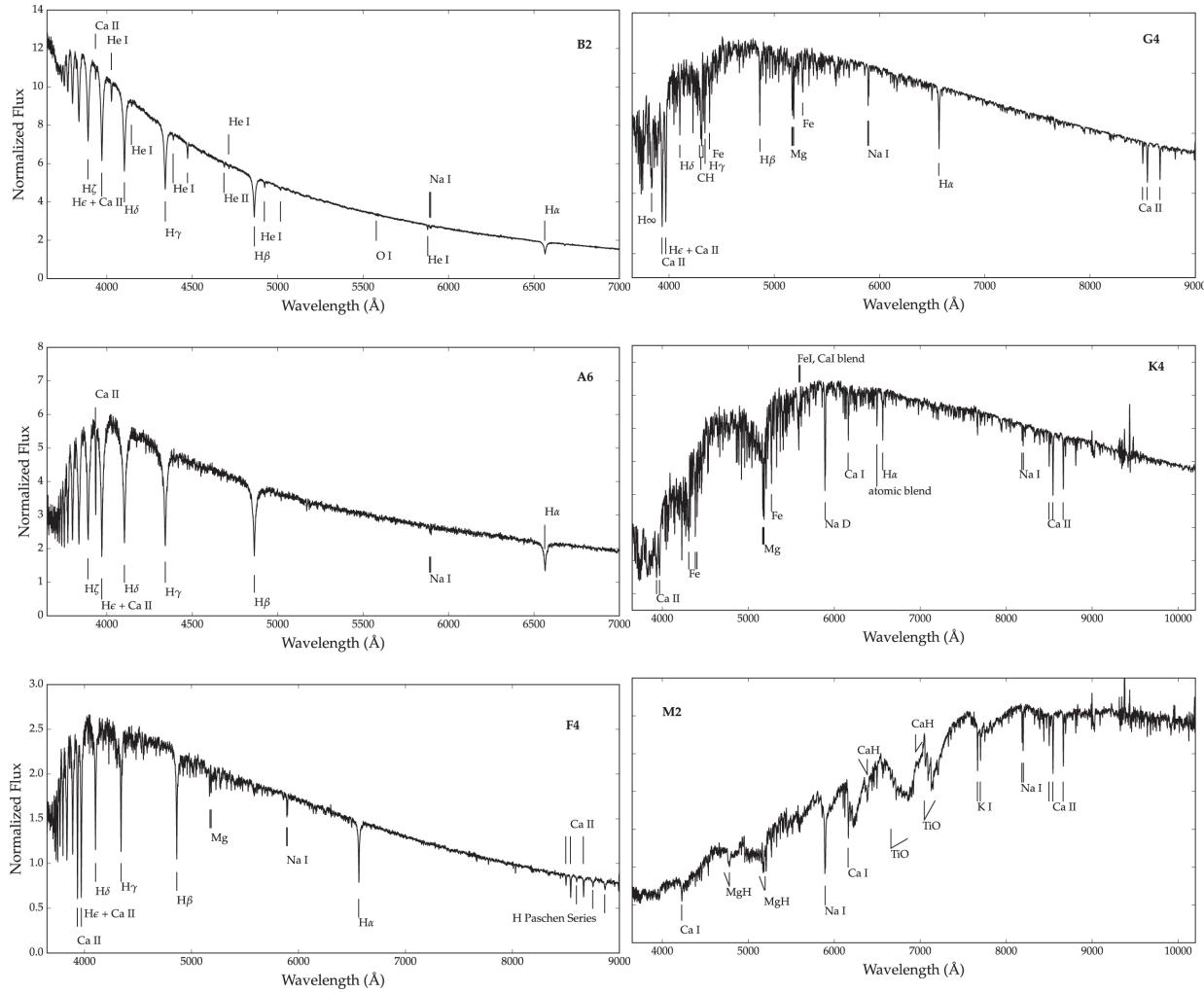


<https://ui.adsabs.harvard.edu/abs/2017MNRAS.471.3699M/abstract>

Temps of LTY dwarfs are difficult?

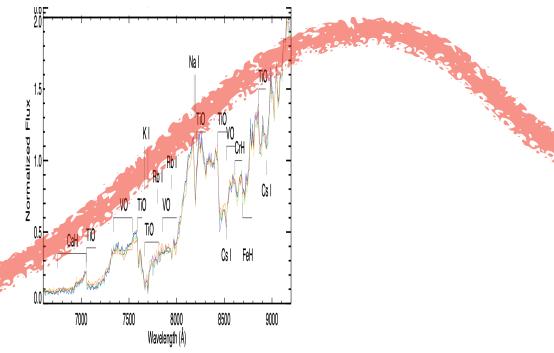
- There's no “continuum” to measure, just these silly molecules everywhere!





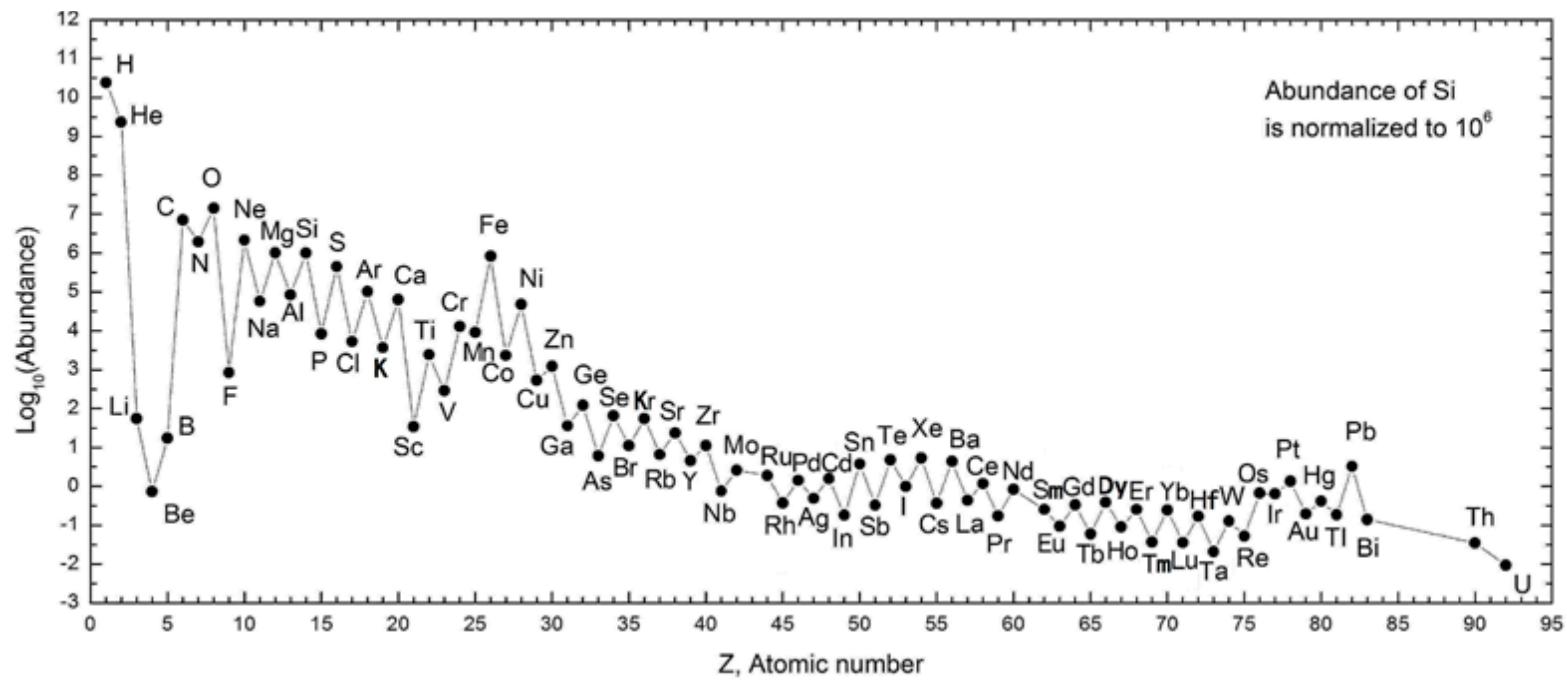
No blue flux!

Need IR data!



[Fe/H] notation!

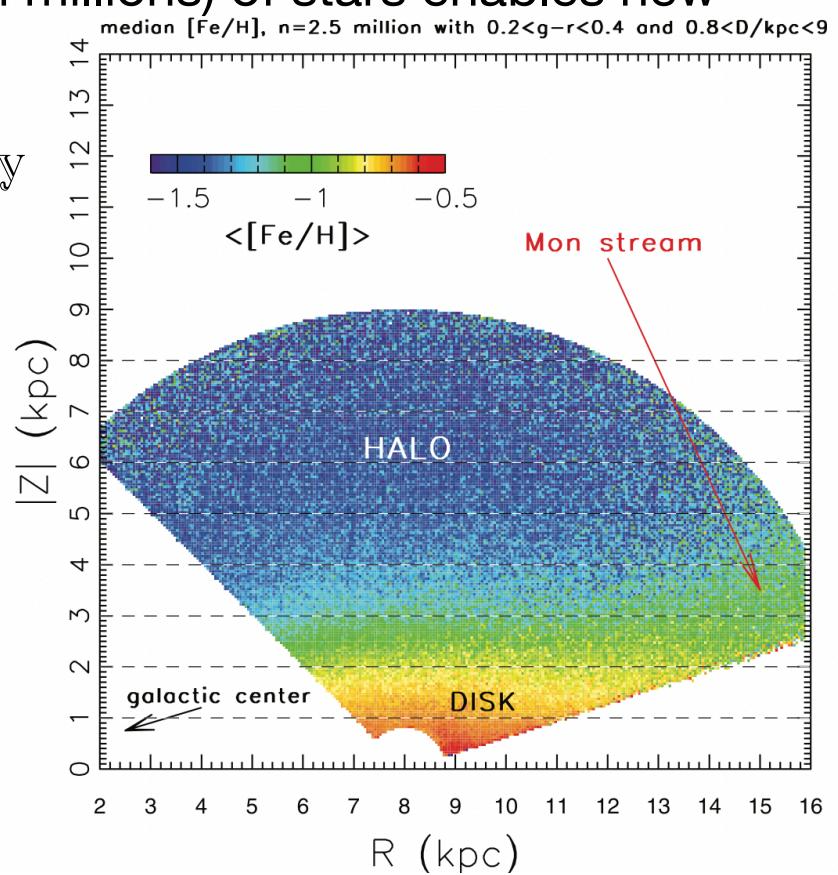
$$[\text{Fe}/\text{H}] = \log_{10} \left(\frac{N_{\text{Fe}}}{N_{\text{H}}} \right)_{\text{star}} - \log_{10} \left(\frac{N_{\text{Fe}}}{N_{\text{H}}} \right)_{\text{sun}}$$



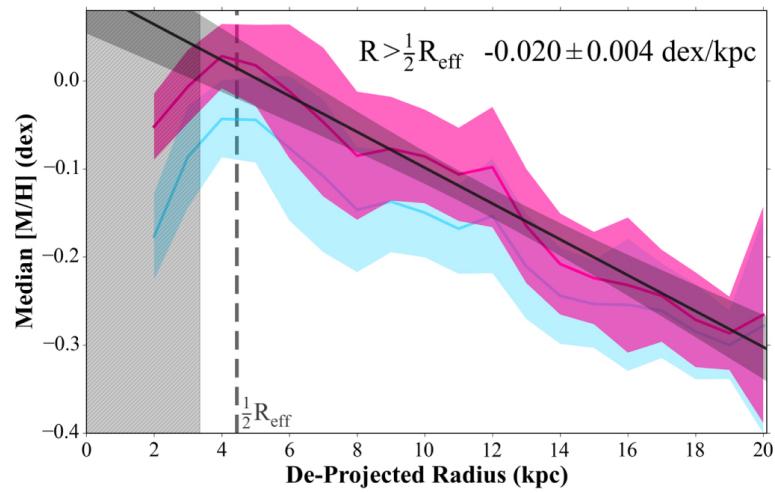
Composition (aka Metallicity)

- Doing this for hundreds of thousands (or even millions) of stars enables new studies of the composition of our galaxy!
- Wonderful new term: chemical cartography

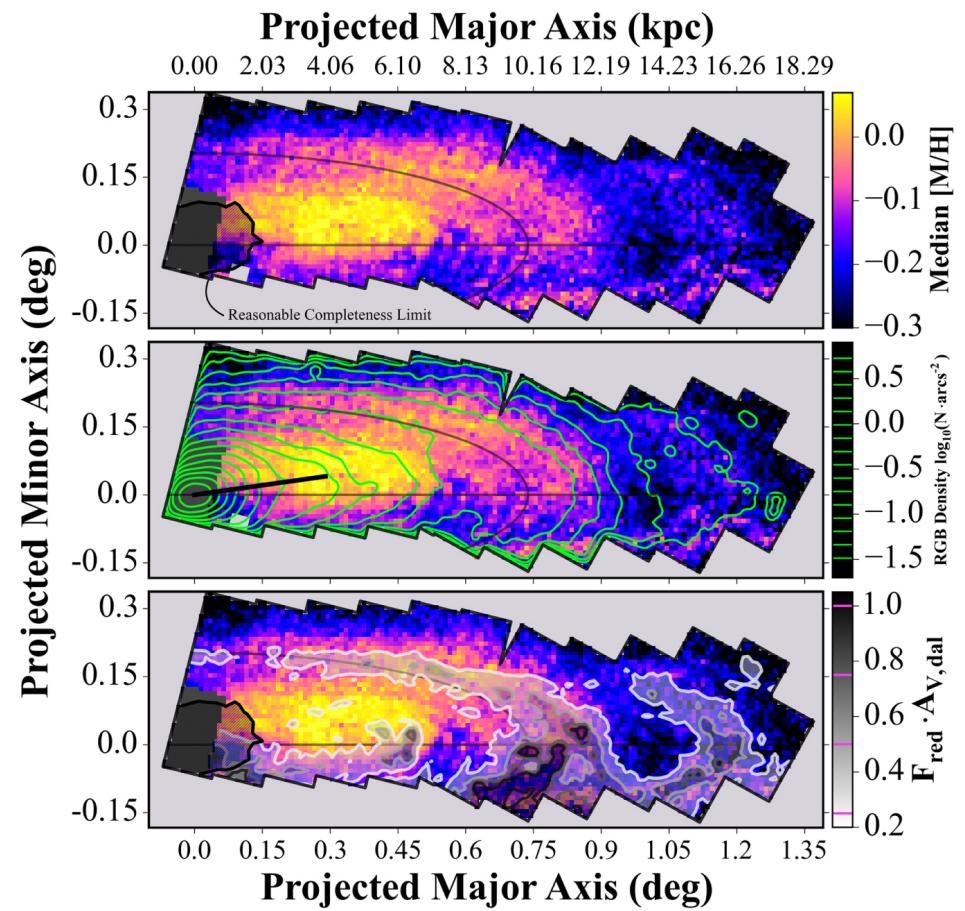
Ivezic+2008



Stellar Metallicity in *other* Galaxies!

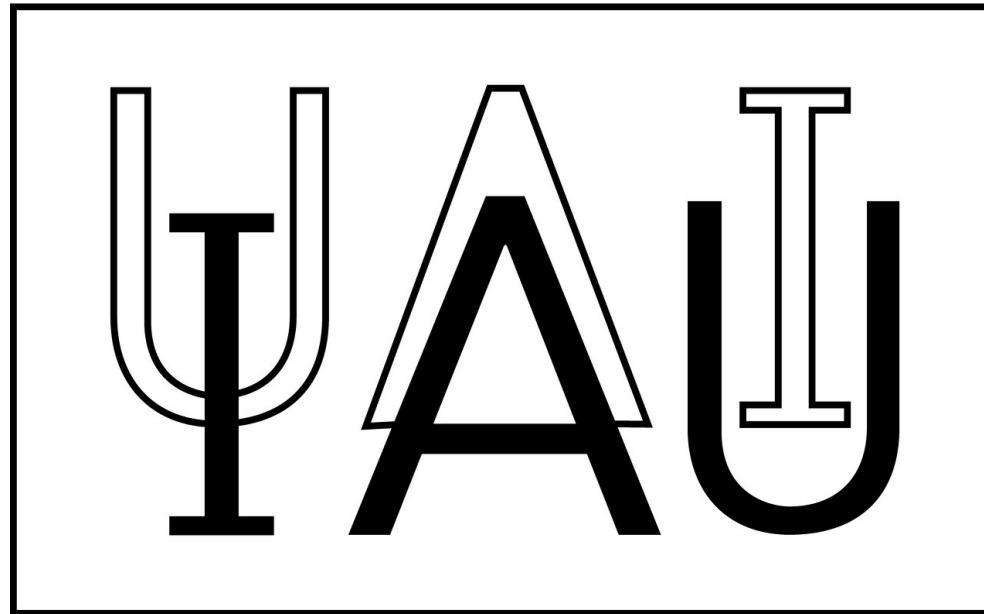


<https://ui.adsabs.harvard.edu/abs/2015AJ....150..189G>



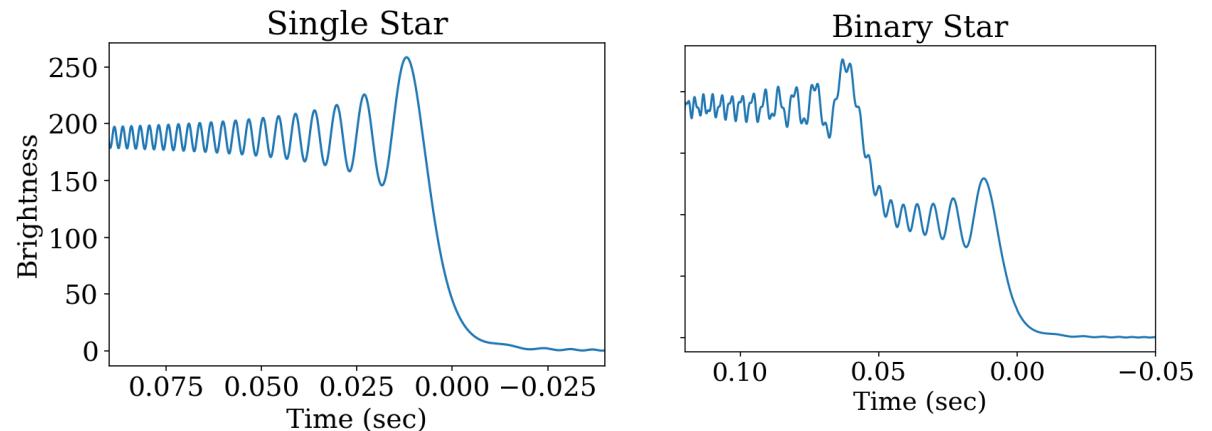
Who decides things?

- 1AU? Names? Is Pluto a Planet?!?!
- Meet the IAU...



Occultation

- The wiggles are caused by diffraction!!



A good primer here:

<http://spiff.rit.edu/richmond/occult/bessel/bessel.html>

HW 1

- Reading that data file...
- I like “Pandas”, you could also use Astropy Tables

```
In [3]: gaia = pd.read_csv('Gao2018_GaiaEDR3.csv')
gaia.shape
```

```
Out[3]: (1502, 67)
```

```
In [4]: gaia.columns
```

```
Out[4]: Index(['angDist', '_RAJ2000', '_DEJ2000', 'E', 'GaiaDR2', 'RAJ2000', 'DEJ2000',
       'PRF', 'Simbad', 'ra_epoch2000', 'dec_epoch2000', 'errHalfMaj',
       'errHalfMin', 'errPosAng', 'source_id', 'ra', 'ra_error', 'dec',
       'dec_error', 'parallax', 'parallax_error', 'parallax_over_error', 'pm',
       'pmra', 'pmra_error', 'pmdec', 'pmdec_error',
       'astrometric_n_good_obs_al', 'astrometric_gof_al',
       'astrometric_chi2_al', 'astrometric_excess_noise',
       'astrometric_excess_noise_sig', 'astrometric_params_solved',
       'pseudocolour', 'pseudocolour_error', 'visibility_periods_used', 'ruwe',
       'duplicated_source', 'phot_g_mean_flux', 'phot_g_mean_flux_error',
       'phot_g_mean_mag', 'phot_bp_mean_flux', 'phot_bp_mean_flux_error',
       'phot_bp_mean_mag', 'phot_rp_mean_flux', 'phot_rp_mean_mag',
       'phot_bp_rp_excess_factor', 'bp_rp', 'dr2_radial_velocity',
       'dr2_radial_velocity_error', 'dr2_rv_nb_transits',
       'dr2_rv_template_teff', 'dr2_rv_template_logg', 'panstarrs1',
       'sdssdr13', 'skymapper2', 'urat1', 'phot_g_mean_mag_error',
       'phot_bp_mean_mag_error', 'phot_rp_mean_mag_error',
       'phot_g_mean_mag_corrected', 'phot_g_mean_mag_error_corrected',
       'phot_g_mean_flux_corrected', 'phot_bp_rp_excess_factor_corrected',
       'ra_epoch2000_error', 'dec_epoch2000_error', 'ra_dec_epoch2000_corr'],
      dtype='object')
```

```
gaia['bp_rp']
gaia['phot_g_mean_mag']
```

HW 1

- Reading that isochrone file...
- I like “Pandas”, you could also use Astropy Tables

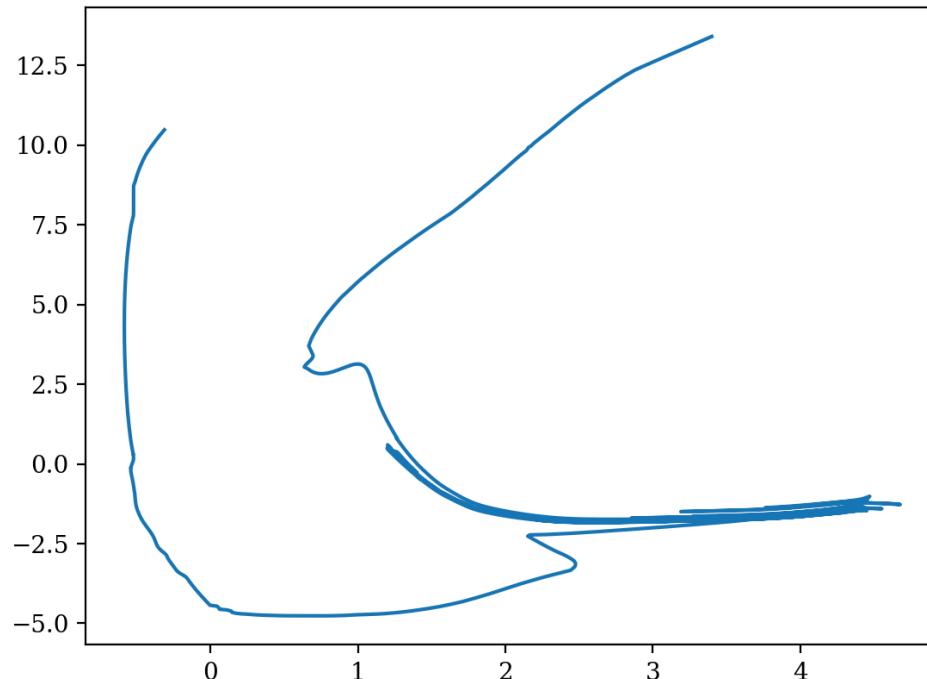
```
In [7]: import pandas as pd  
  
mist = pd.read_table('MIST_iso_61ca3125bac7d.iso.cmd', delim_whitespace=True, skiprows=12)  
  
mist.columns  
  
Out[7]: Index(['EEP', 'log10_isochrone_age_yr', 'initial_mass', 'star_mass',  
       'log_Teff', 'log_g', 'log_L', '[Fe/H]_init', '[Fe/H]', 'Bessell_U',  
       'Bessell_B', 'Bessell_V', 'Bessell_R', 'Bessell_I', '2MASS_J',  
       '2MASS_H', '2MASS_Ks', 'Kepler_Kp', 'Kepler_D51', 'Hipparcos_Hp',  
       'Tycho_B', 'Tycho_V', 'Gaia_G_DR2Rev', 'Gaia_BP_DR2Rev',  
       'Gaia_RP_DR2Rev', 'Gaia_G_MAW', 'Gaia_BP_MAWb', 'Gaia_BP_MAWf',  
       'Gaia_RP_MAW', 'TESS', 'Gaia_G_EDR3', 'Gaia_BP_EDR3', 'Gaia_RP_EDR3',  
       'phase'],  
       dtype='object')
```

HW 1

- Reading that isoc
- I like “Pandas”, yo

```
In [7]: import pandas as pd  
  
mist = pd.read_table('...')  
  
mist.columns  
  
Out[7]: Index(['EEP', 'log10_B', 'log10_Teff', 'Bessell_B', '2MASS_H', '2MASS_J', 'Tycho_B', 'Tycho_J', 'Gaia_BP_EDR3', 'Gaia_RP_DR2F', 'Gaia_RP_MAWF', 'phase'], dtype='object')
```

```
In [9]: plt.plot(mist['Gaia_BP_EDR3'] - mist['Gaia_RP_EDR3'], mist['Gaia_G_EDR3'])
```



Next time:

- Lecture 3 & 4 will be posted to YouTube soon
 - I'll ping on Email & Slack when it's uploaded