A New Spectrophotometric System Based on Sirius

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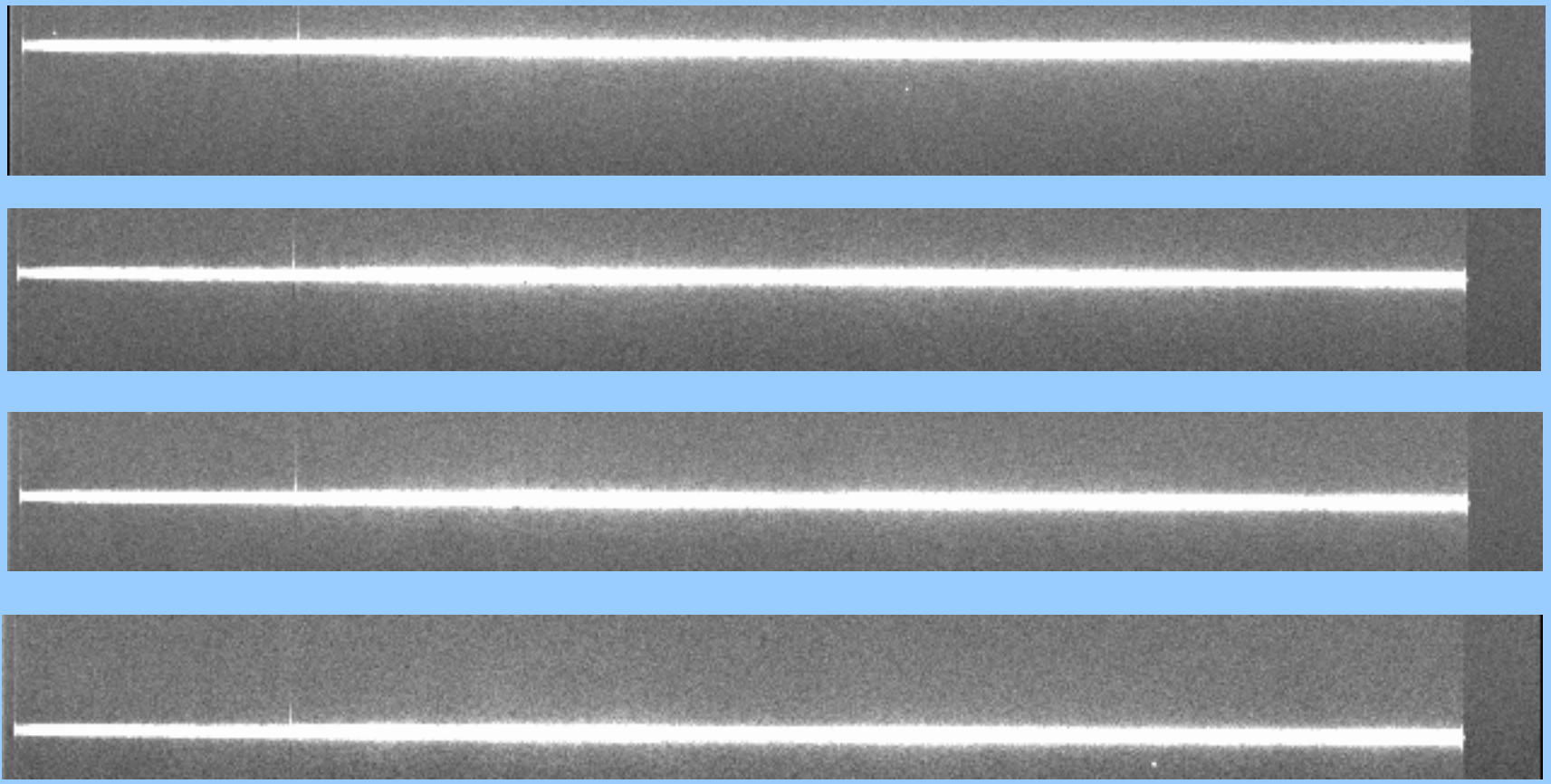
The fundamental photometric standard is Vega. But it is slightly variable and it has a circumstellar shell.

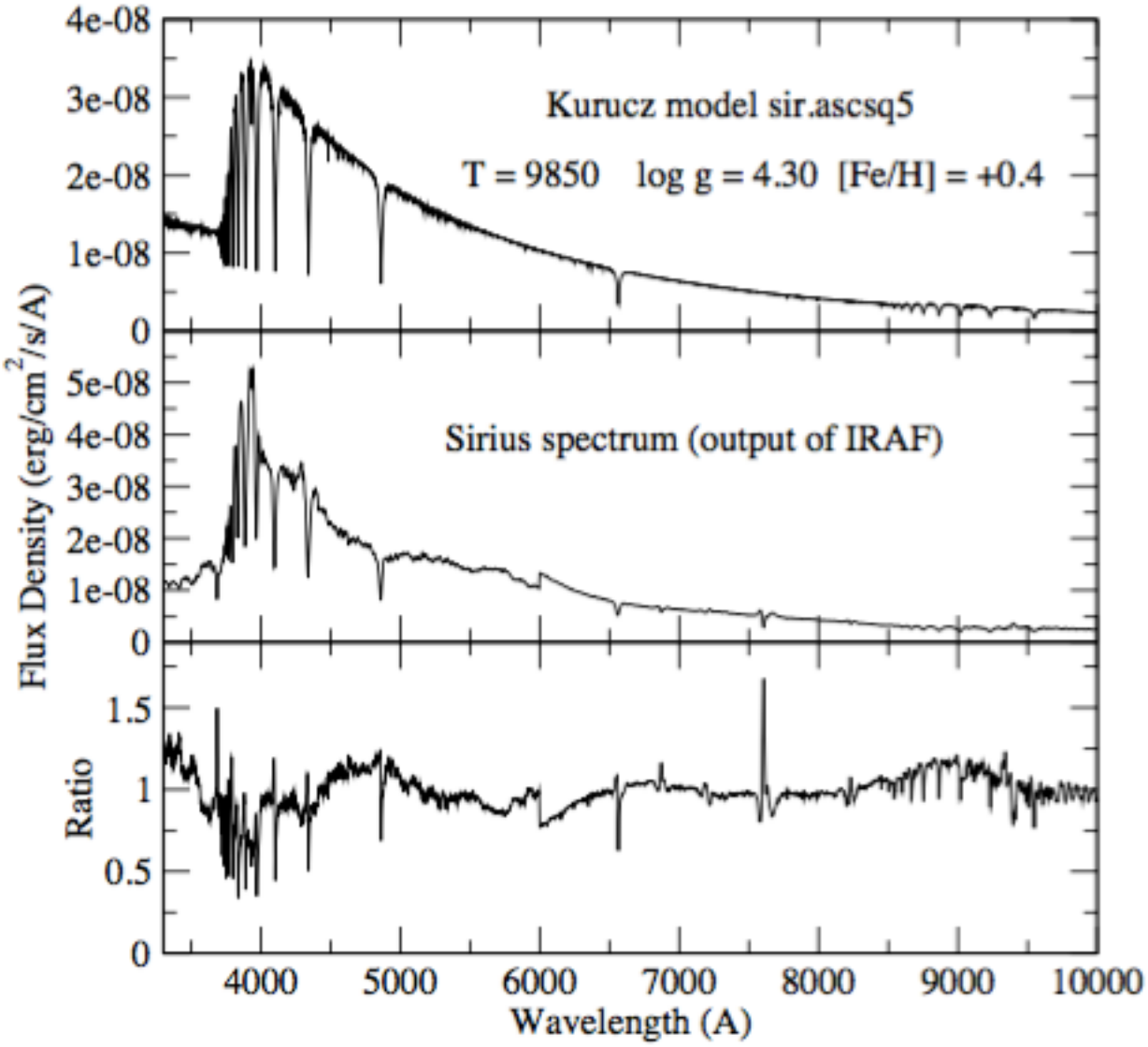
Sirius is easier to model.

Nick Suntzeff obtained spectra of ~20 very bright stars in January of 2003 and January 2005 with the CTIO 1.5-m telescope and its grating spectrometer RCSPEC (2.81 A/px resolution in the blue, 5.43 A/px in the red). He used a 7.5 magnitude neutral density filter to keep from saturating the chip.

We can use these spectra to establish a new fundamental system of spectrophotometry based on Sirius.

Raw spectra were 1274 by 140 pixels. Each star was observed at four slit positions, each subsequent one 30 arcsec further down the slit.





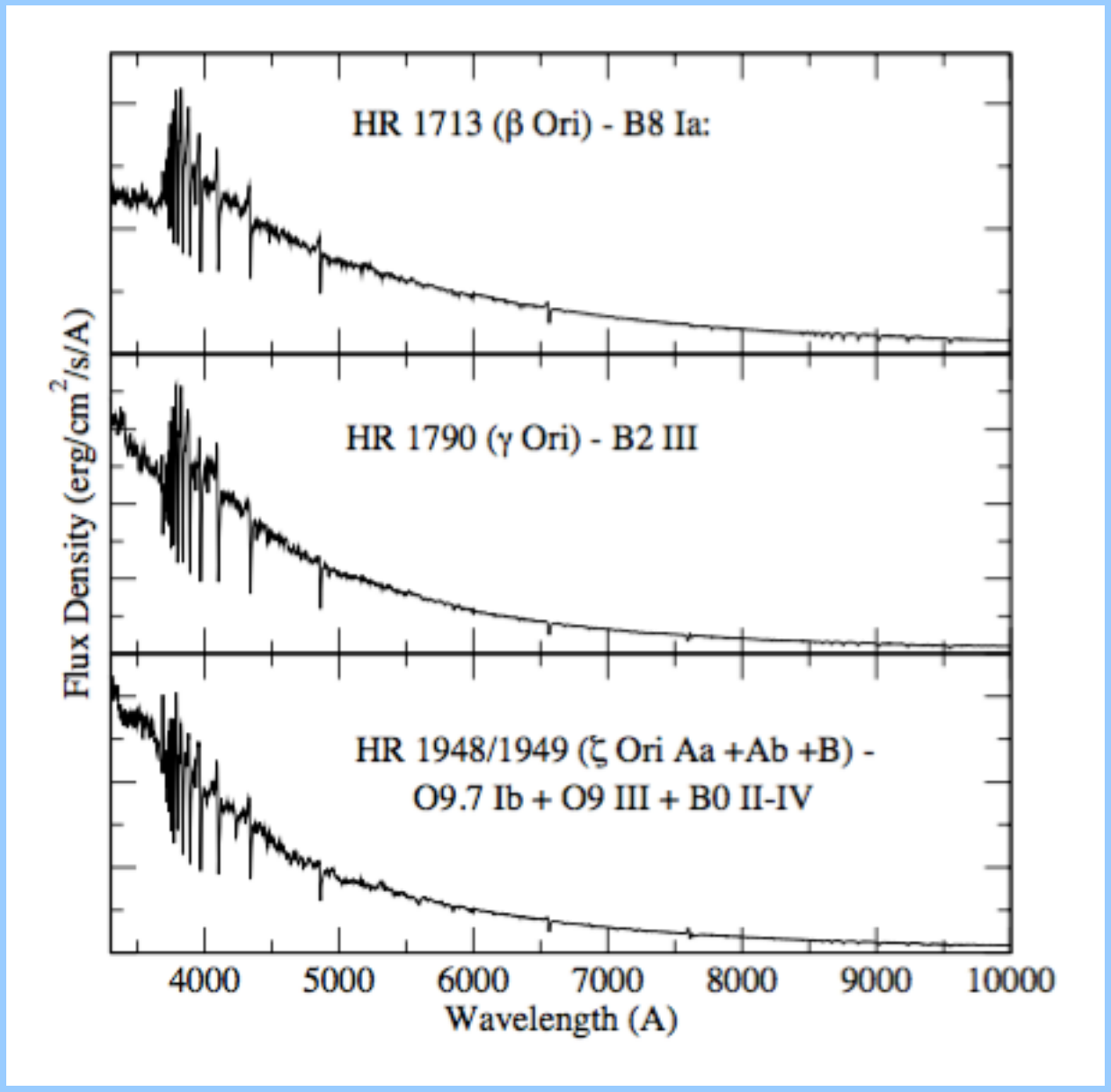
Middle spectrum is based on 18 spectra in the blue and 16 in the red.

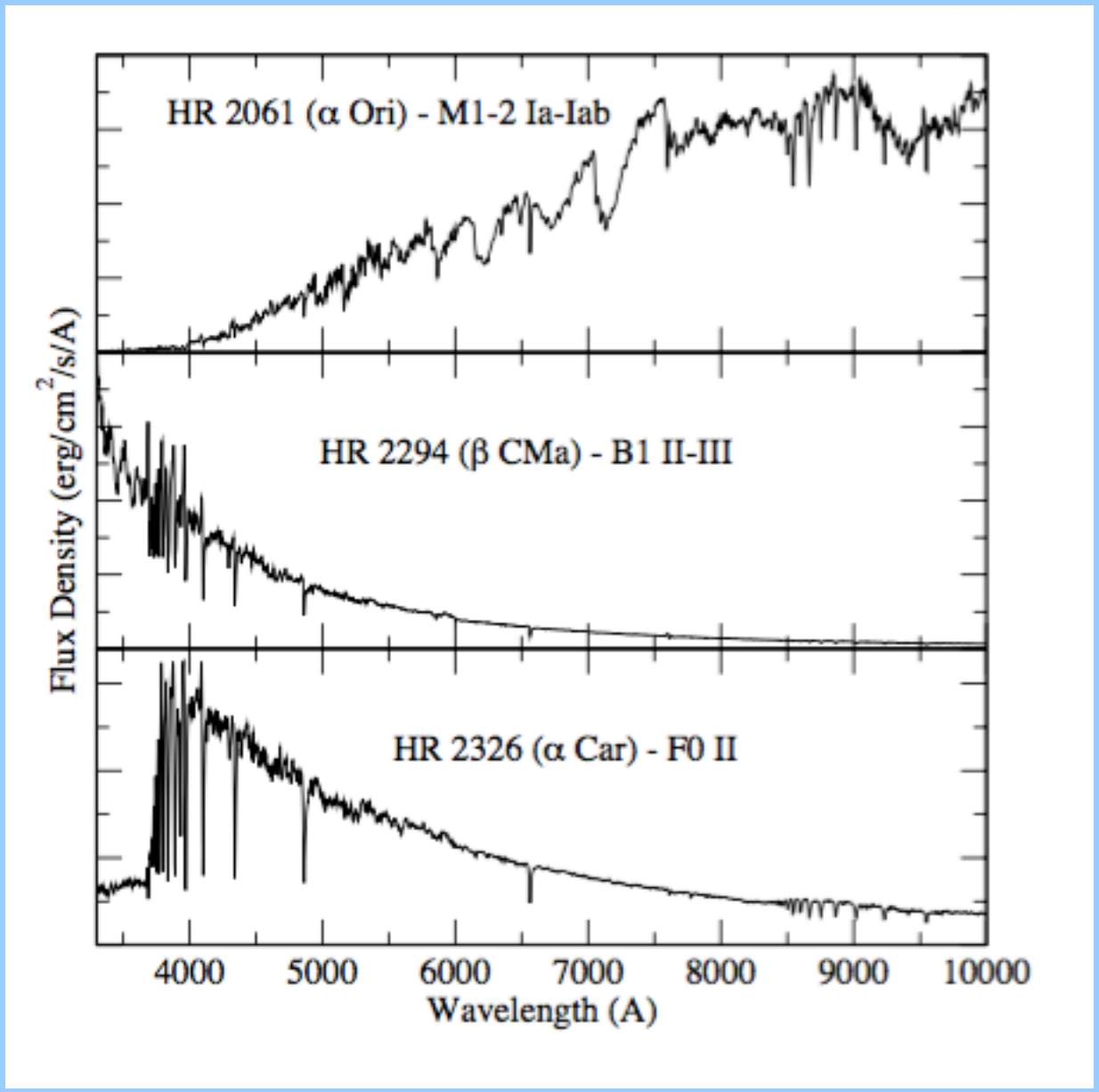
They are stitched together at 6000 A. Spectra of other stars are multiplied by the bottom function to place them on the system of the Sirius model.

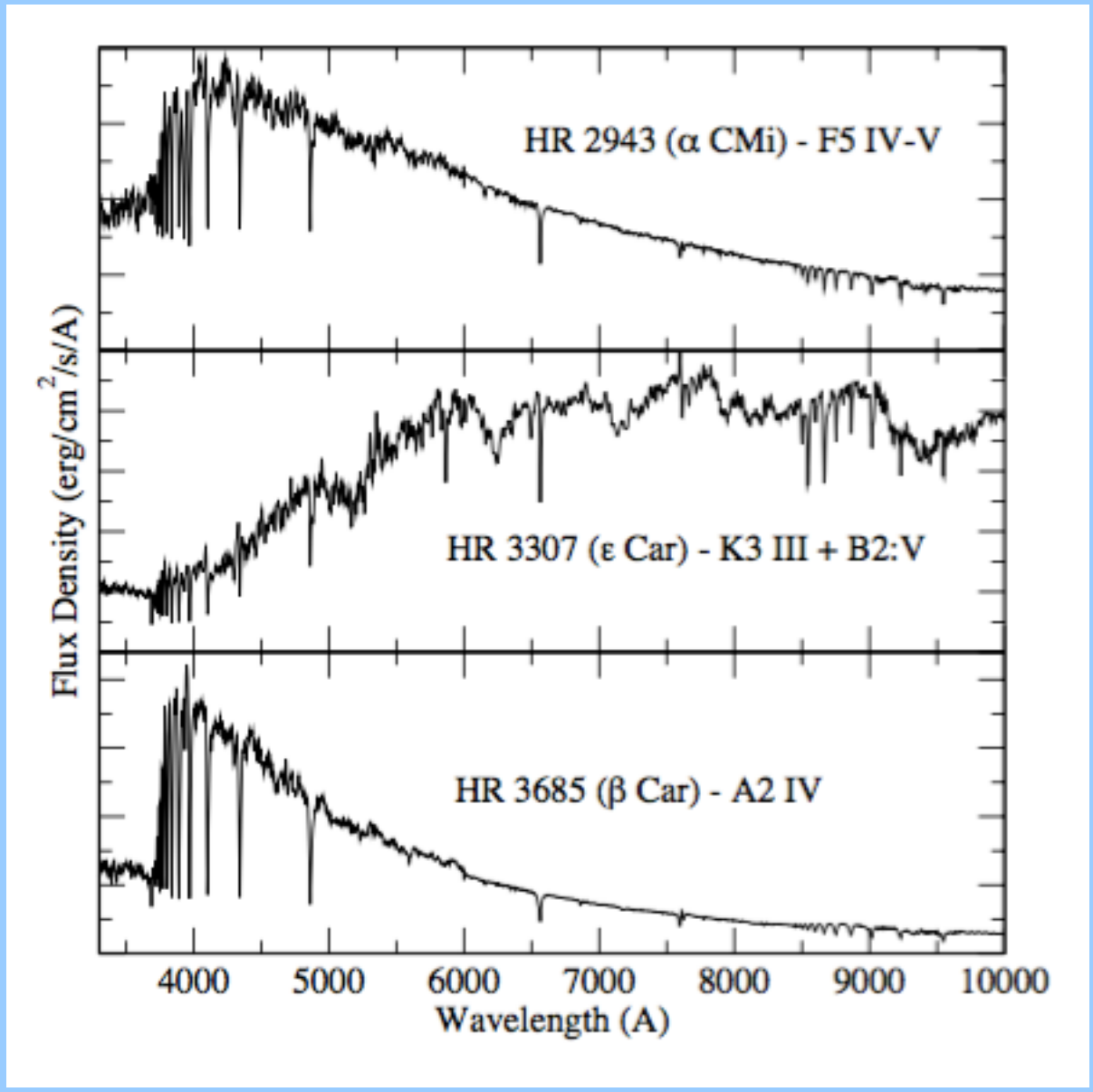
In the spectra that follow some the emission and absorption details are spurious, such as the P Cygni profiles in the hot giants and supergiants.

As Armin Rest pointed out, one has to match the resolution of the Sirius model spectrum to that of the spectra, before the spectral flattening.

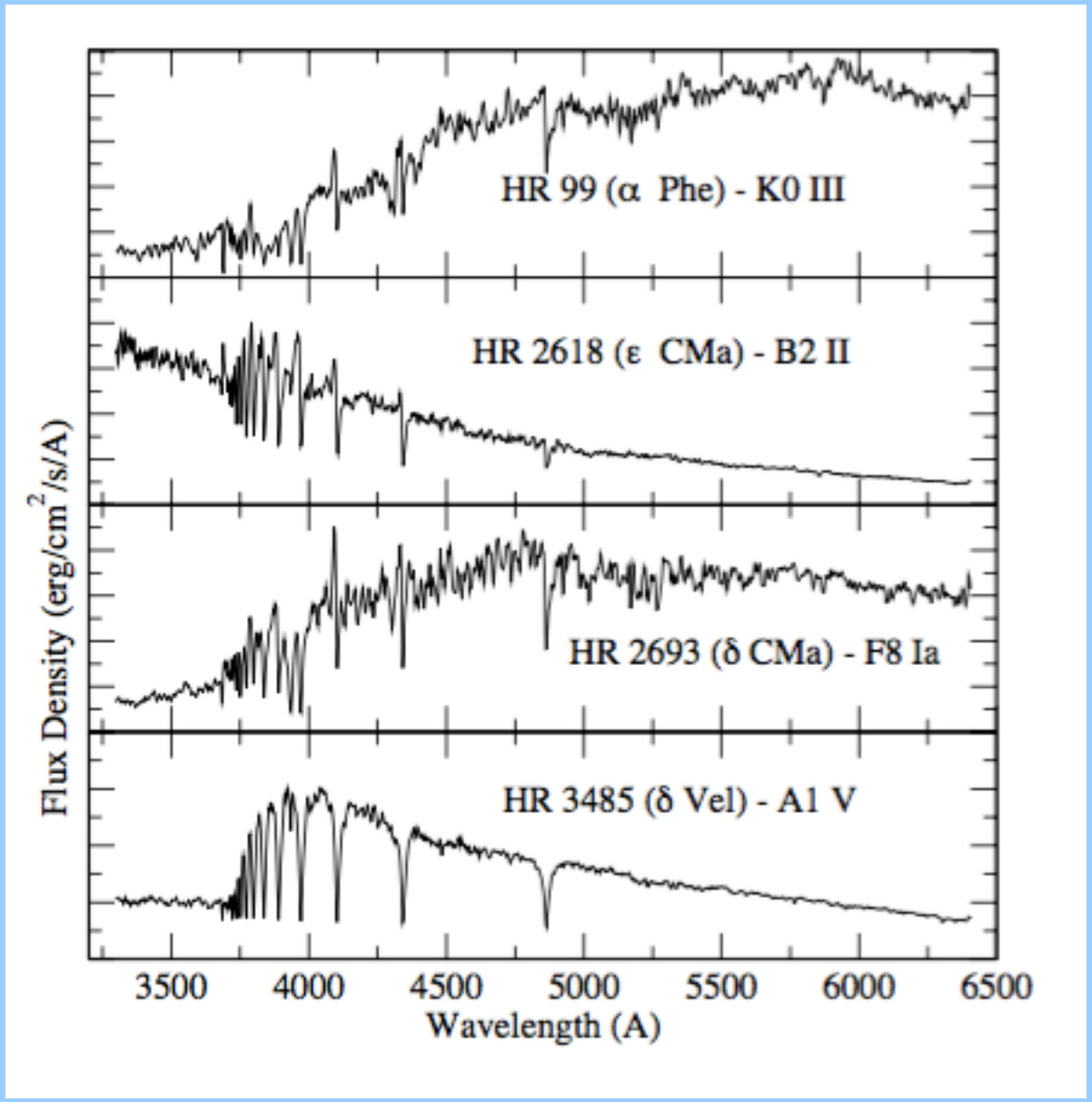
I will get to this in May/June 2016.

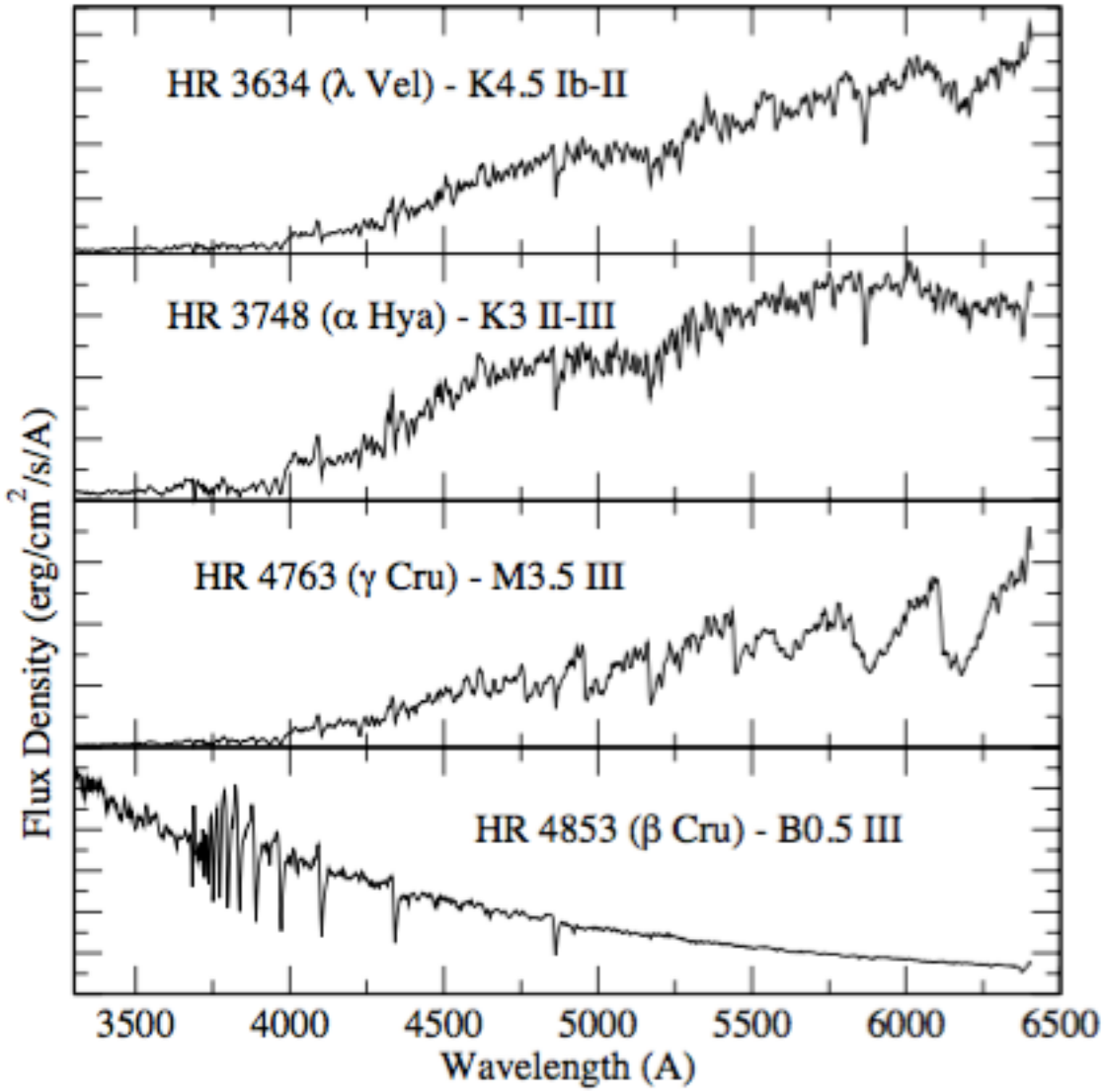

HR 1713 (β Ori) - B8 Ia:
HR 1790 (γ Ori) - B2 III
HR 1948/1949 (ζ Ori Aa +Ab +B) -
O9.7 Ib + O9 III + B0 II-IV
Flux Density (erg/cm^2/s/A)
4000
5000
6000
7000
8000
9000
10000
Wavelength (A)

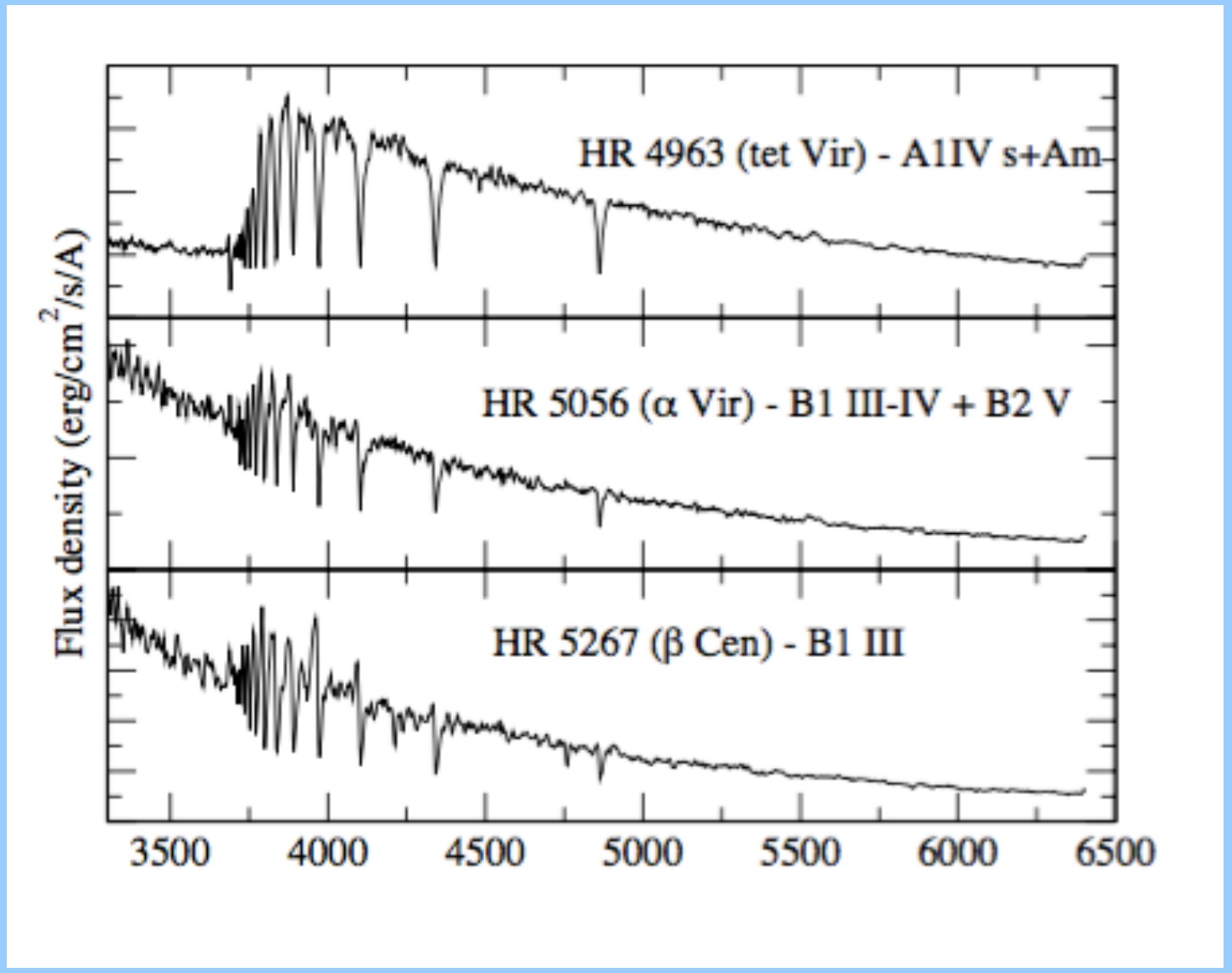

HR 2061 (α Ori) - M1-2 Ia-Iab
HR 2294 (β CMa) - B1 II-III
HR 2326 (α Car) - F0 II
Flux Density (erg/cm^2/s/A)
4000
5000
6000
7000
8000
9000
10000
Wavelength (A)


HR 2943 (α CMi) - F5 IV-V
HR 3307 (ε Car) - K3 III + B2:V
HR 3685 (β Car) - A2 IV
Flux Density (erg/cm^2/s/A)
4000
5000
6000
7000
8000
9000
10000
Wavelength (A)

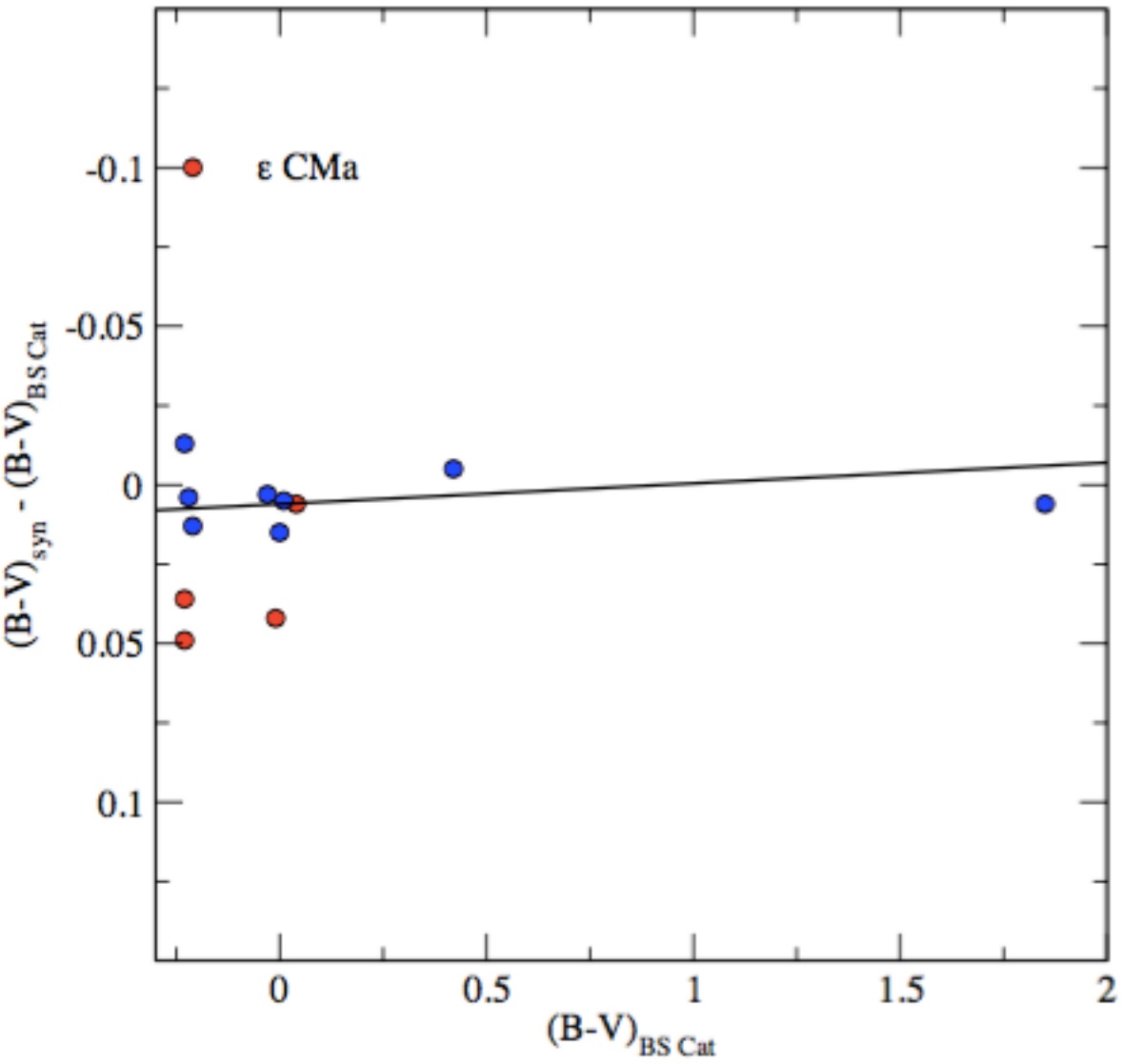
11 stars were observed only with the blue grating
on January 6, 2003.


HR 99 (α Phe) - K0 III
HR 2618 (ε CMa) - B2 II
HR 2693 (δ CMa) - F8 Ia
HR 3485 (δ Vel) - A1 V
Flux Density (erg/cm^2/s/A)
3500
4000
4500
5000
5500
6000
6500
Wavelength (A)

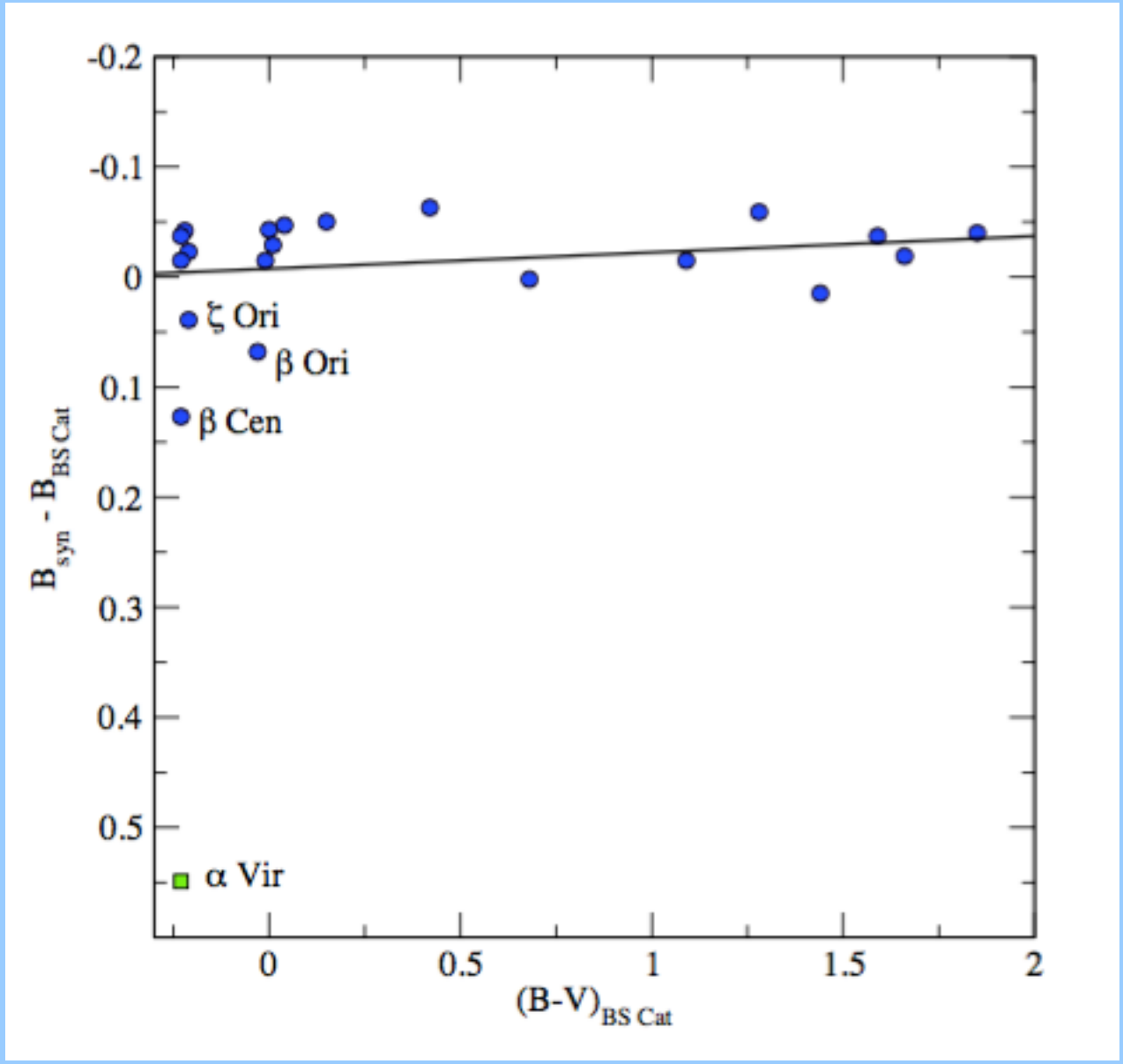

HR 3634 (λ Vel) - K4.5 Ib-II
HR 3748 (α Hya) - K3 II-III
HR 4763 (γ Cru) - M3.5 III
HR 4853 (β Cru) - B0.5 III
Flux Density (erg/cm^2/s/A)
3500
4000
4500
5000
5500
6000
6500
Wavelength (A)


HR 4963 (tet Vir) - A1IV s+Am
HR 5056 (α Vir) - B1 III-IV + B2 V
HR 5267 (β Cen) - B1 III
Flux density (erg/cm^2/s/A)
3500
4000
4500
5000
5500
6000
6500

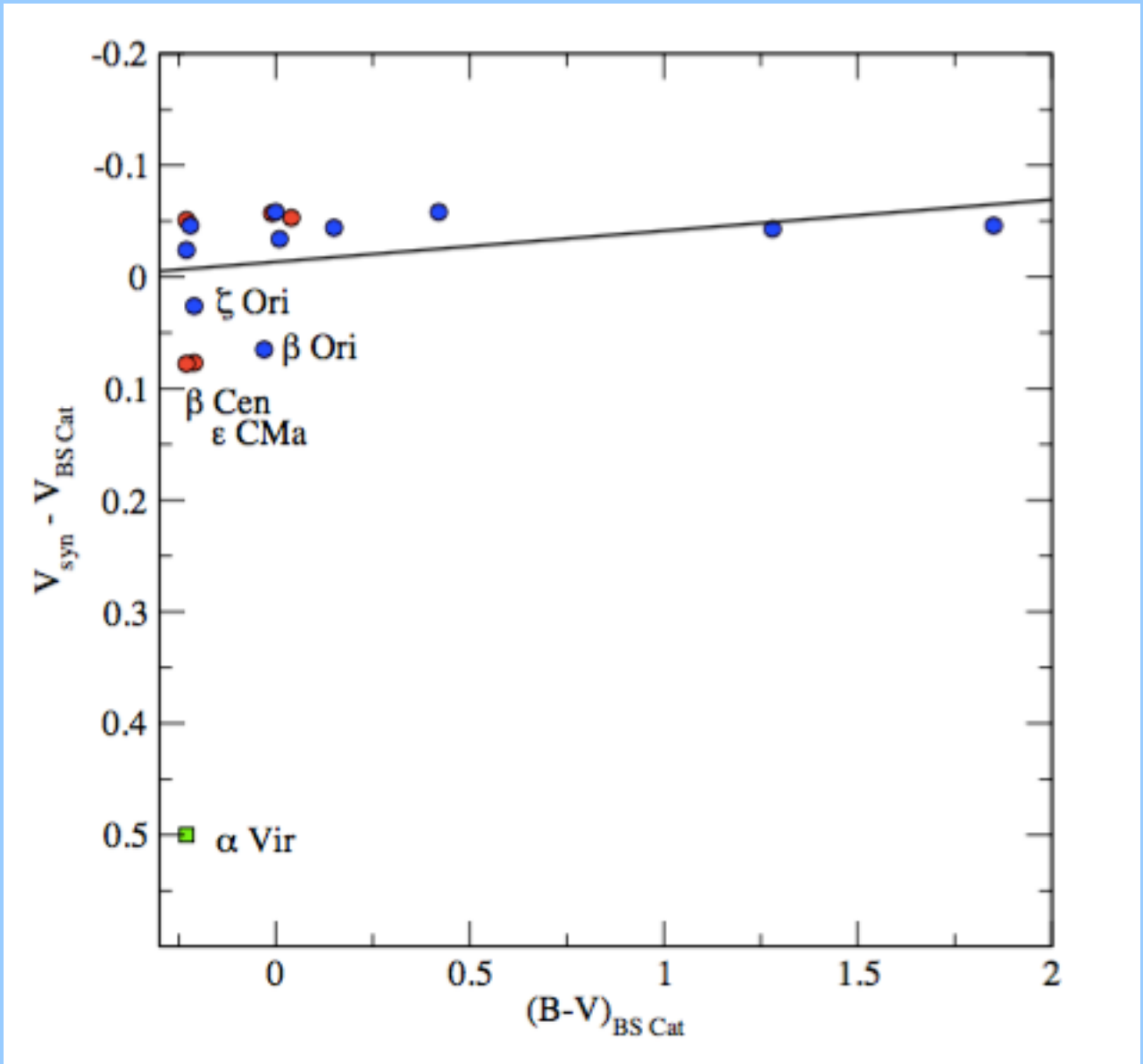
Now as a sanity check, let's use the Bessell (1990) filter specifications and do synthetic photometry on the spectra.



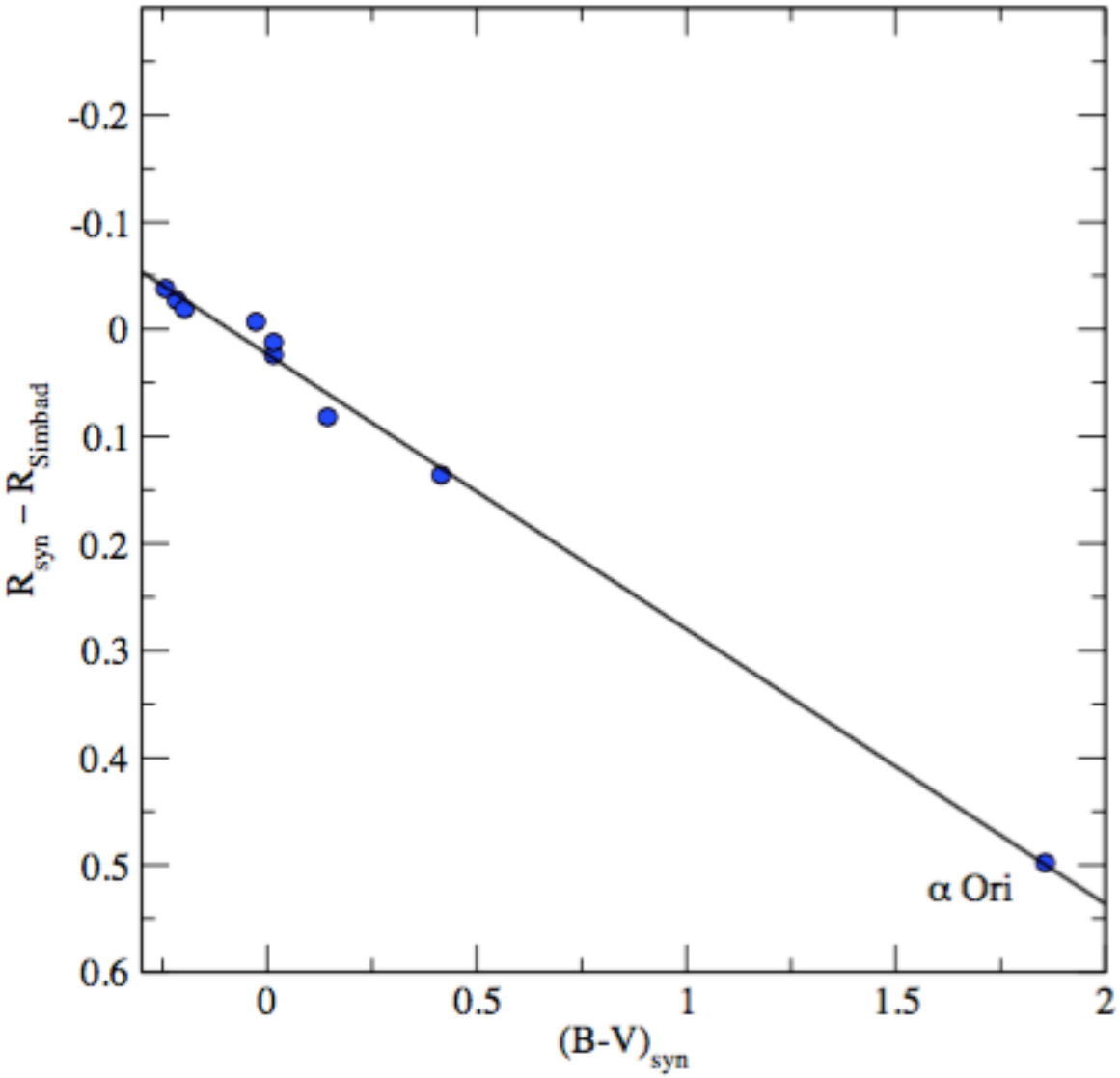
Synthetic B-V colors vs. those from the Bright Star Catalogue.



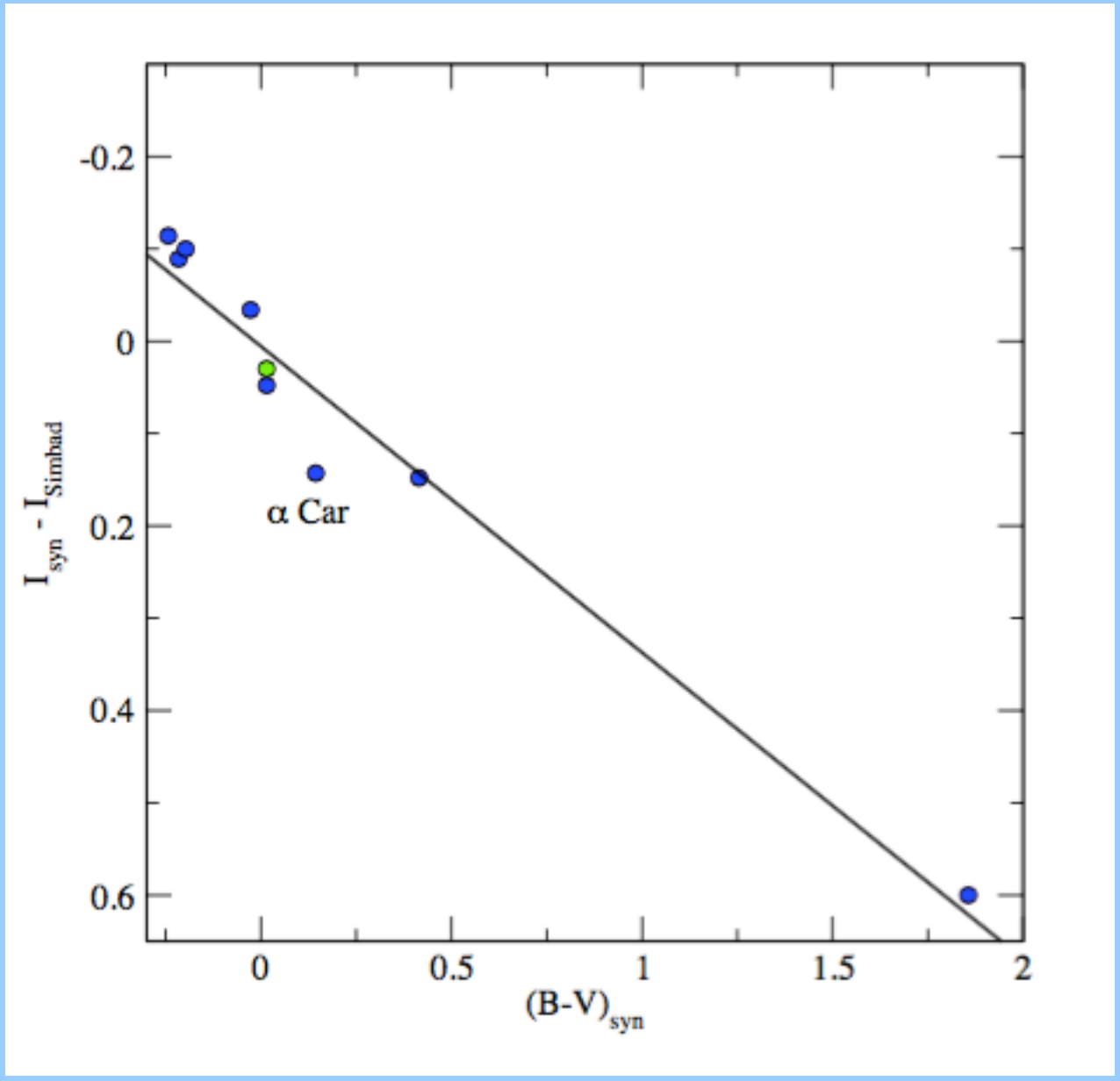
Synthetic B magnitudes vs. those from the Bright Star Catalogue.



Synthetic V magnitudes vs. those from the Bright Star Catalogue.



Now, the R-band magnitudes from Simbad indicate that their band-pass is quite a bit to the red of the Bessell R-band filter specification.



The same goes for the I-band magnitudes.

We need to find the Kron-Cousins R and I mags of these stars.

Should we use a different Kurucz model for Sirius?

The Kurucz model(s) give vacuum wavelengths. Our He-Ar wavelength calibrations use wavelengths in air. Should we scale the Kurucz wavelengths before making the flux function?

How to reconcile an anomaly like α Vir?
Are the values given by the Bright Star Catalogue or Simbad wrong? Was there a passing cloud? Was the dome occulting part of the primary mirror? Are the exposure times in the FITS headers wrong? Or is it variable to a greater degree than previously known?