The colour issue (introduction): λ dependence of wide-band photometry

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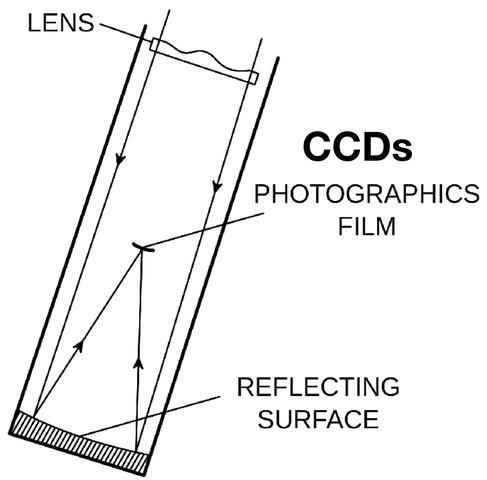
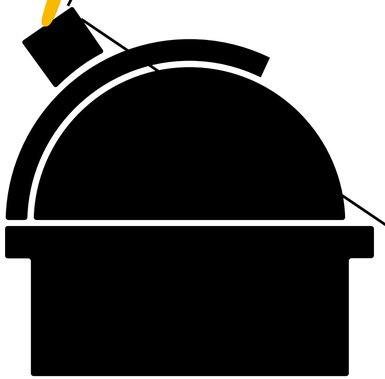
Flux F

Depends on time, elevation etc

Atmosphere : Flux αF



CCDs



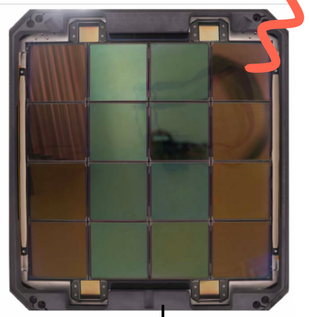
Instrument

Dust spots? Aging?

Mirrors etc. : Flux $\alpha\beta F$

Dust? Frequency dependence of course

Filters : Flux $\alpha\beta\gamma F$

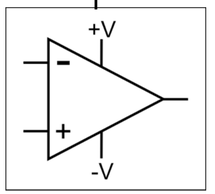


Edges, dust, coating etc.

Detectors : Flux $\alpha\beta\gamma\delta F$

Gain variations etc?

Amplifiers : Flux $\alpha\beta\gamma\delta\varepsilon F$



Signal measured in ADU

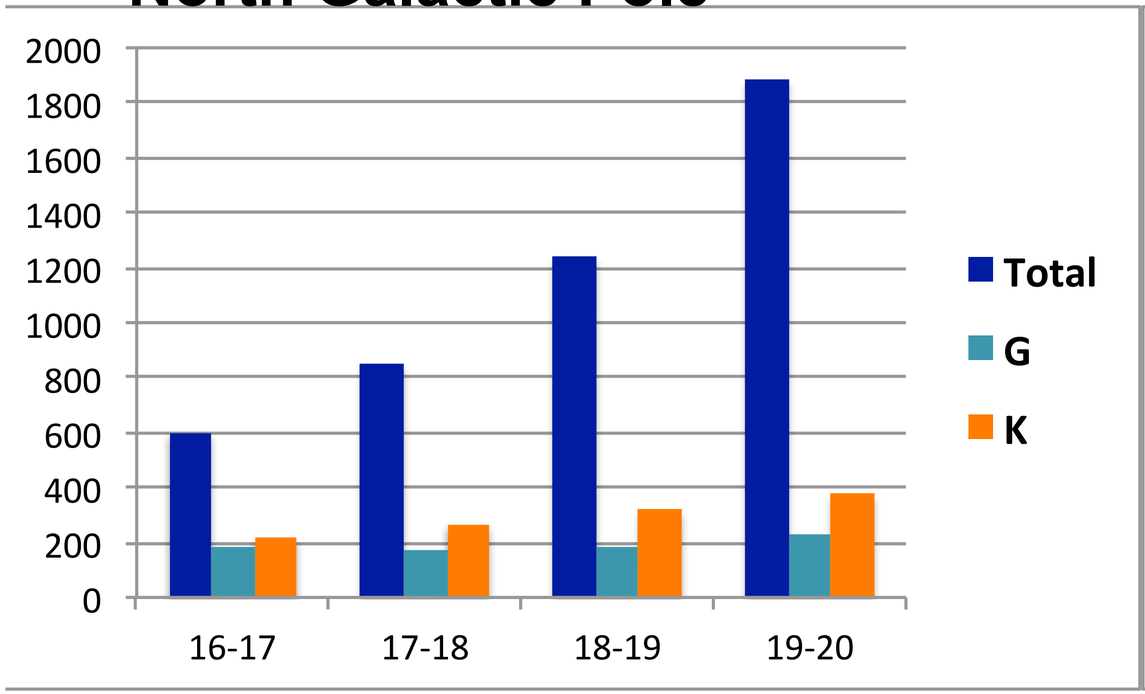
$$m_{meas} = -2.5 \log (F_{meas})$$

$$= -2.5 \log (F) - 2.5 \log (\alpha\beta\gamma\delta\epsilon)$$

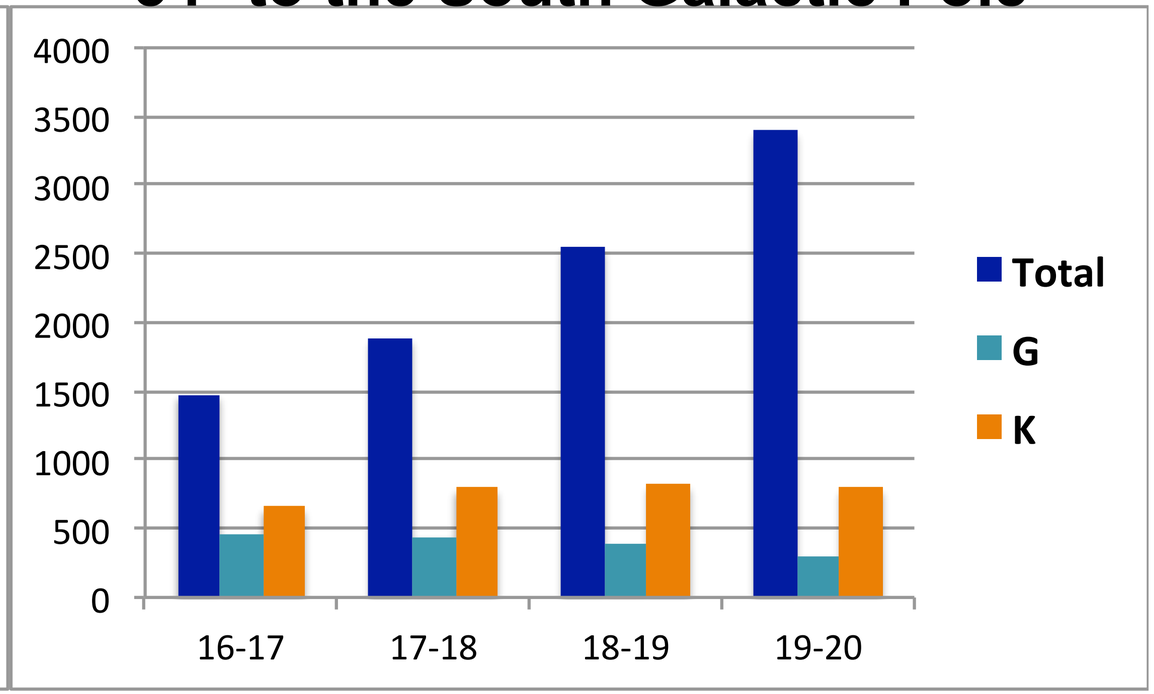
ZP

Calibrator distribution varies over the FoV

North Galactic Pole



54° to the South Galactic Pole



130 G&K * / deg^2 / 1 mag

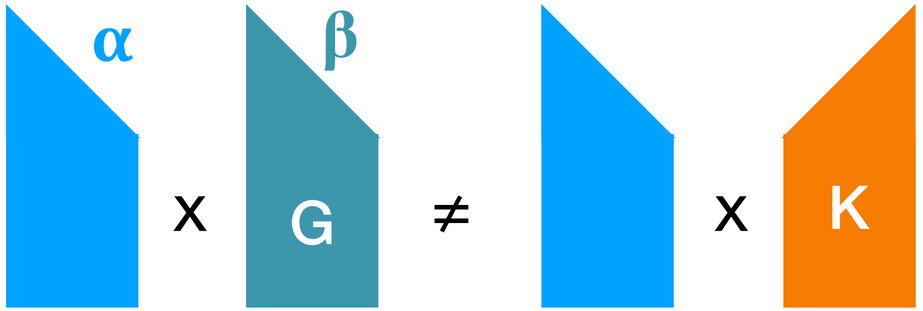
300 G&K * / deg^2 / 1 mag

λ dependence of wide-band photometry

As we integrate over the filter bandwidth, we assume flat fluxes to potentially different spectral shapes

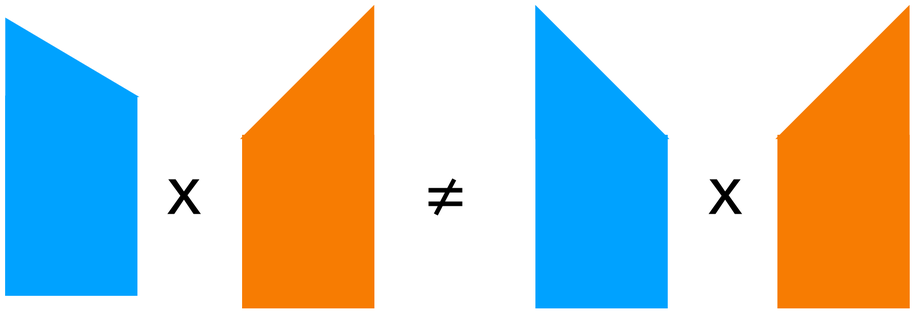
Here the atmosphere is stable

two different star spectra



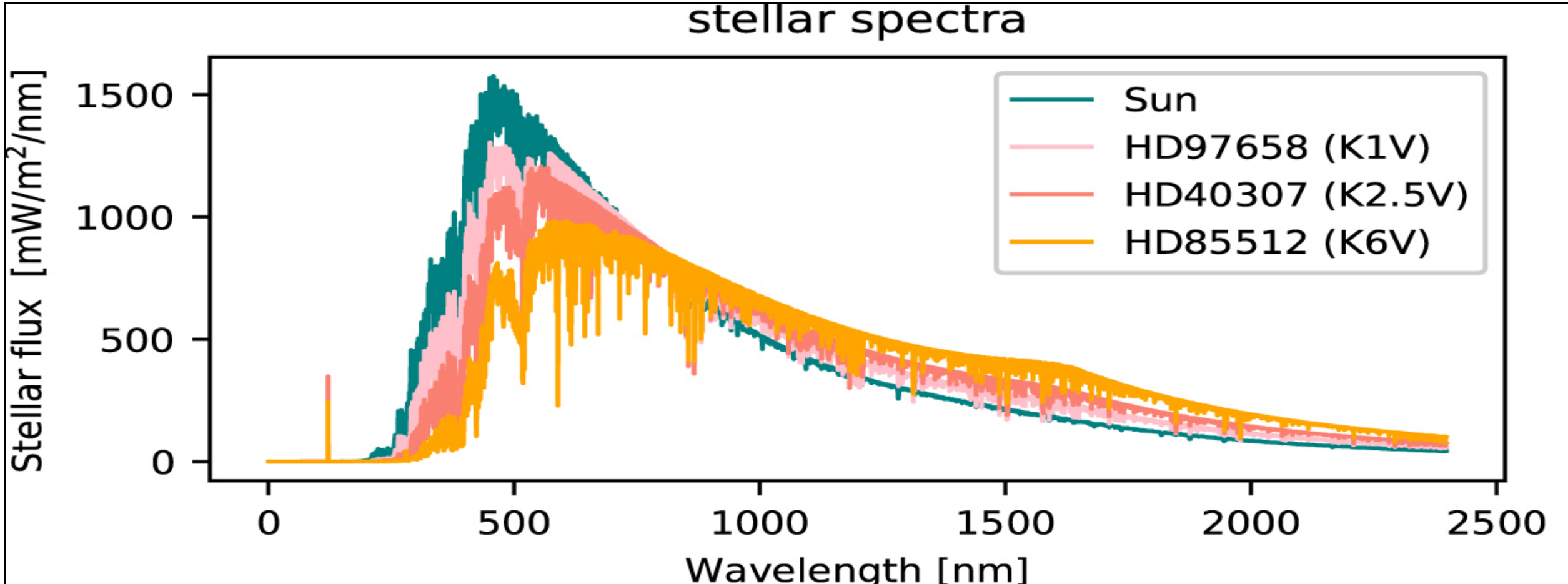
here the atmosphere changes

same star spectrum



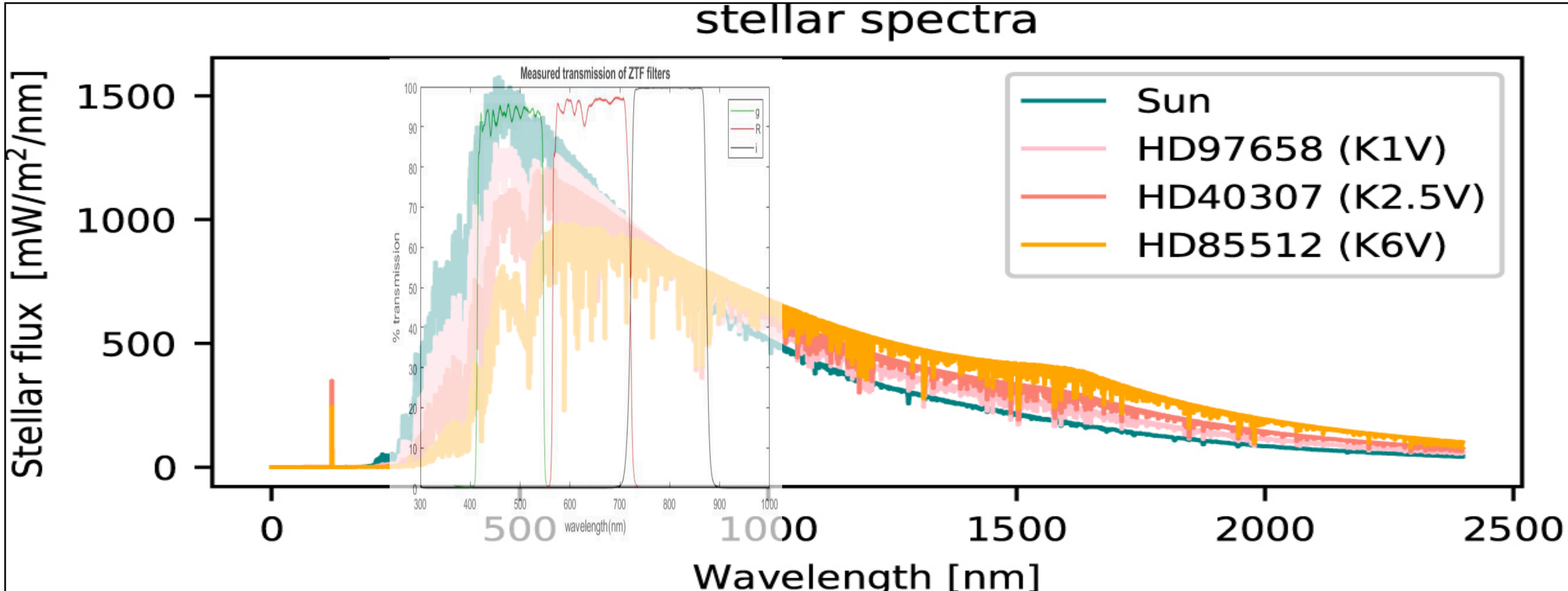
Colour of calibrators and targets (SN 1a e.g.)

- G and K-dwarves are stable and adequate foreground stars



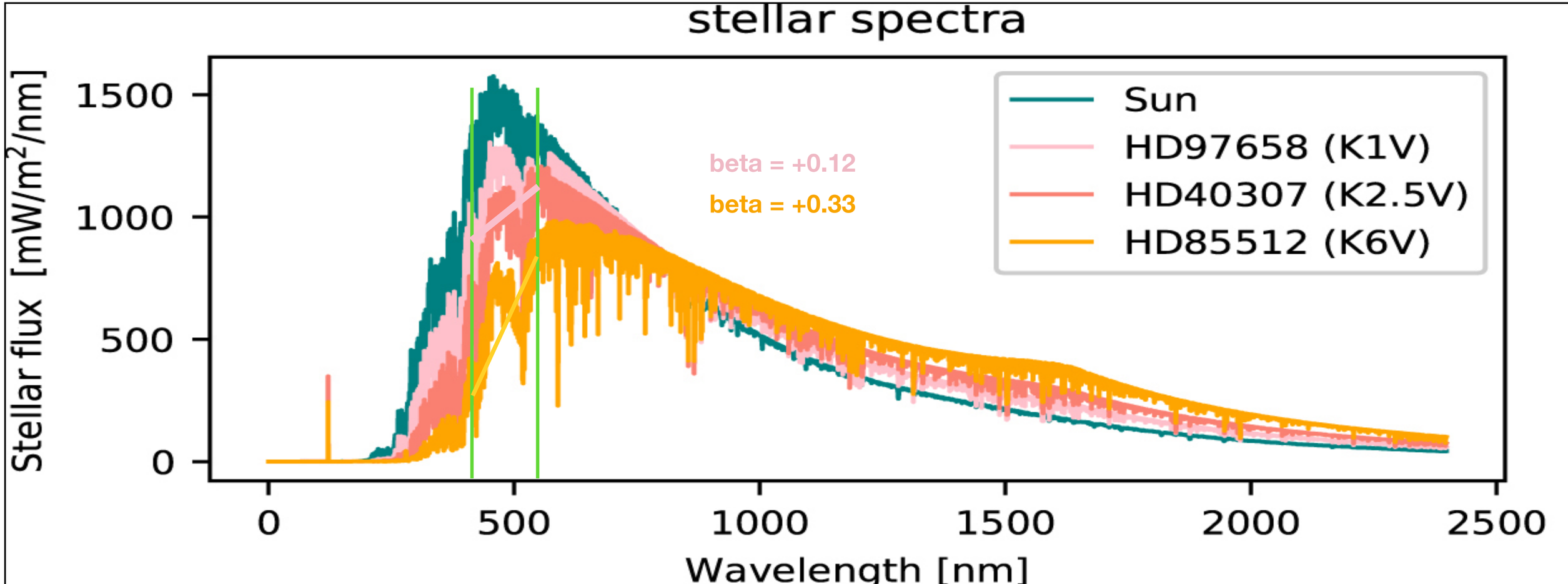
Colour of calibrators and targets (SN 1a e.g.)

- K-dwarves have a varied spectral behaviour within *r* filter passband



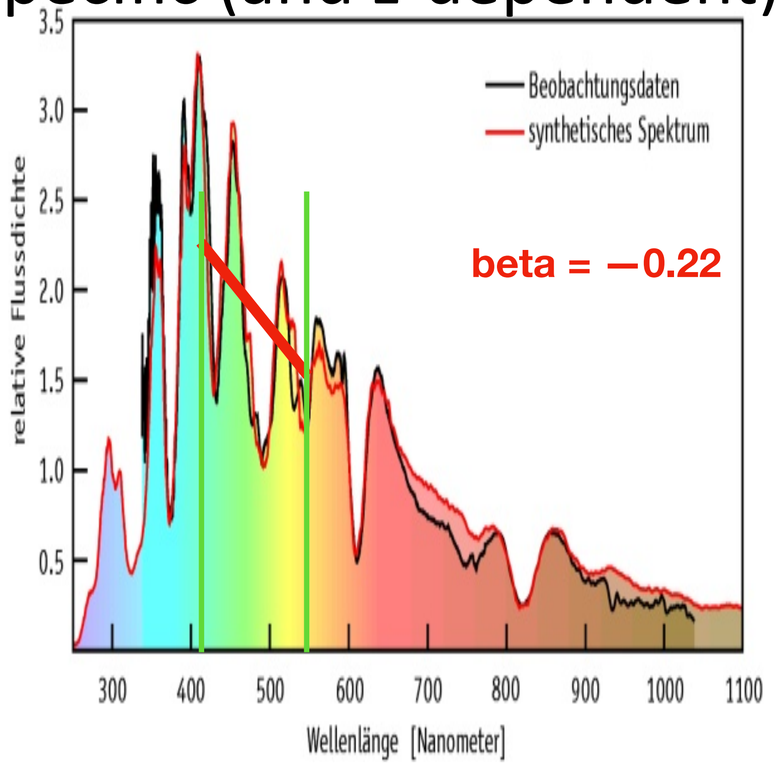
Colour of calibrators and targets (SN 1a e.g.)

- K-dwarves have a varied spectral behaviour within *r* filter passband



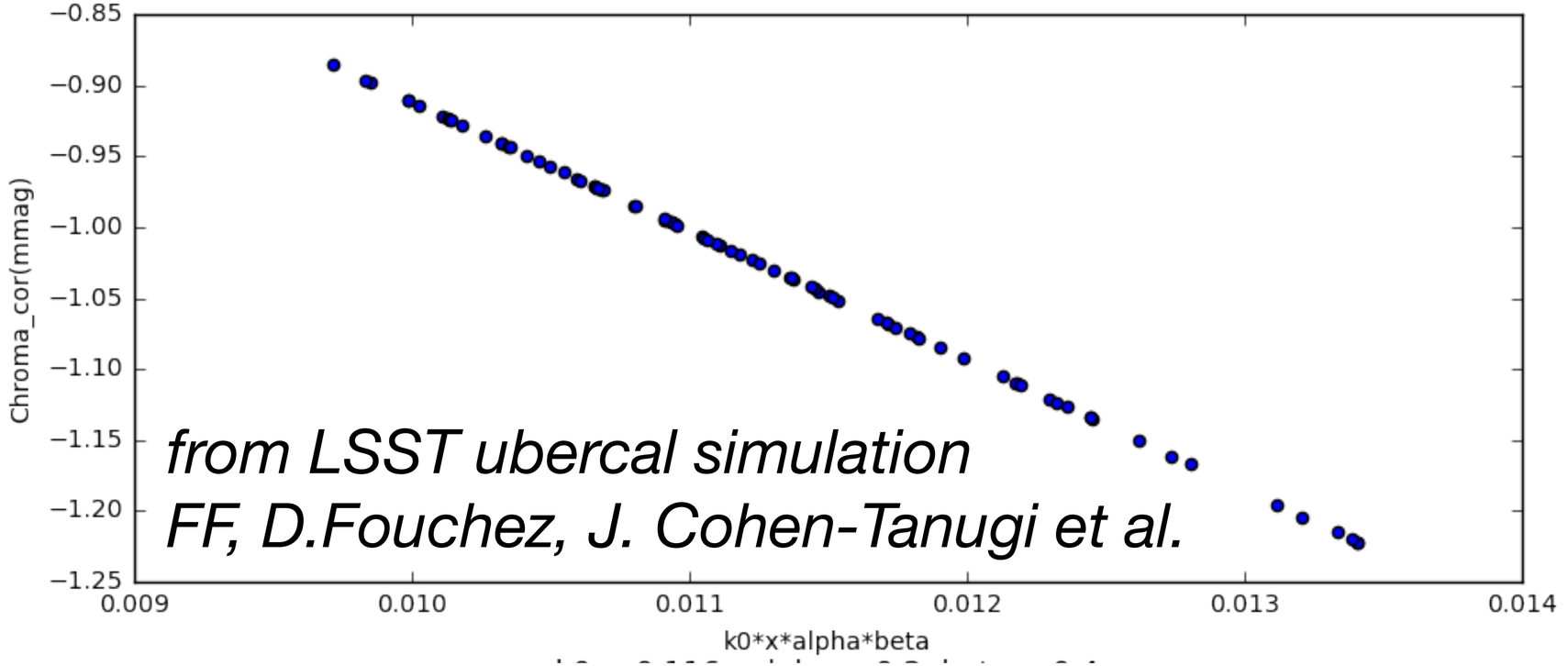
Colour of calibrators and targets (SN 1a e.g.)

SN 1a have a specific (and z-dependent) behaviour



Chromatic effect is linear !

atmospheric attenuation $\boldsymbol{k_0} = 0.1$
atmospheric slope $\boldsymbol{\alpha} = 0.2$
star slope $\boldsymbol{\beta} = 0.4$
=> Effect is
linear with the product $\alpha\,\beta\,k_0\,x$ and ~ 1 mmag effect



How to see and correct it… and check

- Separate ubercal fits with ≠ calibrator colours:

  measure Zero Point colour dependence
- Infer star slopes $\boldsymbol{\beta}$ from GAIA (spectro-)photometry and fit atm. $\boldsymbol{\alpha}(t)$
- Implement this correction in ubercal fit
- Check on data that ZP does not depend from calibrator colour anymore