MEASURING REDDENING WITH SLOAN DIGITAL SKY SURVEY STELLAR SPECTRA AND RECALIBRATING SFD

Edward F. Schlafly[1] and Douglas P. Finkbeiner 2010

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Previous study on foreground reddening

- Fitzpatrick reddening law (F99):
  R(V) = A(V)/E(B-V)
  E(B-V) = (B-V)observed - (B-V)intrinsic
  For Milky Way, R(V) ~ 3.1

- Schlegel et al 1998 (SFD):
  Use IRAS and COBE to create a relatively high (~ few arcmin) extinction map of the sky

- Schlafly et al 2010(S10):
  use photometry from SDSS, recommend a 14% recalibration of the SFD dust map
  $E(B-V) = 0.86 * E(B-V)_{SFD}$

- Schlafly and Finkbeiner 2011: refine S10
  most popular distinction map currently

SDSS Data: photometry calibrated by “ubercalibration” (Padmanabhan et al. 2008)

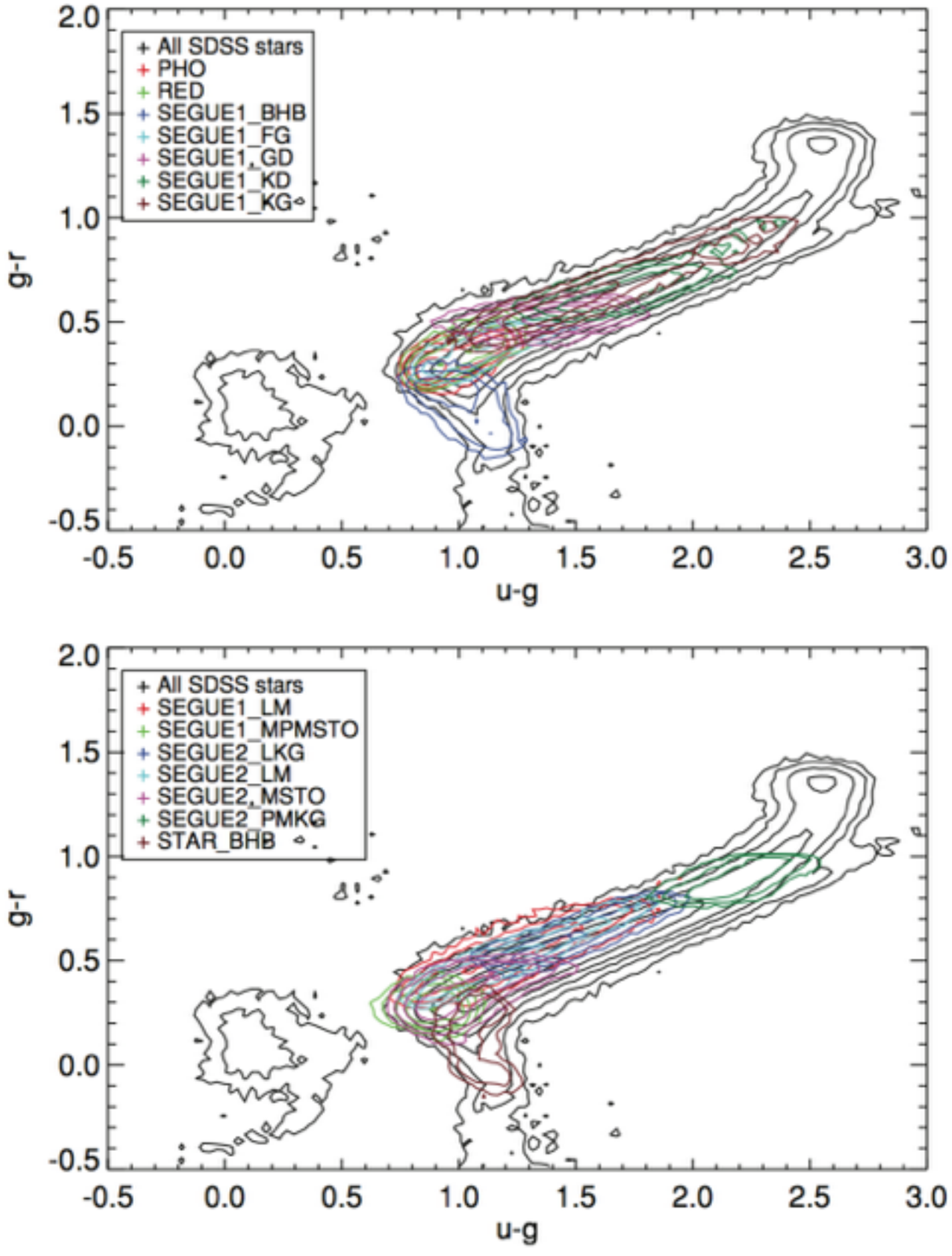


Table 1
SDSS Spectral Targets

Target Type	No. of Stars	Description
PHO	15894	Spectrophotometric standards
RED	14353	Reddening standards
SEGUE1_BHB	12603	BHB stars
SEGUE1_FG	5065	FG stars
SEGUE1_GD	44495	G dwarfs
SEGUE1_KD	13459	K dwarfs
SEGUE1_KG	16012	K giants
SEGUE1_LM	22273	Low-metallicity stars
SEGUE1_LOW_KG	2606	Low-latitude K giants
SEGUE1_LOW_TO	6432	Low-latitude turnoff stars
SEGUE1_MPMSTO	26885	Metal-poor F stars
SEGUE2_LKG	19634	K giants
SEGUE2_LM	13785	Low-metallicity stars
SEGUE2_MSTO	31767	Main-sequence turnoff stars
SEGUE2_PMKG	10566	K giants
STAR_BHB	5667	Main survey BHB stars
Total	261496	

SDSS Data: Spectroscopy

Use **SSPP** to **estimate temperature, metallic and gravity** of each star. Use ANNRR estimator which doesn't depend on photometry.

The stellar parameters are **transformed into predicted ugriz colors** using the **MARCS** grid of model atmospheres.

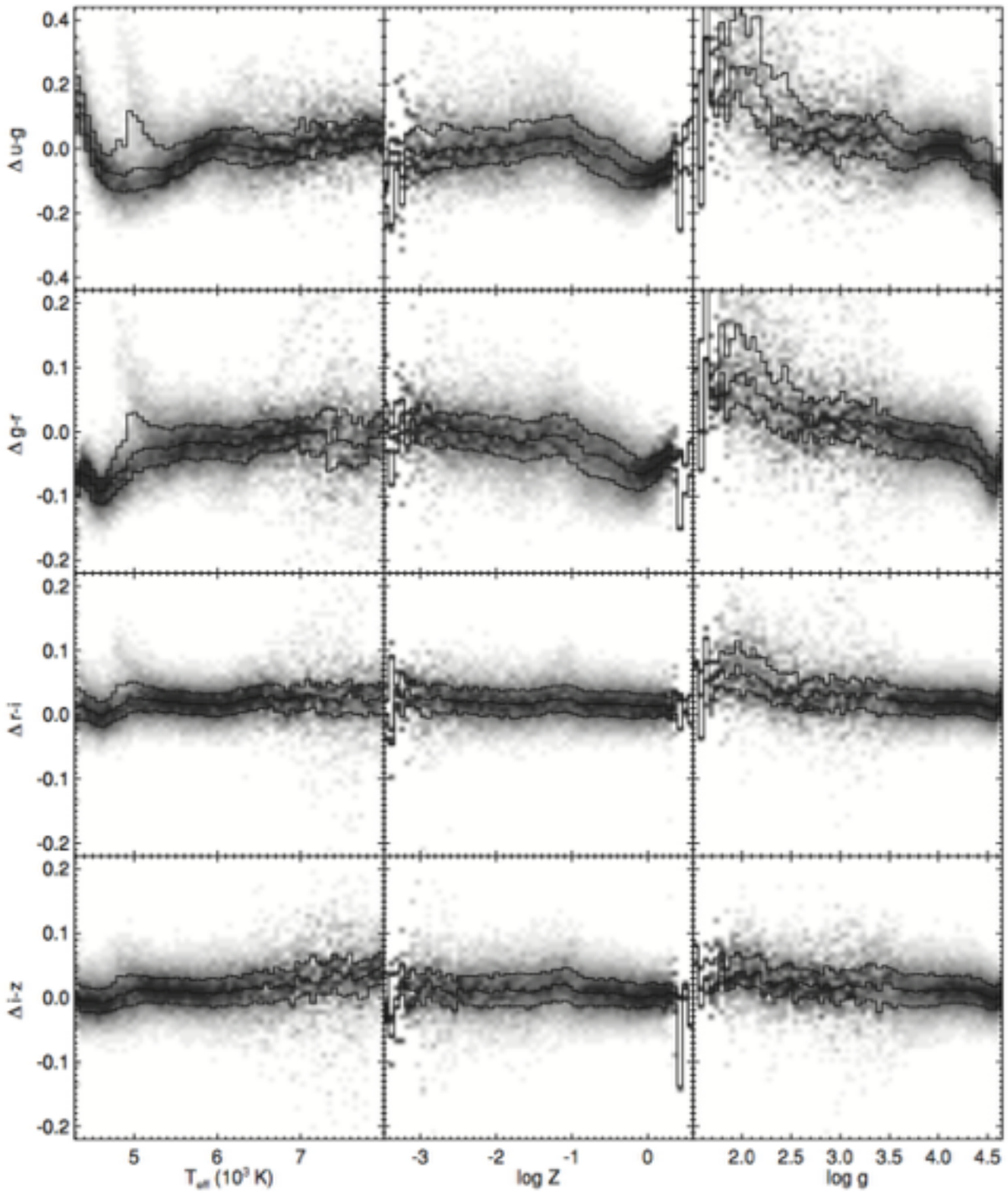
SDSS Data: Selection Cut

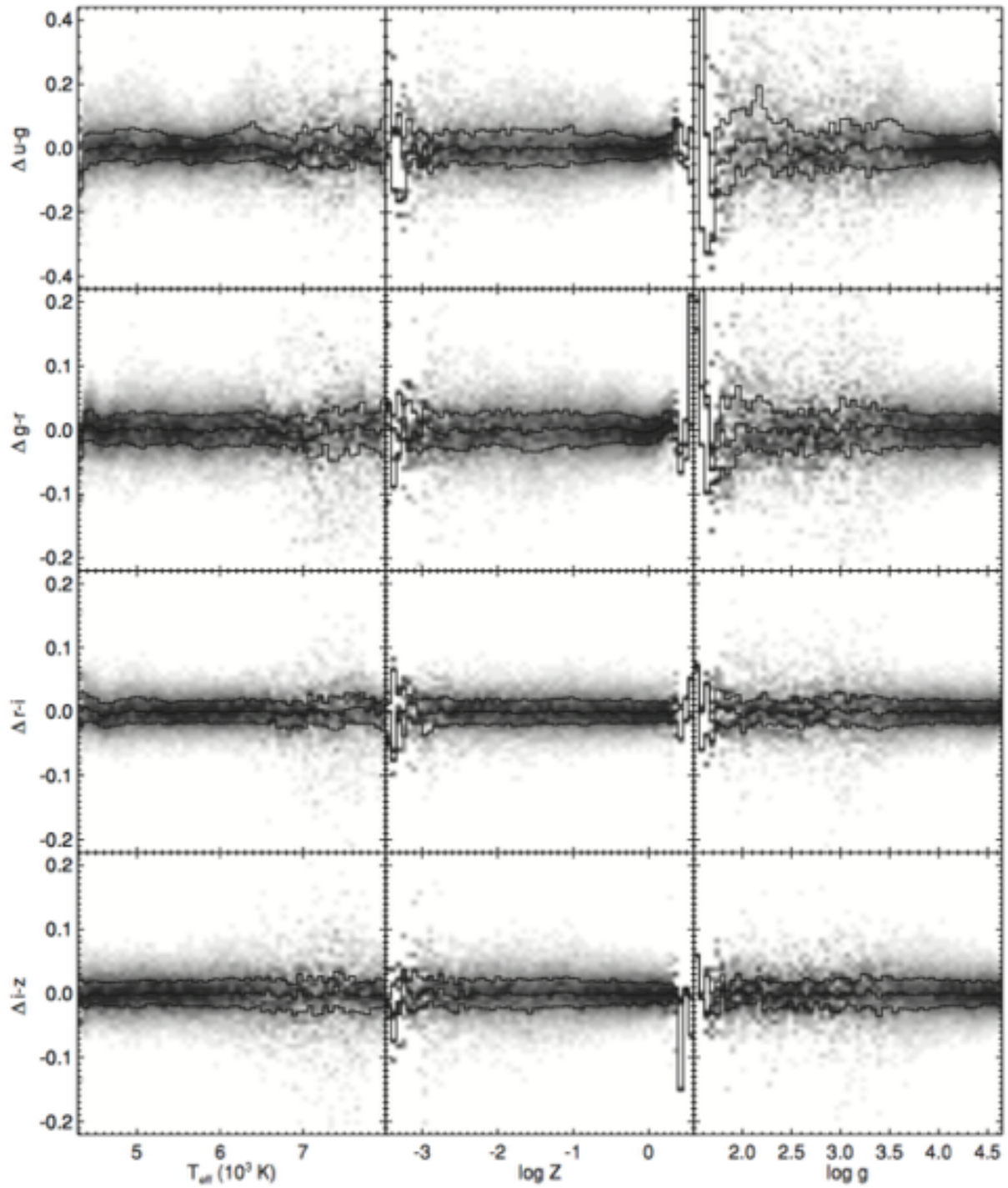
Exclude stars with unusual colors: g-r>1mag, dwarf targets, with stellar parameter marked as unreliable by the SSPP.

The remaining stars are divided into different types: standard, FG, BHB, K, other

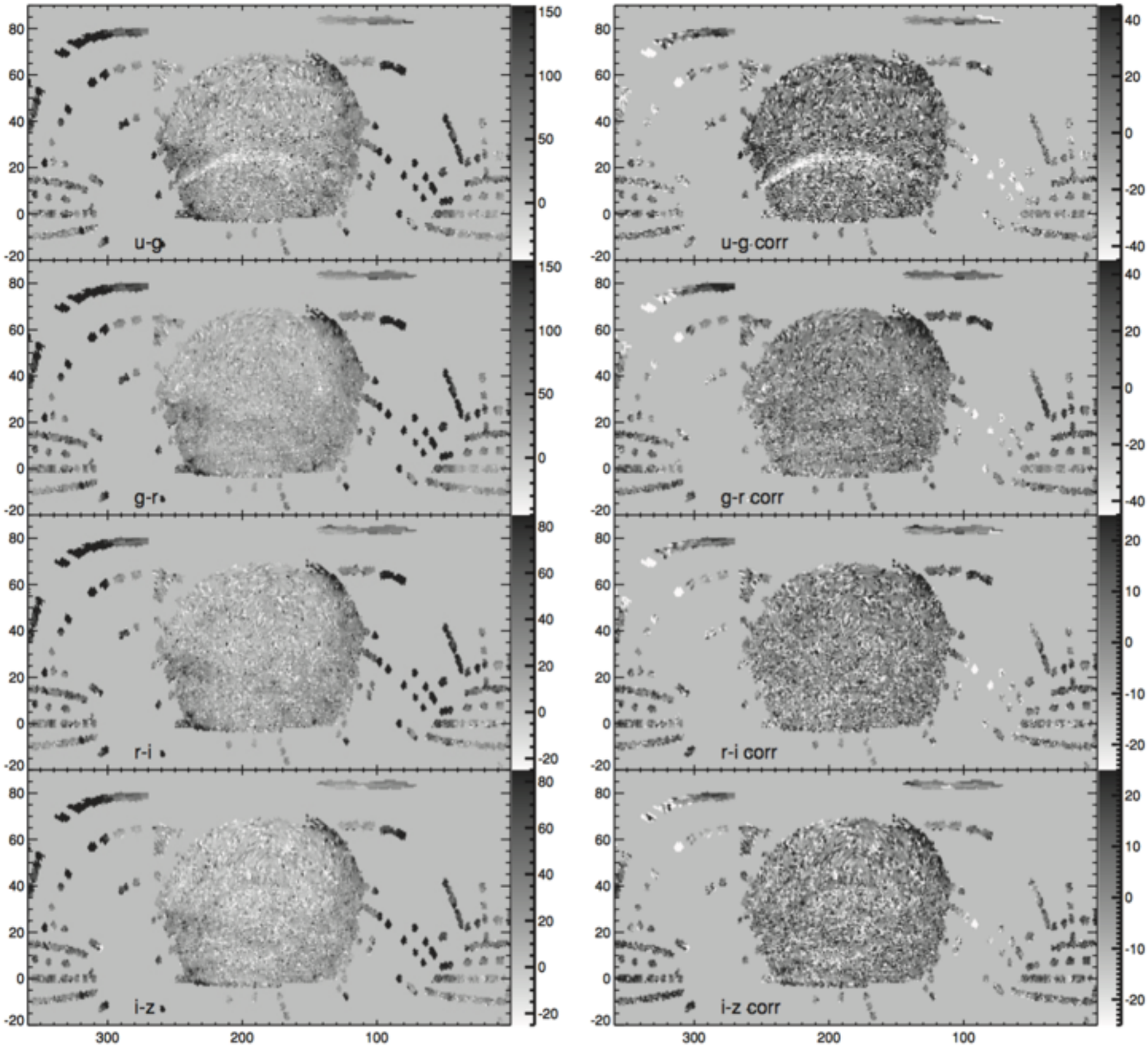
Finally, $\Delta_{a-b} = (a-b)_{obs} - (a-b)_{pre}$

Result: at |b|>50, Δ~0 calibration





Result: reddening map



Result: calibration for SFD

$$R_{a\text{-}b} = E_{a\text{-}b} / E(B\text{-}V)_{SFD}$$

fit without zero-point offset

$$\Delta_{a-b} = R_{a-b}E(B-V)_{\rm SFD} + C,$$

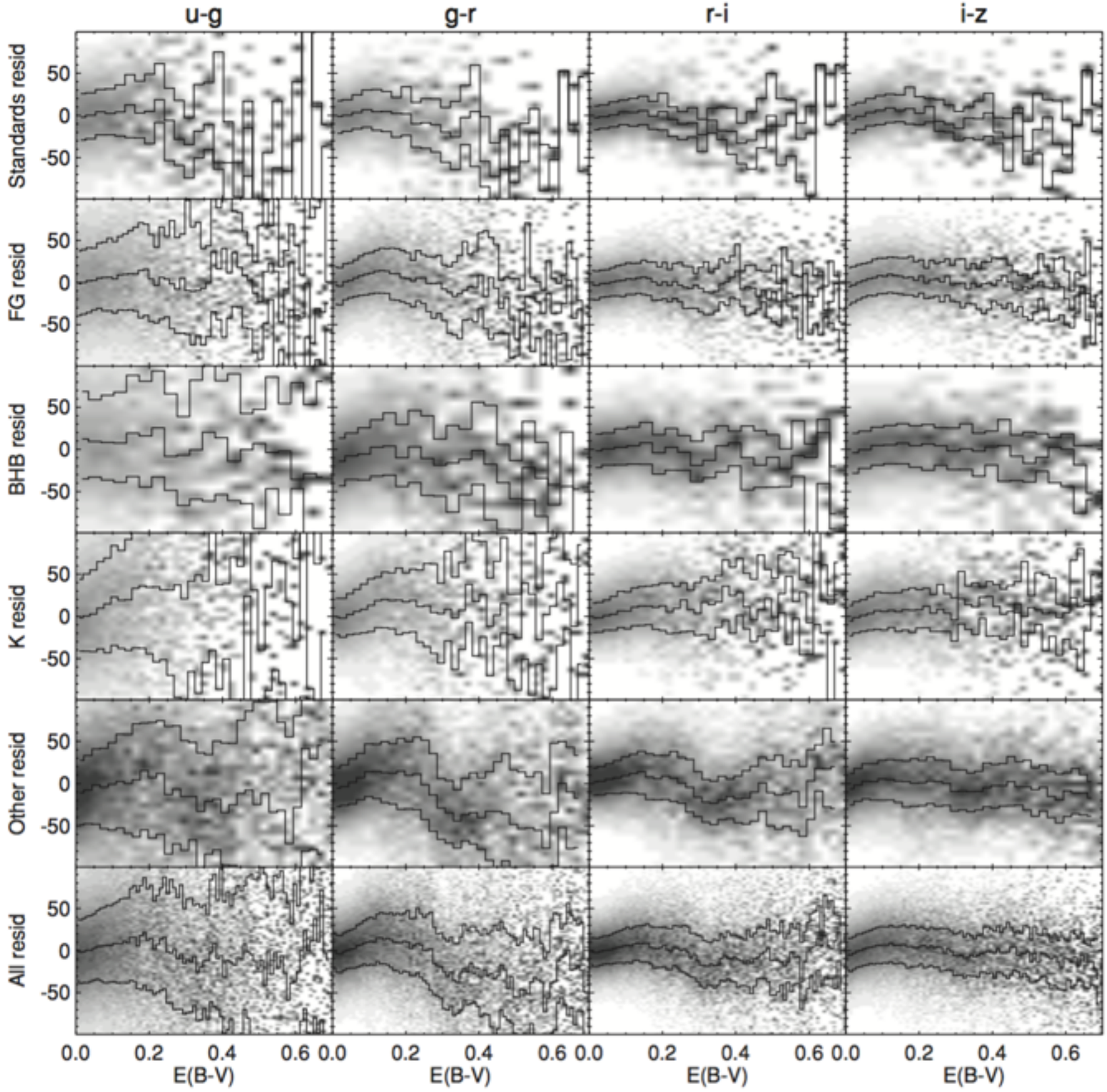
fit with zero-point offset

$$\Delta_{a-b} = R_{a-b}E(B-V)_{\rm SFD} + C_r$$

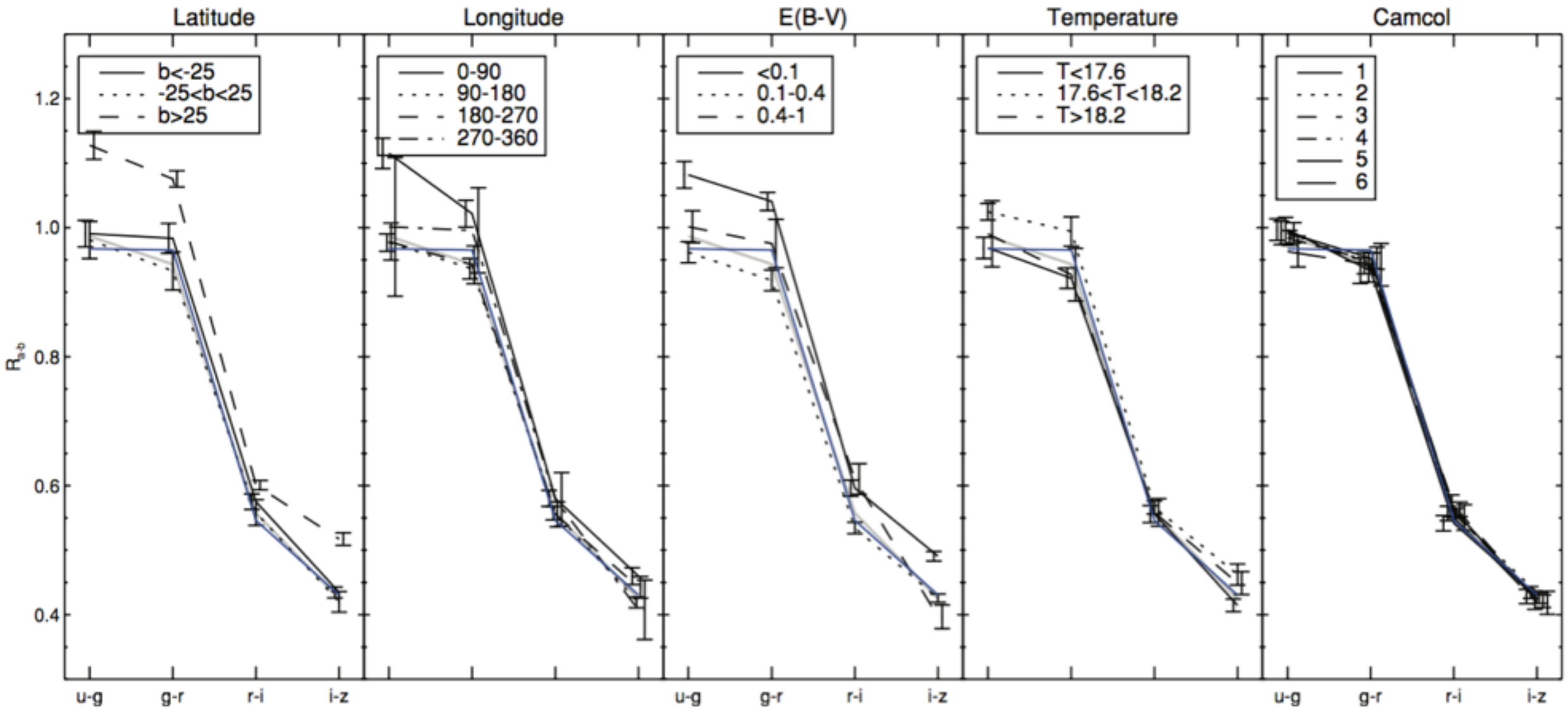
the fits with and without zero-point offsets agree to within 4%

The results confirm the preference for an Rv = 3.1 F99 reddening law and a 14% recalibration of SFD.

Result: residual VS SFD



Result: fits to different sky regions



north south color asymmetry:
maybe age and metallicity changes in stellar populations