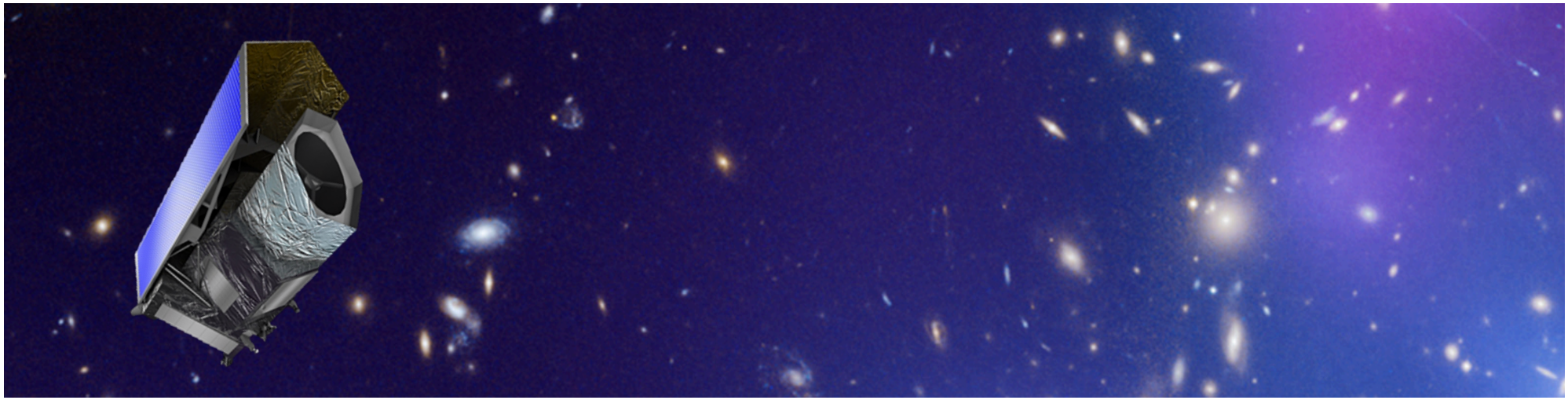
SED-dependent Galactic Extinction Prescription for Euclid and Future Cosmological Surveys



Audrey Galametz

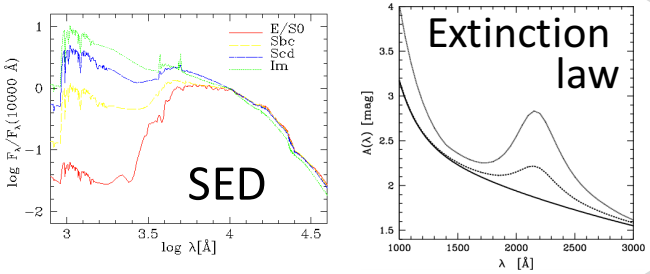
MPE, Garching

On behalf of the Euclid Photometric Redshift Organization Unit

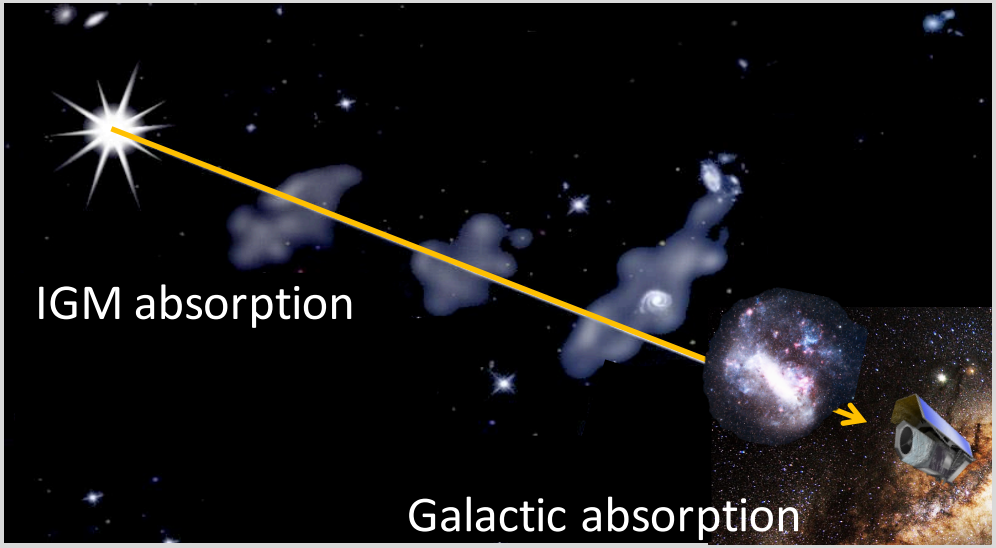
The template-fitting algorithm

SED + Parameter Space

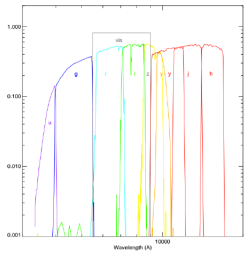
IntE$_{B-V}$



Redshift grid



Filters



Template Flux catalogue

$$\chi^2(z, SED) = \sum_{i=1}^{Nfilt} \frac{(F_{i,obs} - \alpha F_{i,temp}(z,SED))^2}{\sigma(F_{i,obs})}$$

$$\alpha = \sum_j \frac{Fj,obs\ Fj,temp}{\sigma j^2} \Big/ \sum_j \frac{Fj,temp^2}{\sigma j^2}$$

$$\mathcal{L}(\text{type}_{\text{SED}}, \text{EXT\_LAW}, \text{E(B-V)}, z) = e^{-\frac{\chi^2}{2}}$$

Observed Flux catalogue

Priors

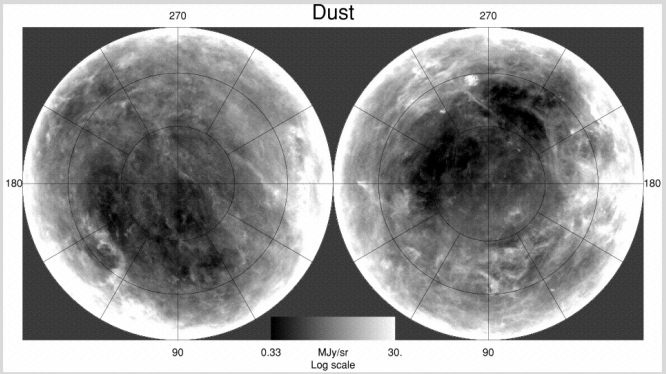
PDF(z)

Galactic extinction

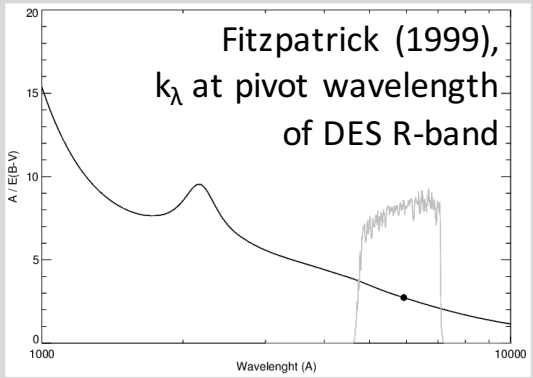
Classic Implementation of galactic extinction in extragalactic surveys

Line-of sight E_{B-V} Milky Way Absorption curve

Schlegel et al. (1998)



X



➔ $\Delta m = E_{B-V} \times k_{pivot}$

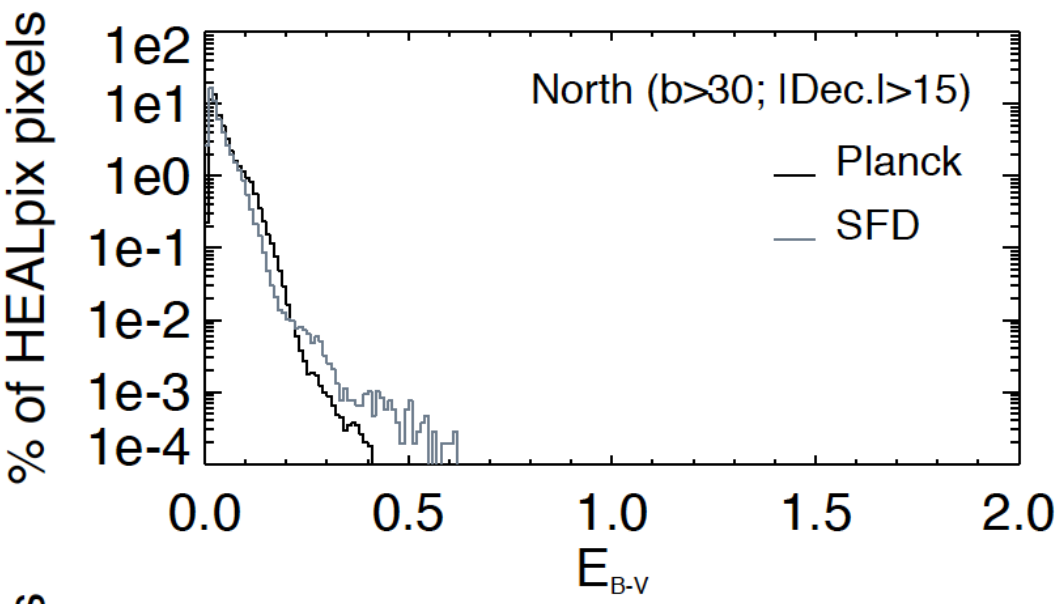
BUT

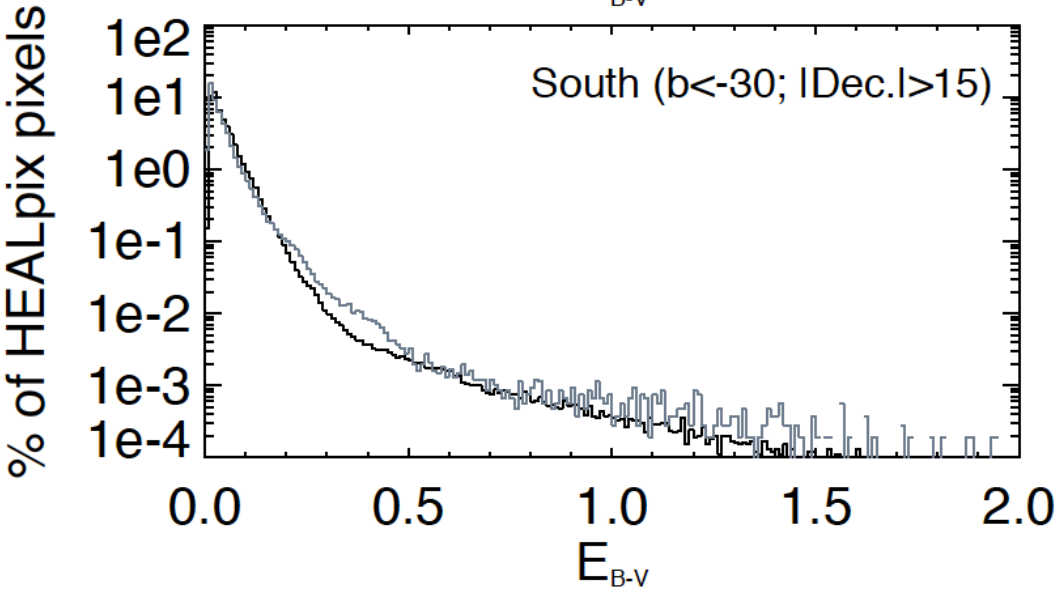
$$f_{obs,Filt} = \frac{\int_{Filt} f_{sed}(\lambda)\, 10^{-0.4\, E_{B-V}\, k_\lambda}\, T_{Filt}(\lambda)\, d\lambda}{\int_{Filt} T_{Filt}(\lambda)\, \frac{c}{\lambda^2}\, d\lambda}$$

If fluxes measured in broad-band filters, galactic extinction depends on SED.

BUT No knowledge of the source SED a-priori

Galactic extinction in Euclid Wide

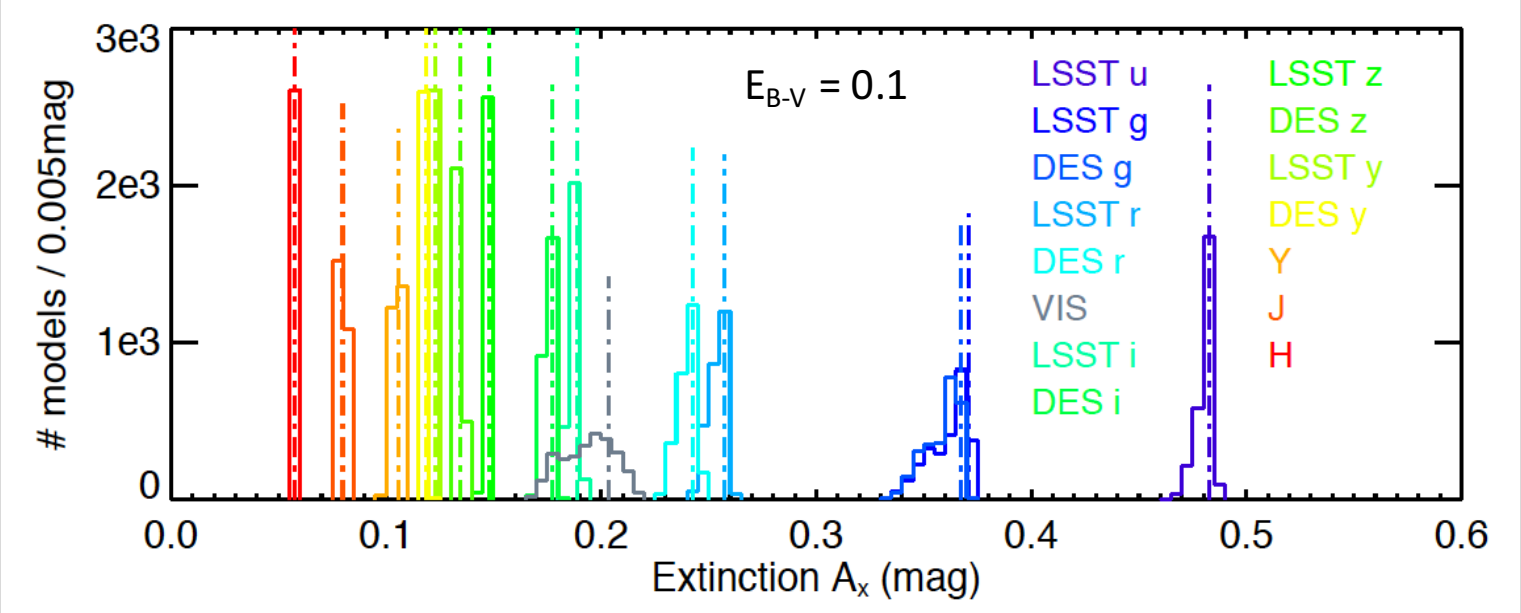




SED-dependent Galactic extinction

- Dependence of extinction with source SED

$$f_{obs,Filt} = \frac{\int_{Filt} f_{sed}(\lambda)\, 10^{-0.4\, E_{B-V}\, k_\lambda}\, T_{Filt}(\lambda)\, d\lambda}{\int_{Filt} T_{Filt}(\lambda)\, \frac{c}{\lambda^2}\, d\lambda}$$



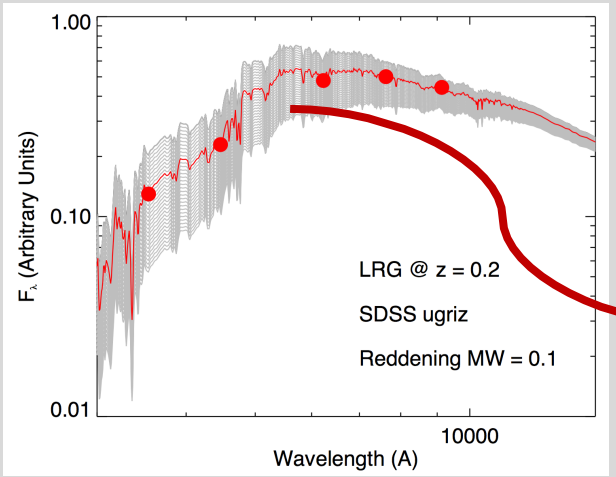
Galametz et al. 2017

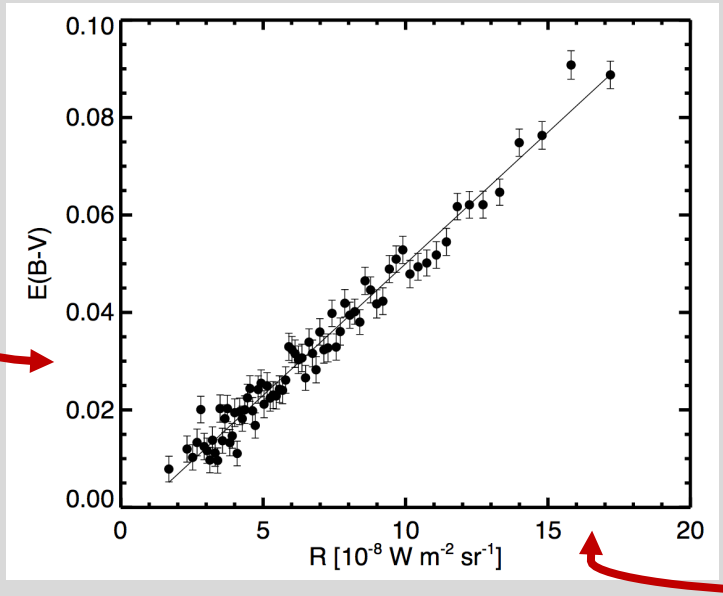
SED-dependent Galactic extinction

- Dependence of extinction with source SED
- Dependence of reddening map calibration with standard source SED

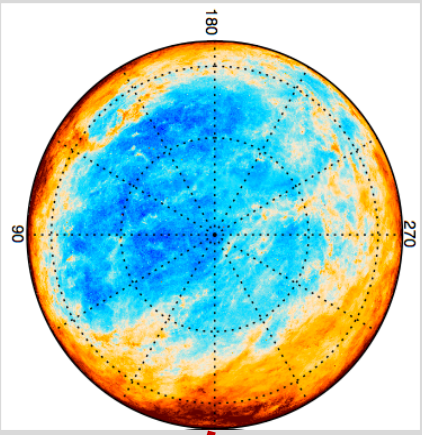
$$f_{obs,Filt} = \frac{\int_{Filt} f_{sed}(\lambda)\, 10^{-0.4\, E_{B-V}\, k_\lambda}\, T_{Filt}(\lambda)\, d\lambda}{\int_{Filt} T_{Filt}(\lambda)\, \frac{c}{\lambda^2}\, d\lambda}$$

Linearly rescaling dust column density maps i.e., deriving the scaling factor p
with E_{B-V} = pD using the observed color excesses
of stars or standard cosmological sources with known SED





Planck Radiance map



Planck Collaboration XI (2014)

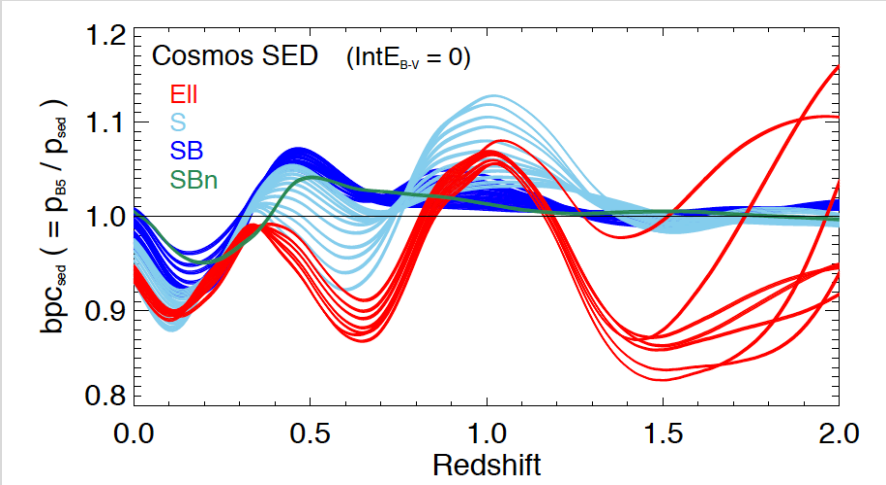
Galametz et al. 2017

SED-dependent Galactic extinction

- Dependence of extinction with source SED
- Dependence of reddening map calibration with standard source SED

$$f_{obs,Filt} = \frac{\int_{Filt} f_{sed}(\lambda)\, 10^{-0.4\, E_{B-V}\, k_\lambda}\, T_{Filt}(\lambda)\, d\lambda}{\int_{Filt} T_{Filt}(\lambda)\, \frac{c}{\lambda^2}\, d\lambda}$$

Schlegel E_{B-V} map calibrated using **local elliptical galaxies**
Planck E_{B-V} map calibrated using **quasars**
using MW law calibrated on **B5 stars** (e.g. Fitzpatrick 1999)
and applied to **whatever SED**



Band-pass corrections are required to adequately rescale the E_{B-V} derived for a given SED to a specific SED

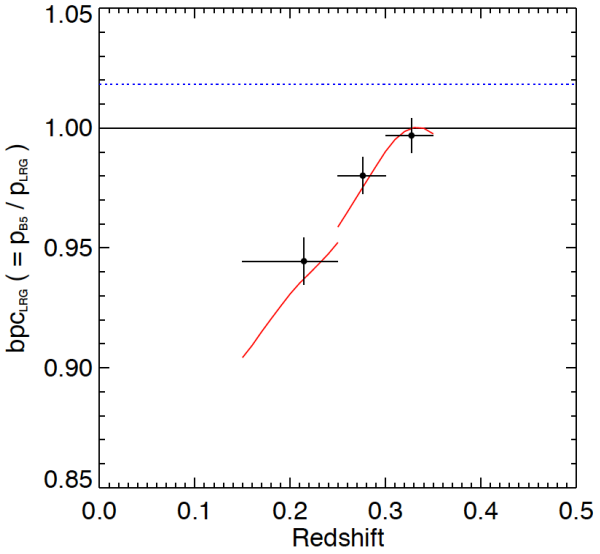
Can vary by up to 20%

Galametz et al. 2017

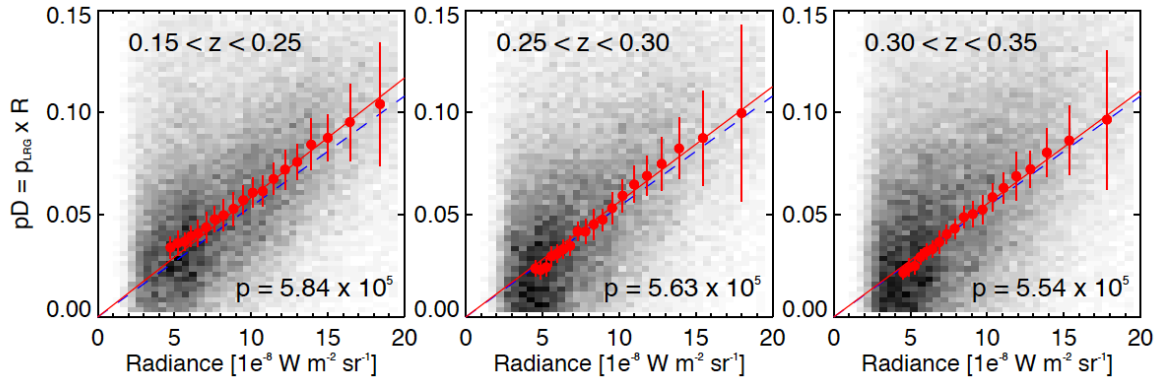
SED-dependent Galactic extinction

- Dependence of extinction with source SED
- Dependence of reddening map calibration with standard source SED

$$f_{obs,Filt} = \frac{\int_{Filt} f_{sed}(\lambda)\, 10^{-0.4\, E_{B-V}\, k_\lambda}\, T_{Filt}(\lambda)\, d\lambda}{\int_{Filt} T_{Filt}(\lambda)\, \frac{c}{\lambda^2}\, d\lambda}$$



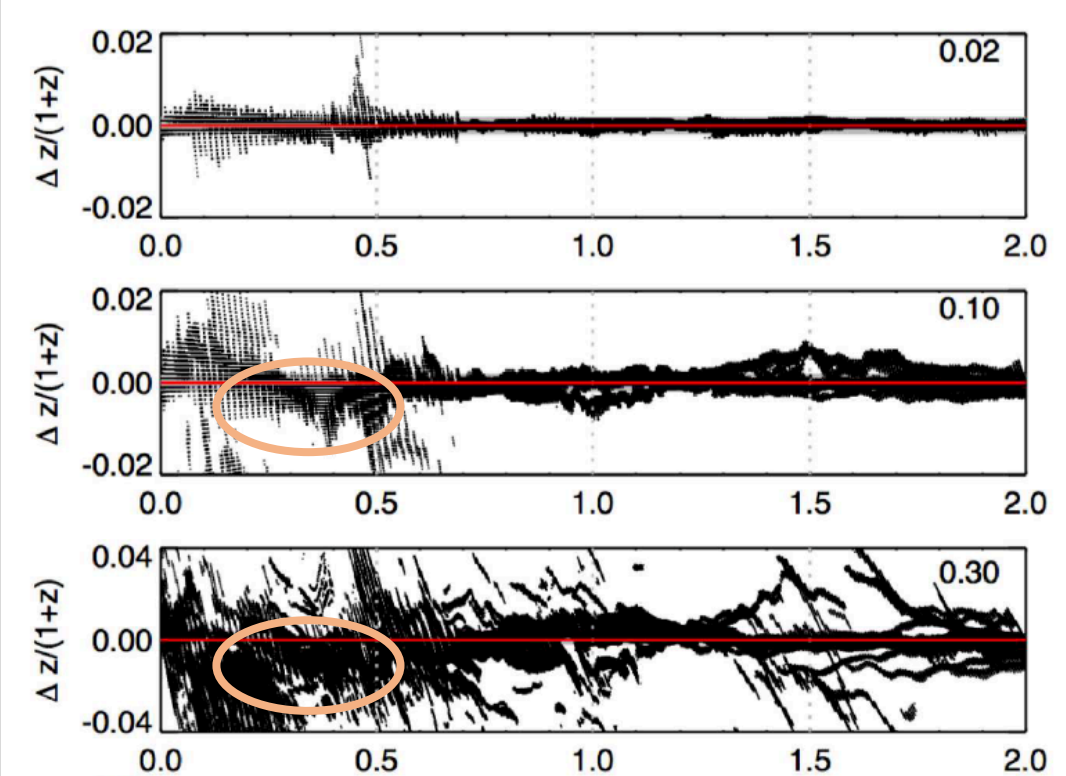
k_λ from Fitzpatrick et al. 1999 - Planck Radiance Map

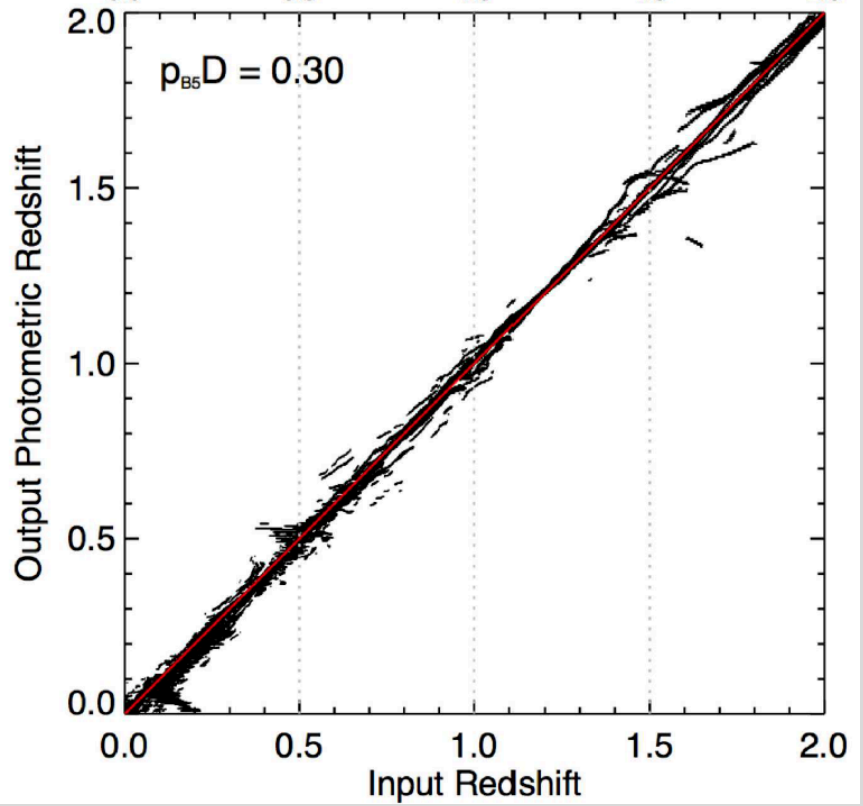


$$p_{\mathrm{LRG}[0.15-0.25]} = (5.84 \pm 0.06) \times 10^5 \ \mathrm{m^2\ sr\ W^{-1}}$$
$$p_{\mathrm{LRG}[0.25-0.30]} = (5.63 \pm 0.04) \times 10^5 \ \mathrm{m^2\ sr\ W^{-1}}$$
$$p_{\mathrm{LRG}[0.30-0.35]} = (5.54 \pm 0.04) \times 10^5 \ \mathrm{m^2\ sr\ W^{-1}}$$

Galametz et al. 2017

Impact on photometric redshifts

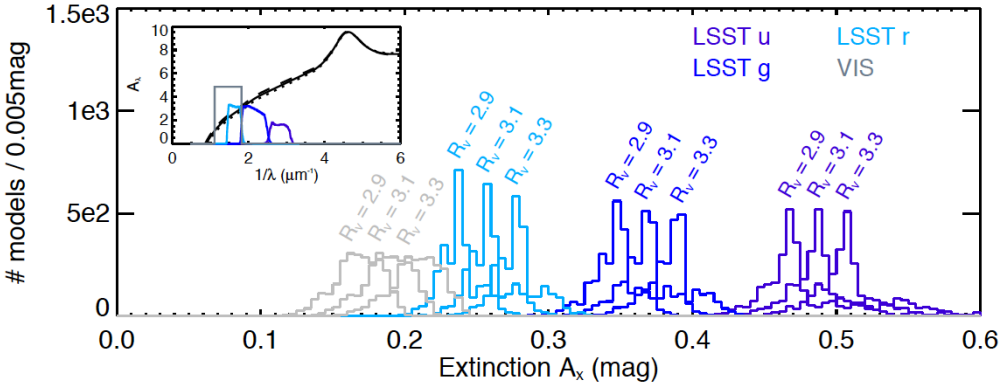


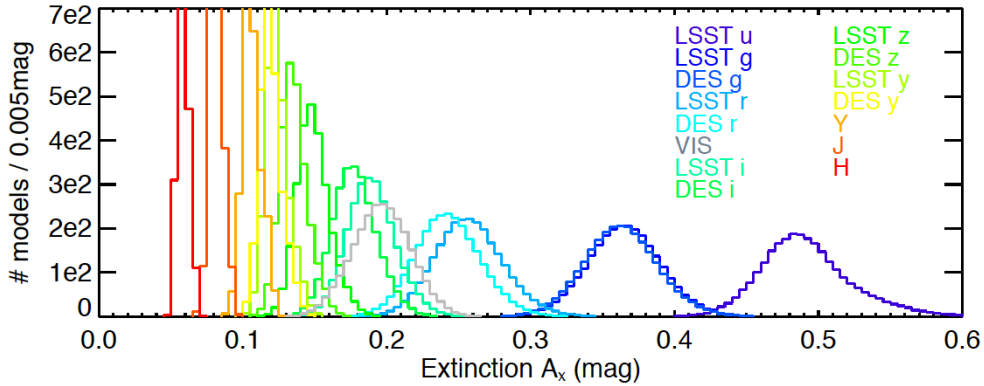


At pD = 0.1, 20% of the source photo-z (at all redshift)
ARE NOT recovered within 0.2%(1+z)

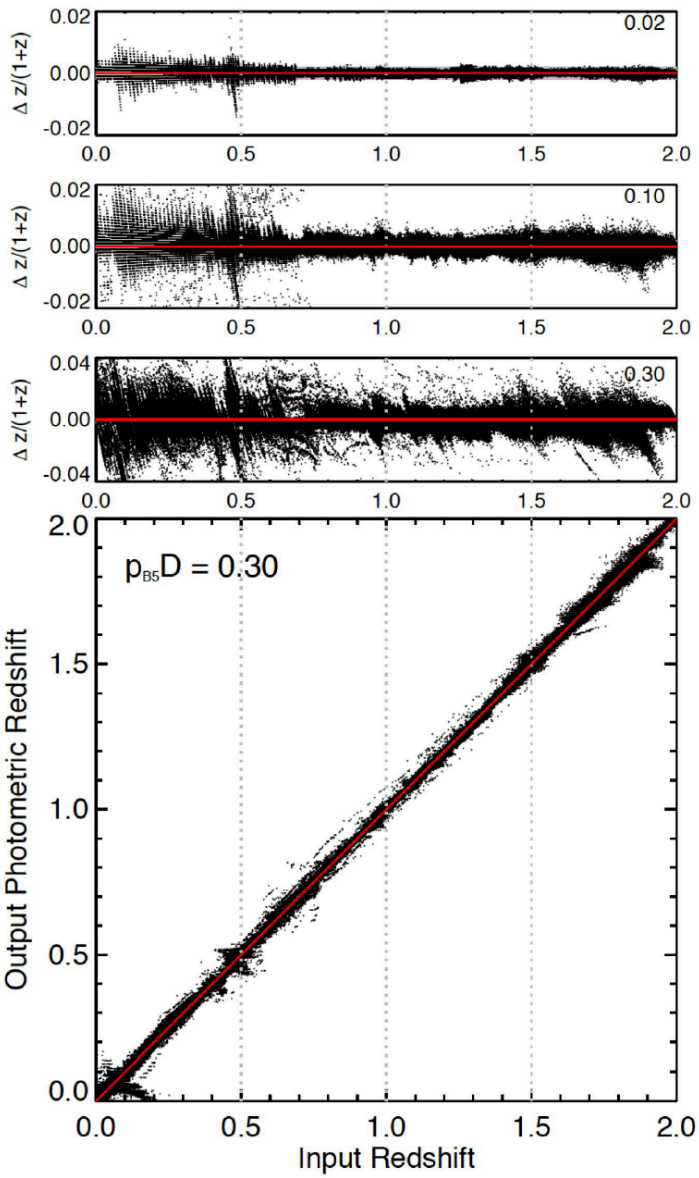
Impact of the uncertainties on R_V

$$f_{obs,Filt} = \frac{\int_{Filt} f_{sed}(\lambda)\, 10^{-0.4\, E_{B-V}\, k_\lambda}\, T_{Filt}(\lambda)\, d\lambda}{\int_{Filt} T_{Filt}(\lambda)\, \frac{c}{\lambda^2}\, d\lambda}$$





More limited bias (< 0.1%(1+z))
Higher scatter



Conclusions / Perspectives

- New prescription of the galactic reddening for the Euclid TFA
- Tests on ‘real’ extragalactic fields with strong LOS reddening
- To be extended to others Euclid working units:
  - Machine-learning Algorithm?
  - Self-organising map?
  - Distortion/shear measurements vs. galaxy color gradients?