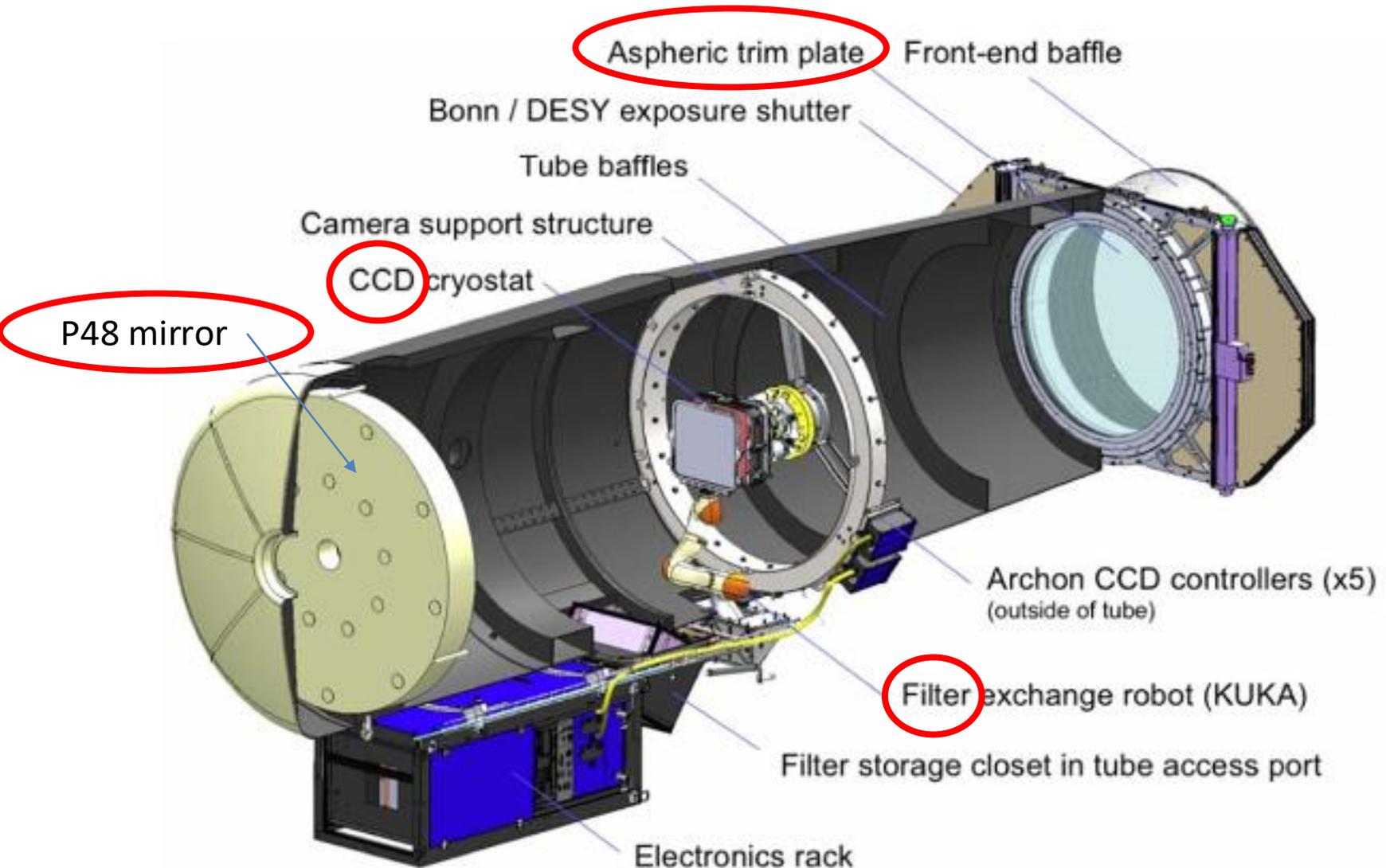# Instrument model
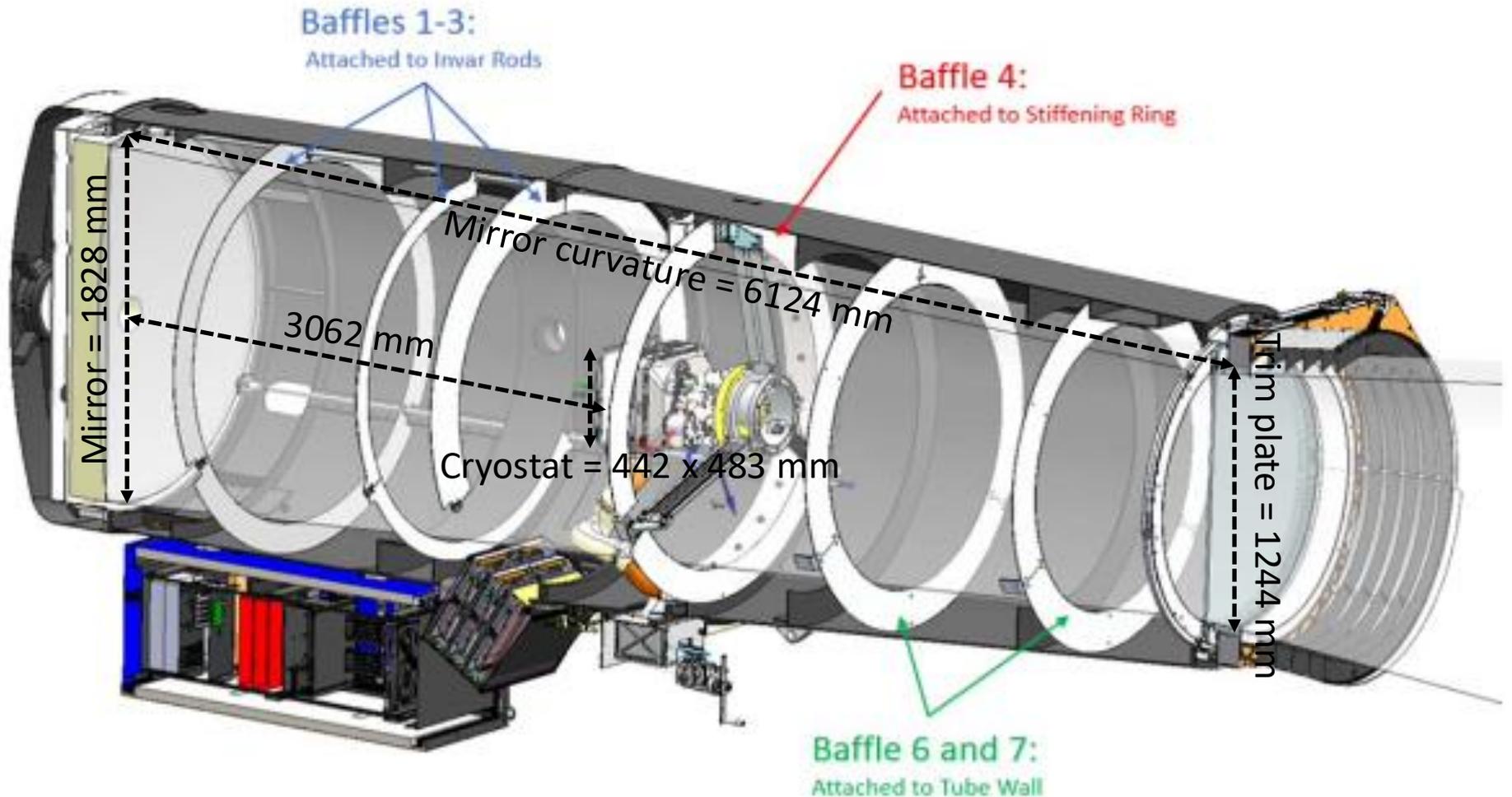
Philippe Rosnet
Laboratoire de Physique de Clermont
Université Clermont Auvergne – CNRS/IN2P3

ZTF instrument
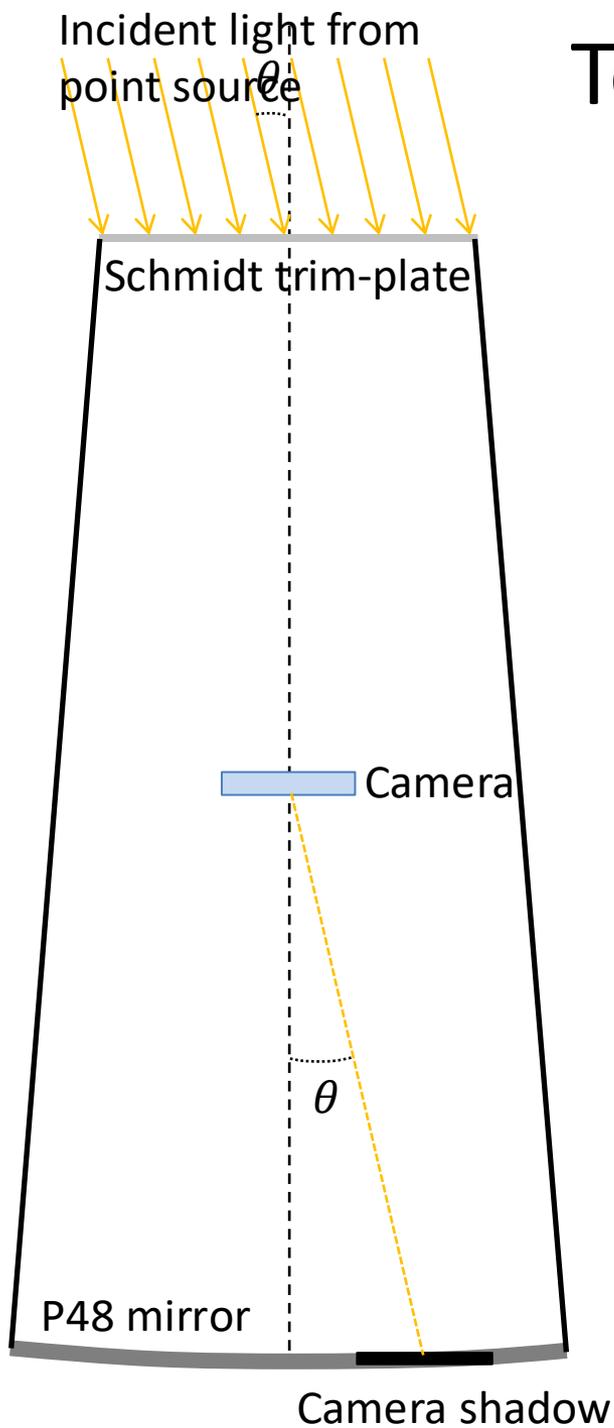

Aspheric trim plate Front-end baffle

Bonn / DESY exposure shutter

Tube baffles

Camera support structure

CCD cryostat

P48 mirror

Archon CCD controllers (x5)
(outside of tube)

Filter exchange robot (KUKA)

Filter storage closet in tube access port

Electronics rack

Telescope scheme

Baffles 1-3:
Attached to Invar Rods

Baffle 4:
Attached to Stiffening Ring

Mirror = 1828 mm

Mirror curvature = 6124 mm

3062 mm

Cryostat = 442 x 483 mm

Trim plate = 1244 mm

Baffle 6 and 7:
Attached to Tube Wall

Telescope model

Incident light from point source

θ

Schmidt trim-plate

Camera

θ

P48 mirror

Camera shadow

- Position (x) on camera correspond to light-rays from sky with incident angle θ

- Hypothesis: projection of pupil and camera on mirror according to incident angle θ (not realistic on scheme: $\theta_{max} \approx 5°$)

x

Camera

Pupil projection on mirror

Mirror

Camera shadow on mirror
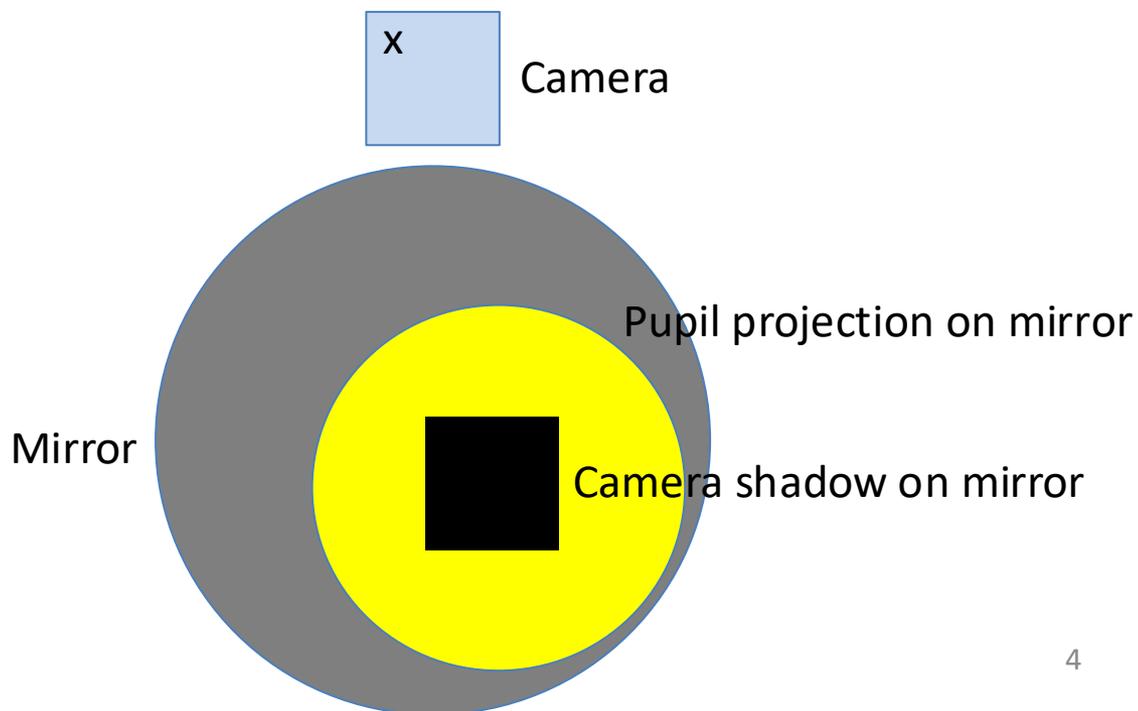
Instrument model: mean incident angle on camera
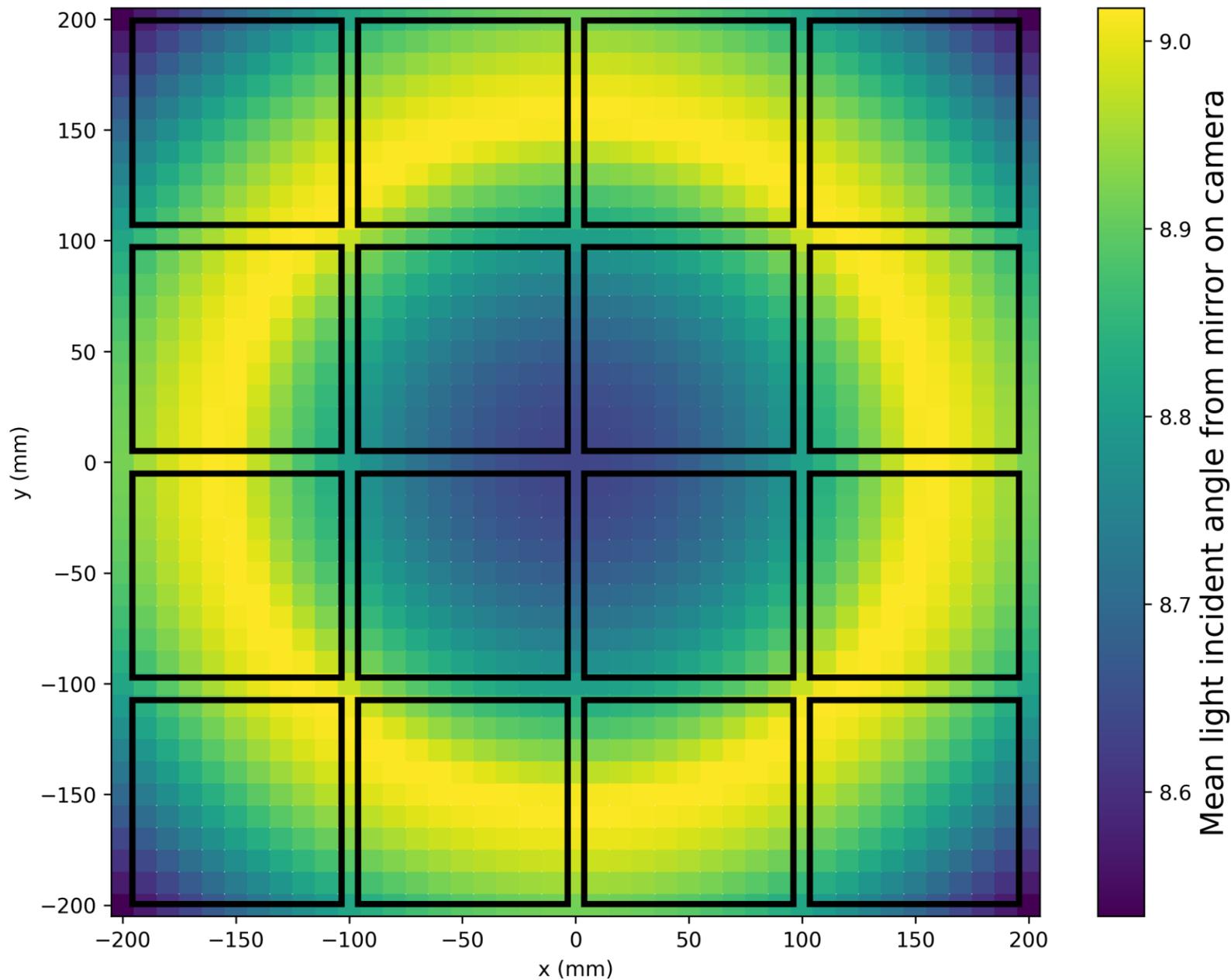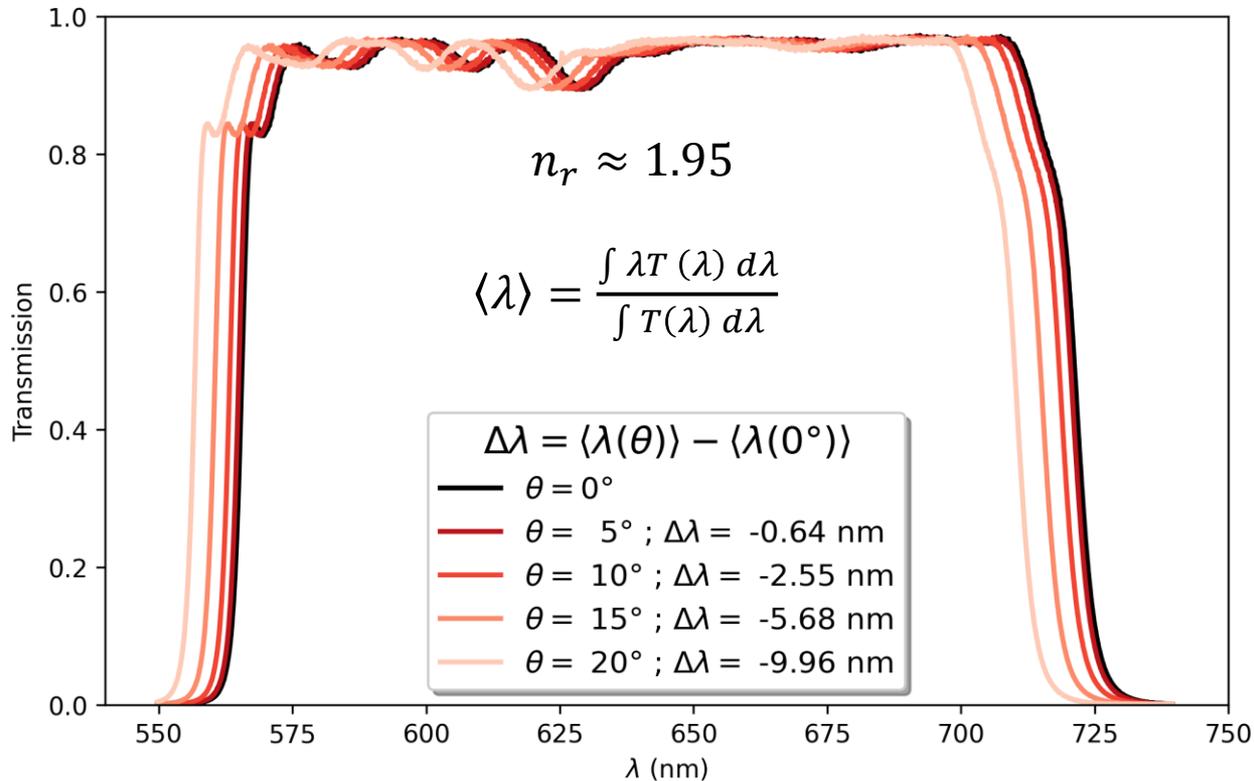
ZTF r-filter shift versus incident light angle

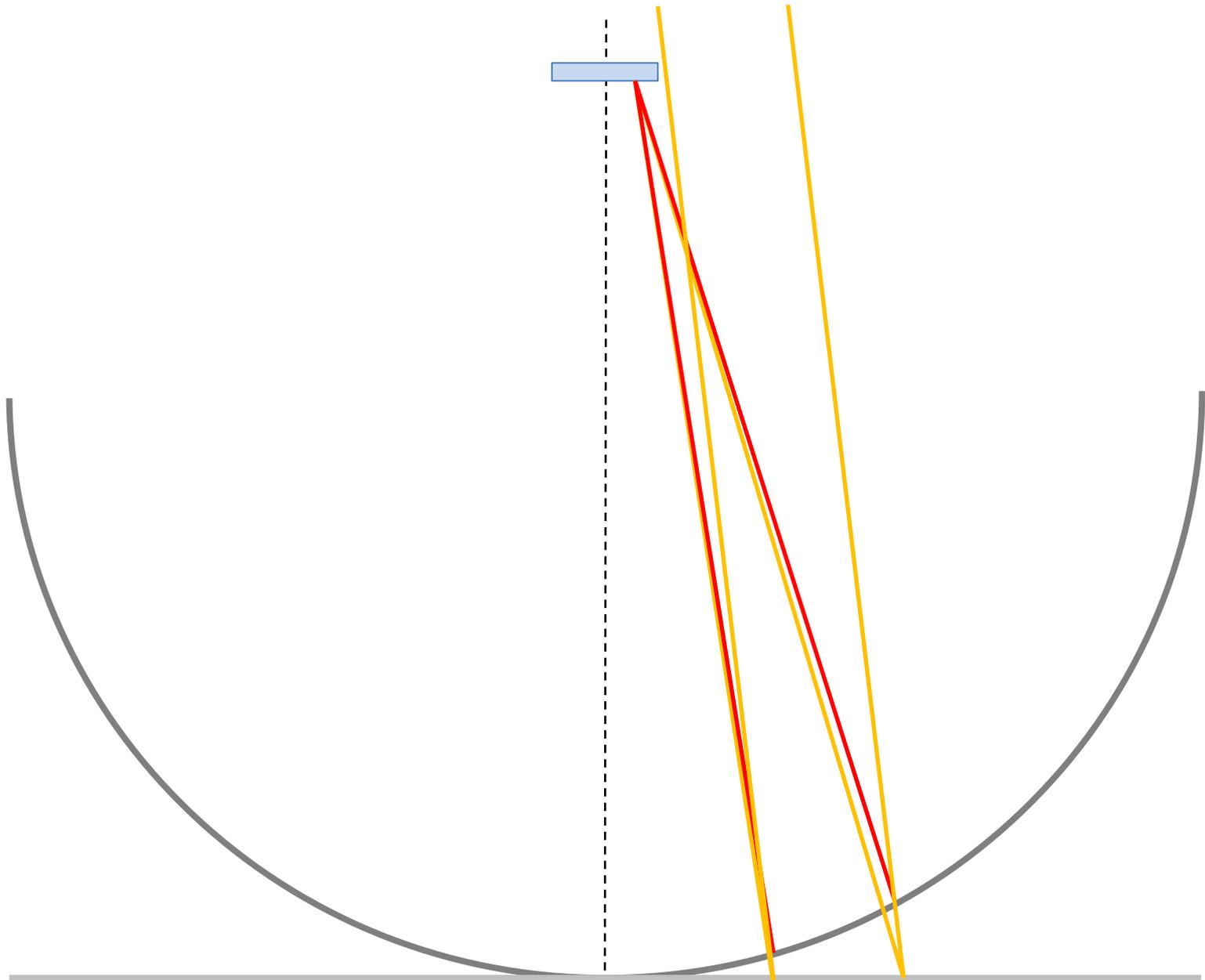- Approximate **angular dependence of interference filter transmission**

  ([arXiv:0908.3808]): $T(\lambda, \theta) = T\left(\lambda \left(\left[1 - \frac{\sin^2\theta}{n^2}\right]^{-1/2}, \theta = 0\right)\right)$

ZTF r-filter transmission

$n_r \approx 1.95$

$$\langle\lambda\rangle = \frac{\int \lambda T(\lambda)\, d\lambda}{\int T(\lambda)\, d\lambda}$$

$\Delta\lambda = \langle\lambda(\theta)\rangle - \langle\lambda(0°)\rangle$

— $\theta = 0°$
— $\theta = 5°$; $\Delta\lambda = $ -0.64 nm
— $\theta = 10°$; $\Delta\lambda = $ -2.55 nm
— $\theta = 15°$; $\Delta\lambda = $ -5.68 nm
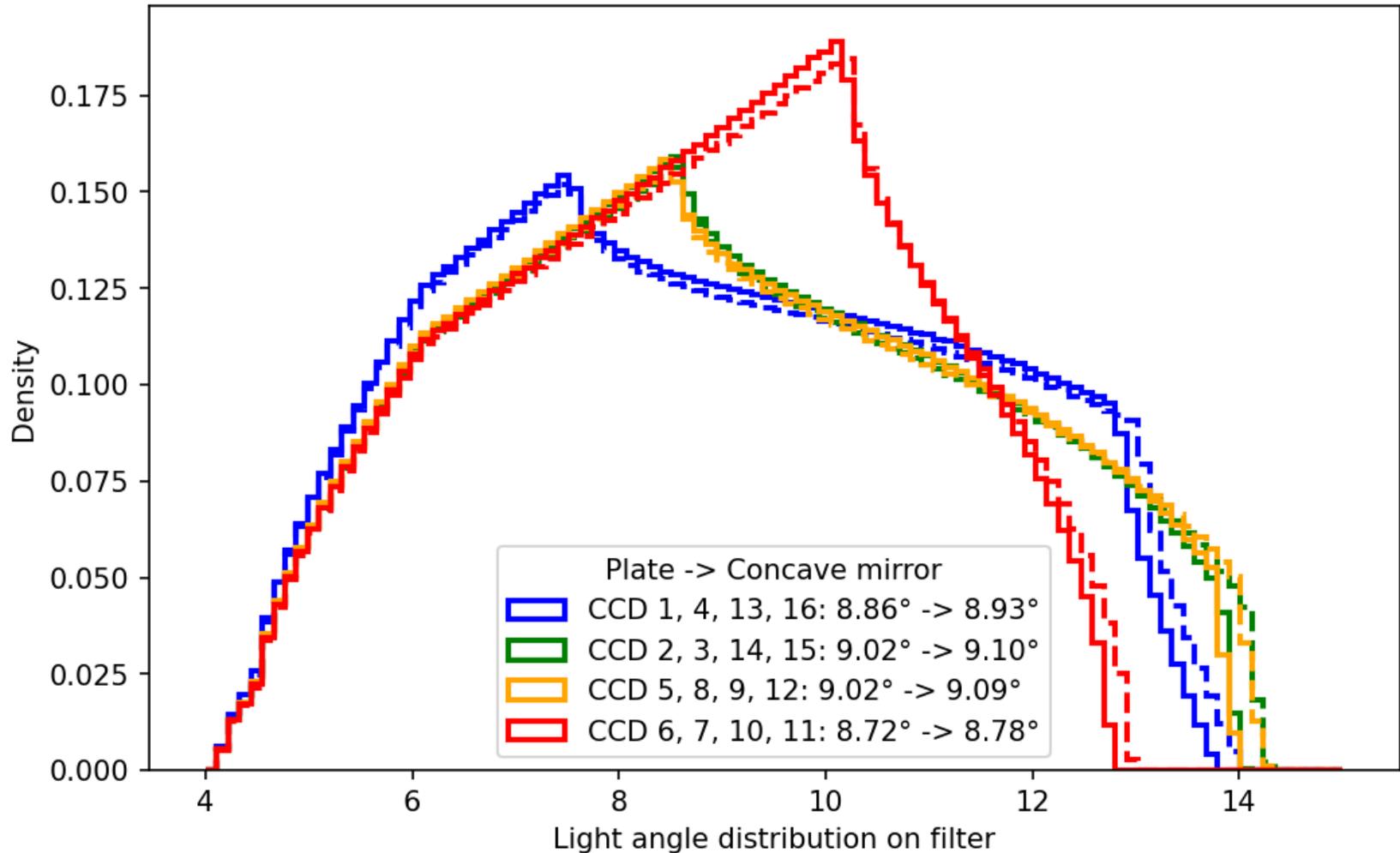— $\theta = 20°$; $\Delta\lambda = $ -9.96 nm

Measured transmission at $\theta = 0°$ is extrapolated to $\theta = 4°$ with an adjustment of refracting index $n_g \approx 1.95$ to match measured transmission at $\theta = 4°$
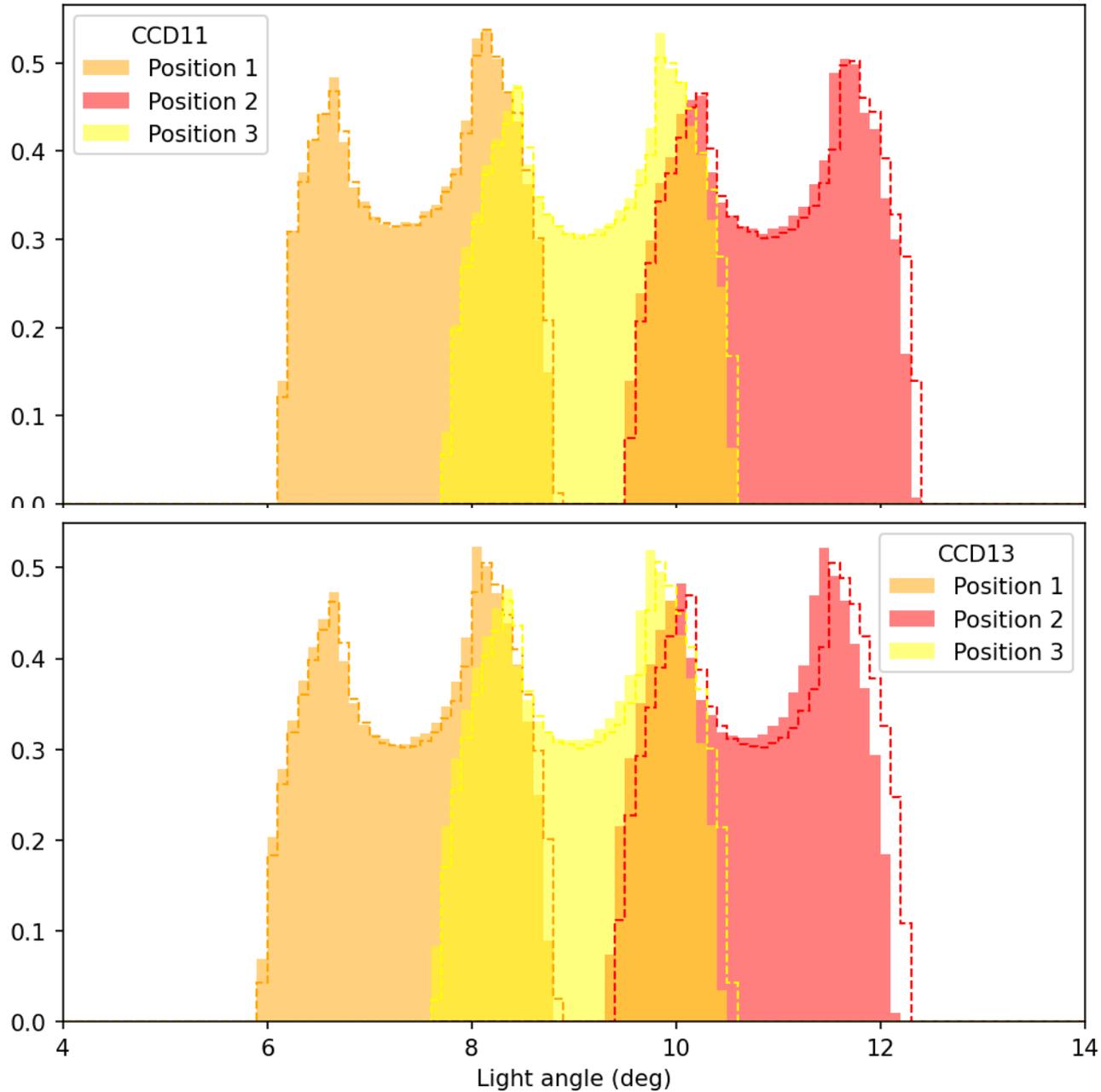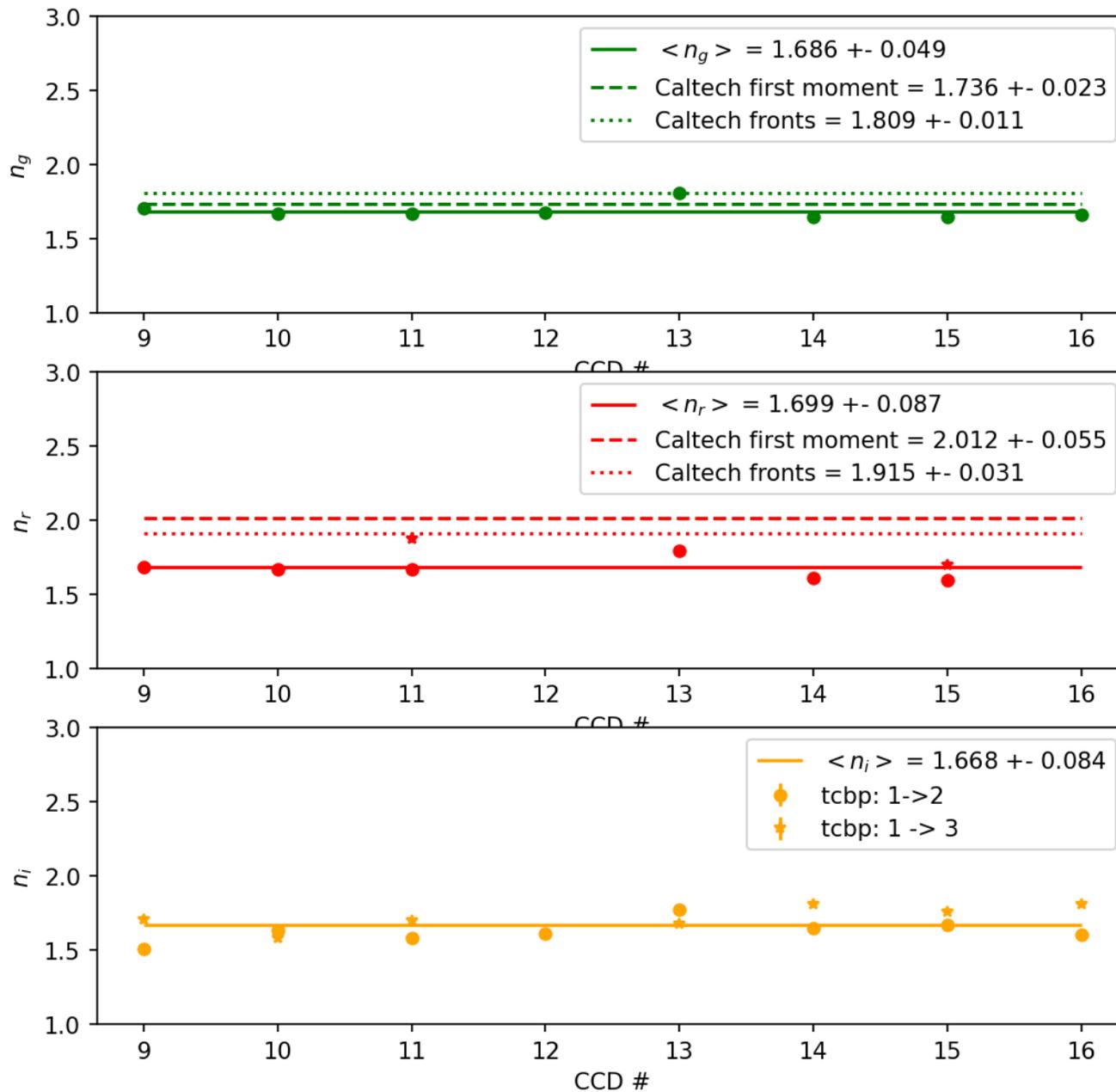
Effect of mirror curvature

Effect of mirror curvature on ZTF beam angles distribution

Effect of mirror curvature on tCBP angle distributions

New indices

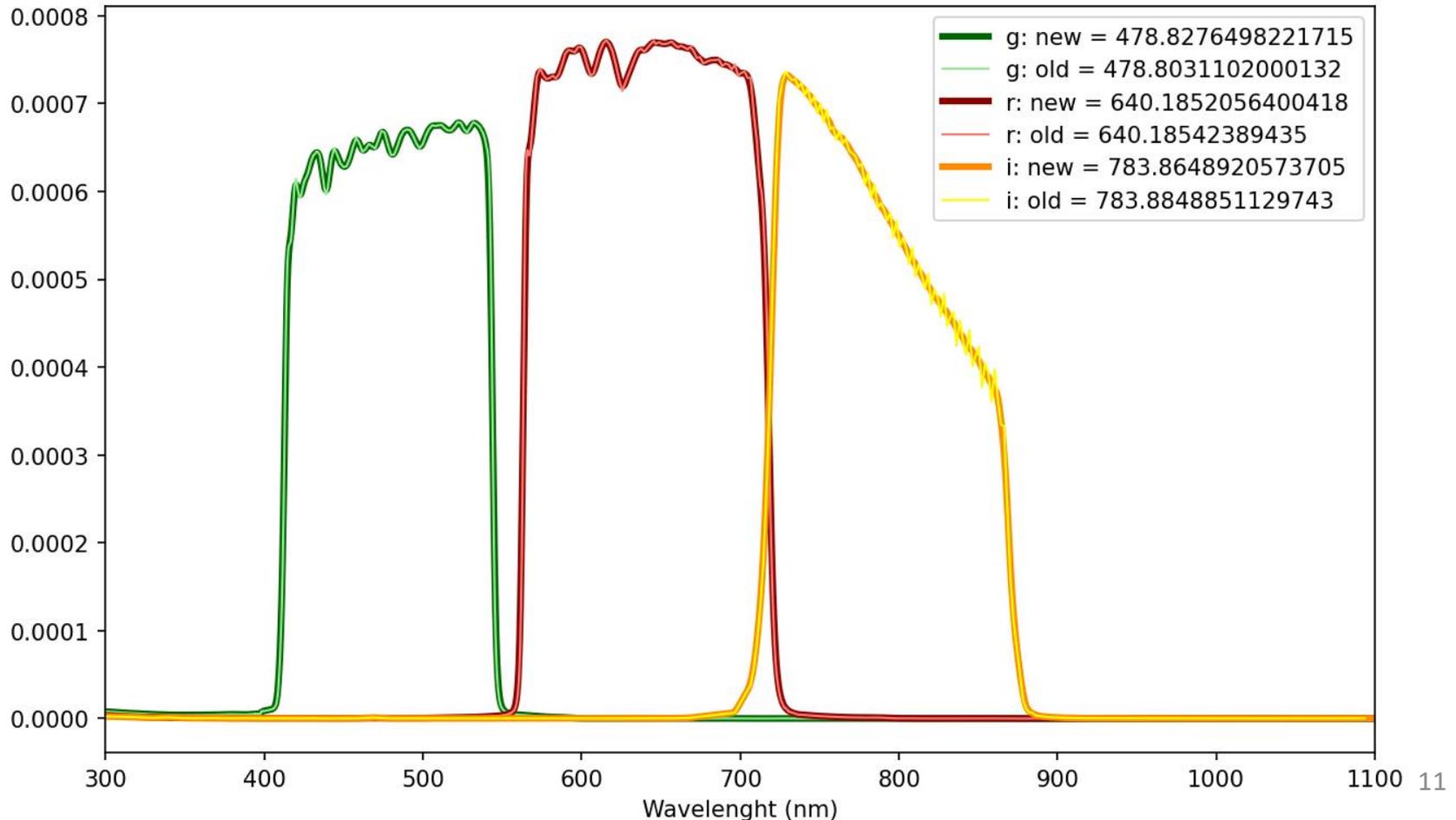# Bug corrected in synthetic filter computation from angle distribution

$$T(x, y, \lambda) = \int T_{\mathrm{opt}}(\lambda) T_{\mathrm{f}}(\lambda, \theta) \left(\frac{dN}{d\theta} \right)_{(x,y)} \epsilon_{\mathrm{QE}}(x, y) d\theta$$

Old: Procedure was applied on full data-frame
- Wavelength
- Transmission

New: Wavelenght range fixed [300;1100] by 0.1 nm

Legend:
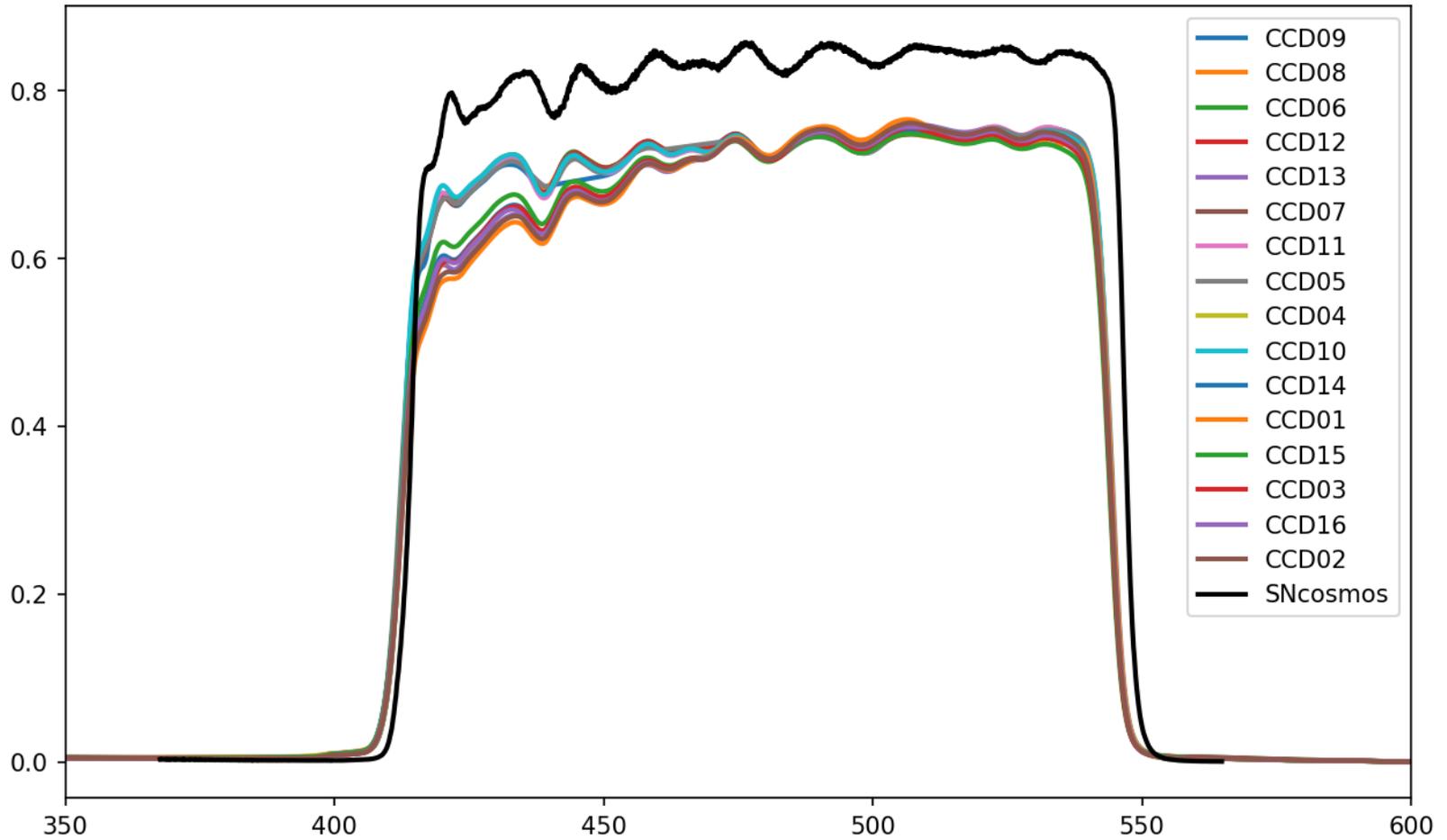- g: new = 478.8276498221715
- g: old = 478.8031102000132
- r: new = 640.1852056400418
- r: old = 640.18542389435
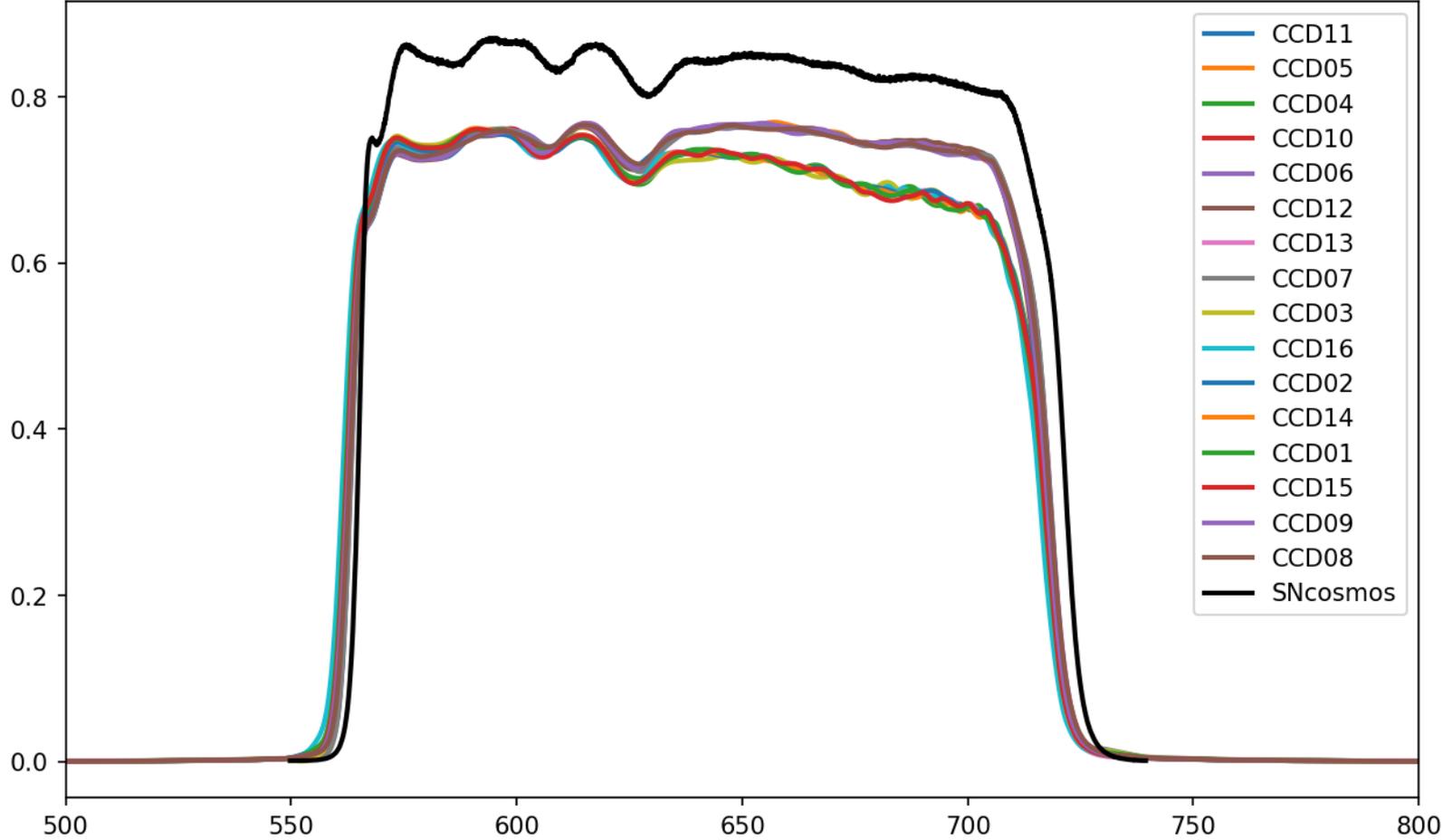- i: new = 783.8648920573705
- i: old = 783.8848851129743

x-axis: Wavelenght (nm)

New g-filters

ztfg

New r-filters

ztfr

New i-filters

ztfi