ZTF QA meeting, 12 March 2021

CCD thickness investigation (5th episode)

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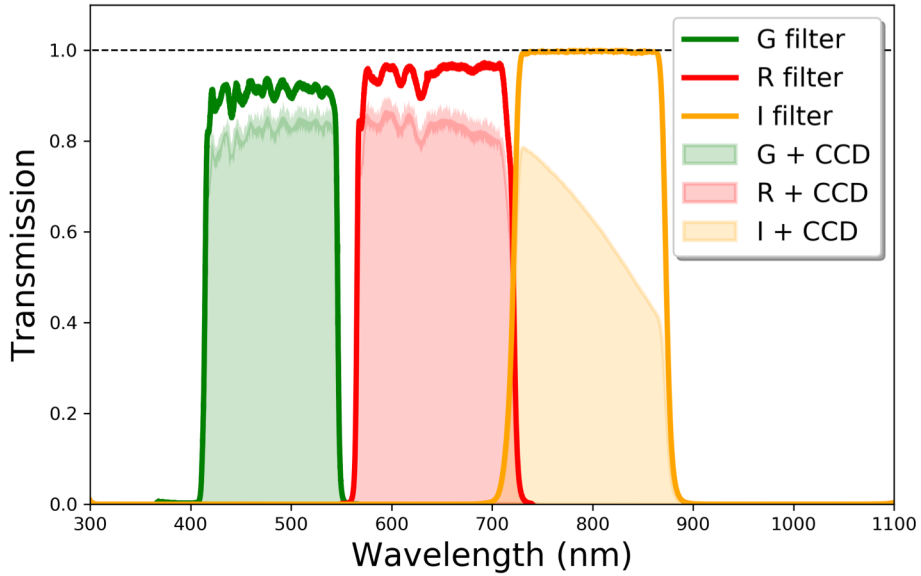
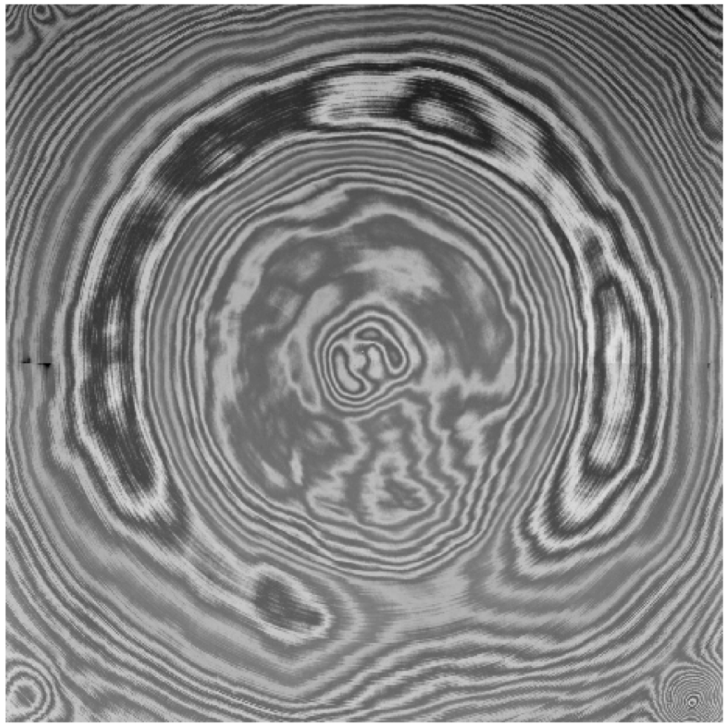
with

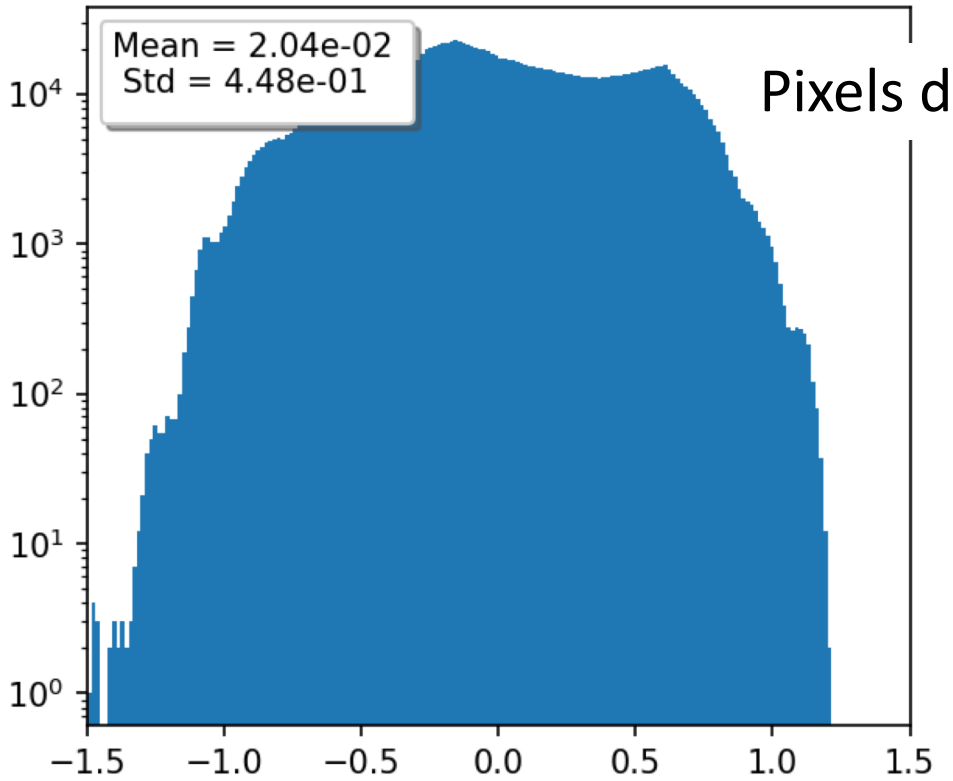
Roger Smith, Steve Kaye, Michael Coughlin and Michael Medford

CCD fringe patterns from PCA analysis of I-band images (M. Medford)



CCD 01 fringe map

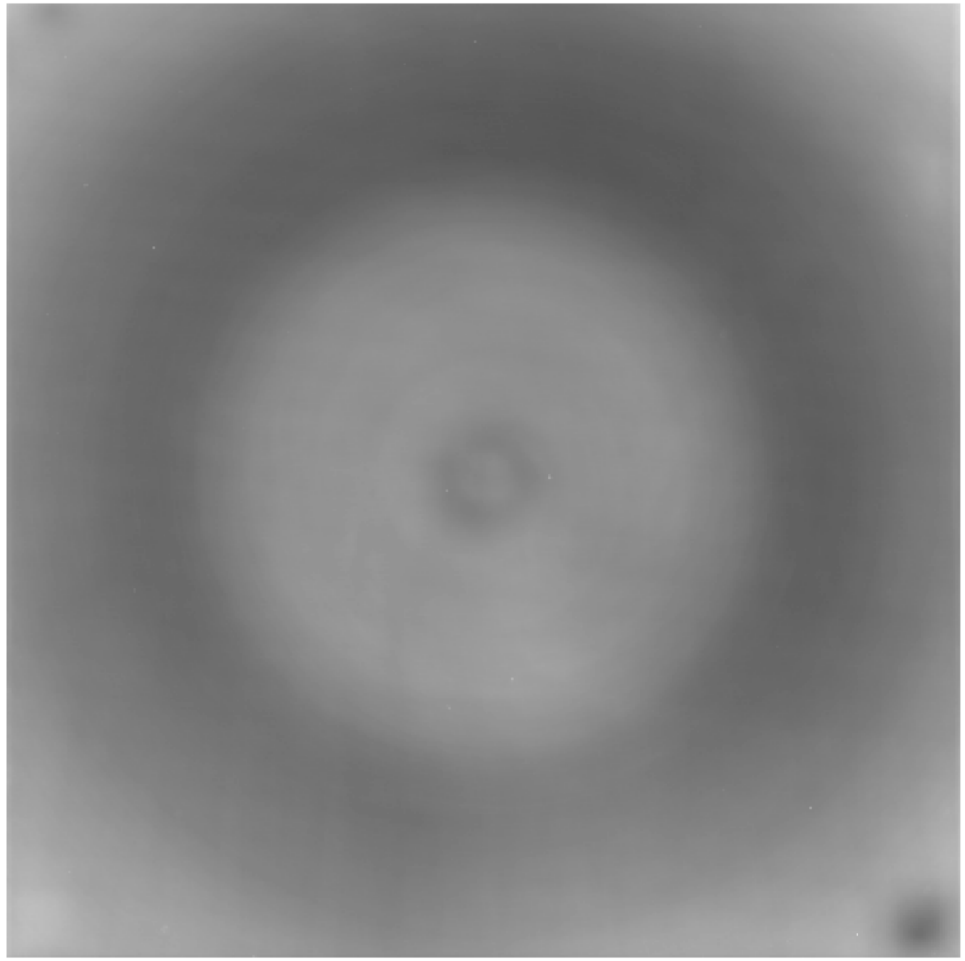


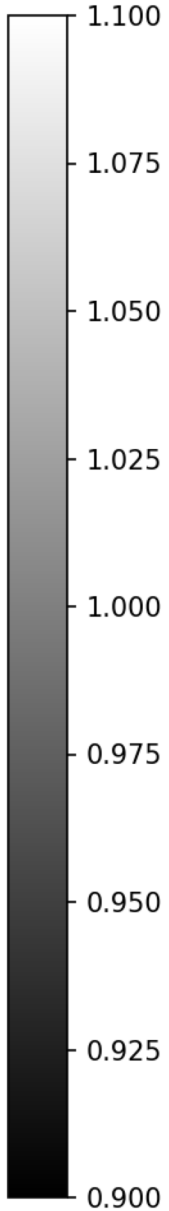


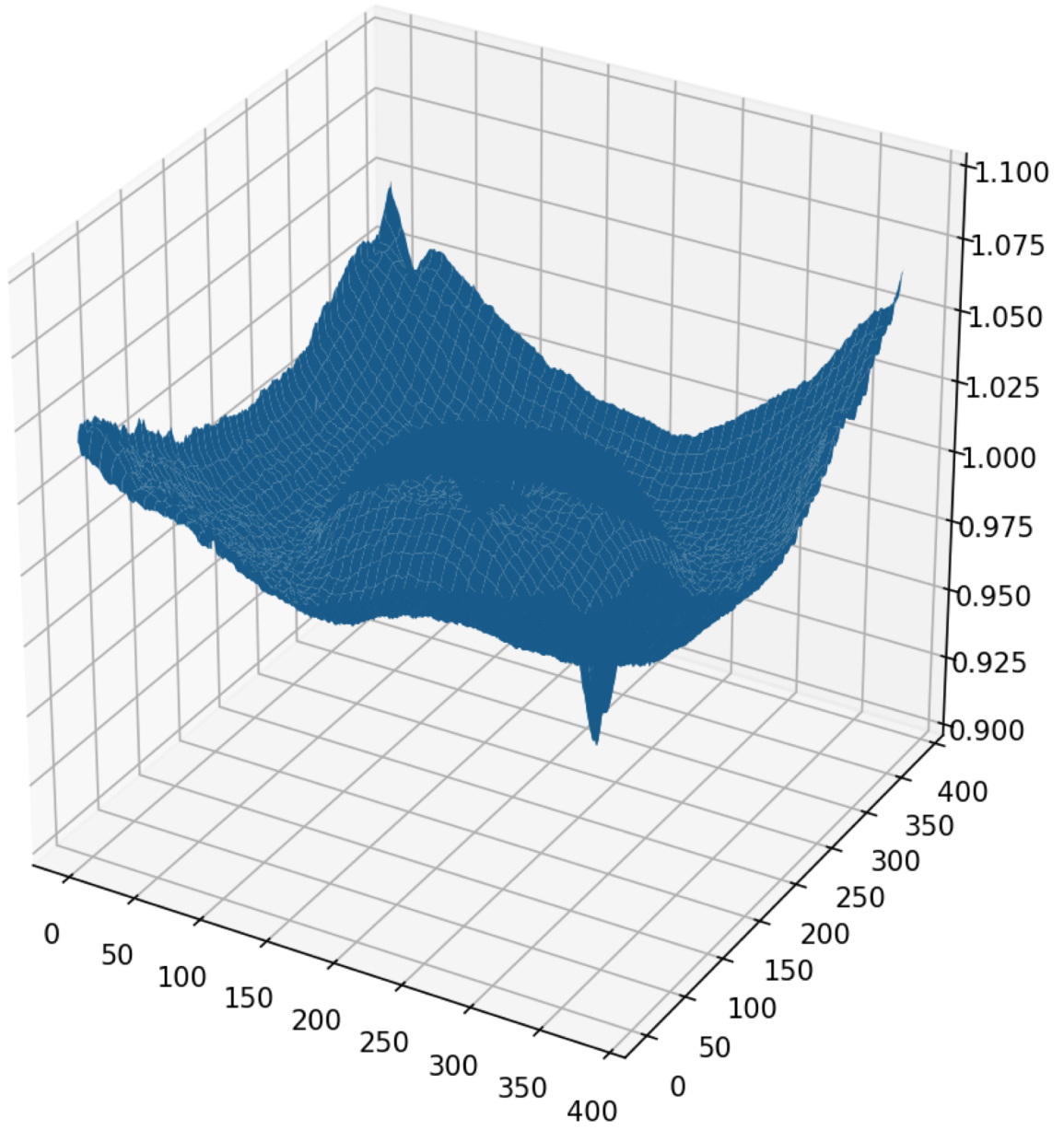
Pixels distribution

Metric of CCD thickness profile = LED flat-field filterless ratio

CCD 01



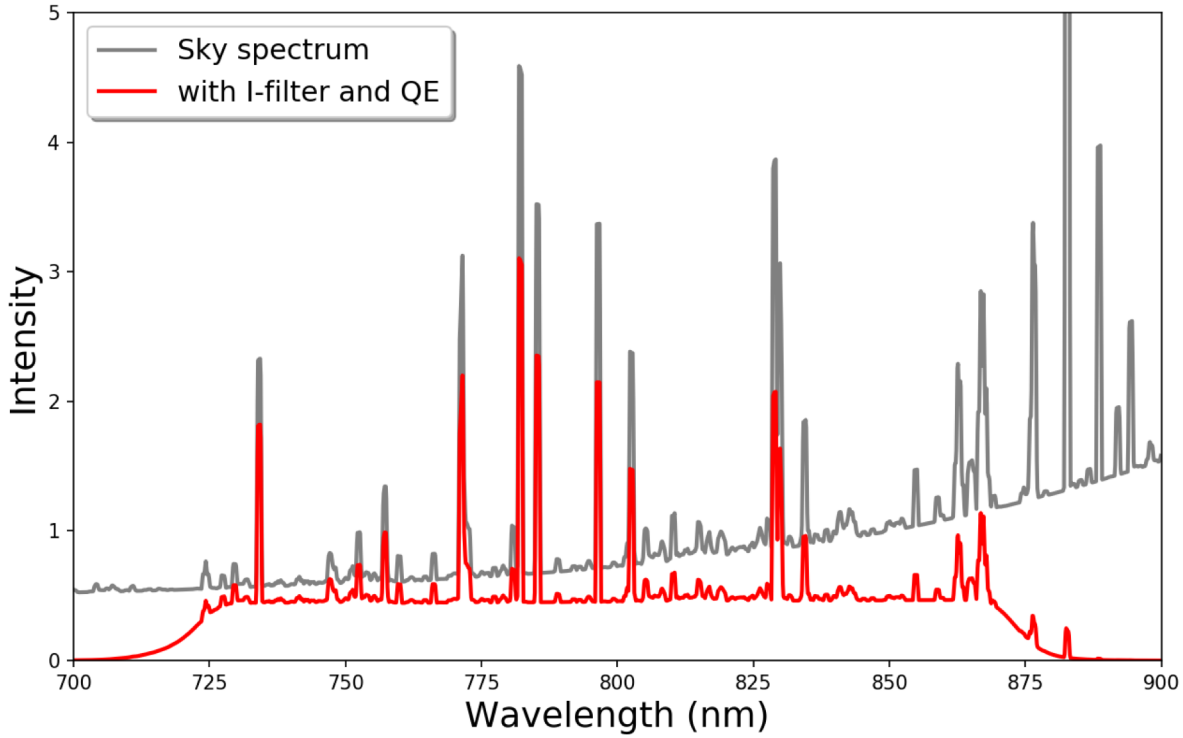


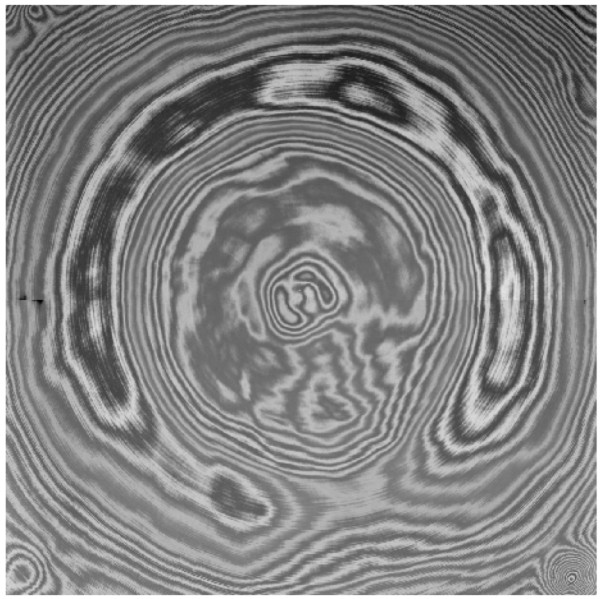


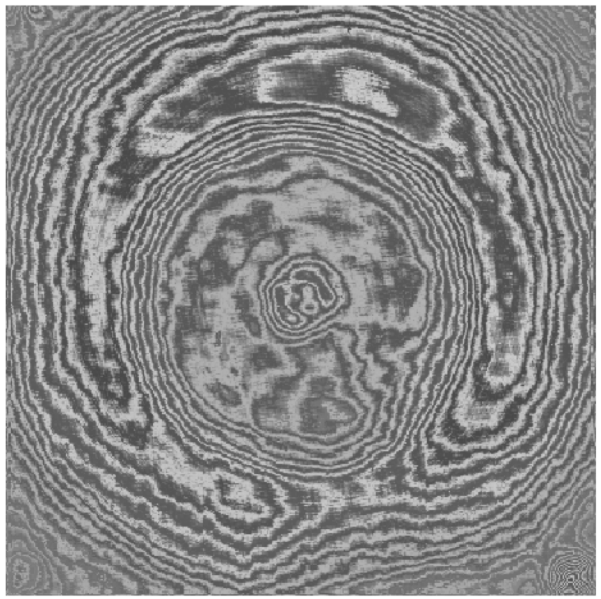
Results with sky spectrum and QE

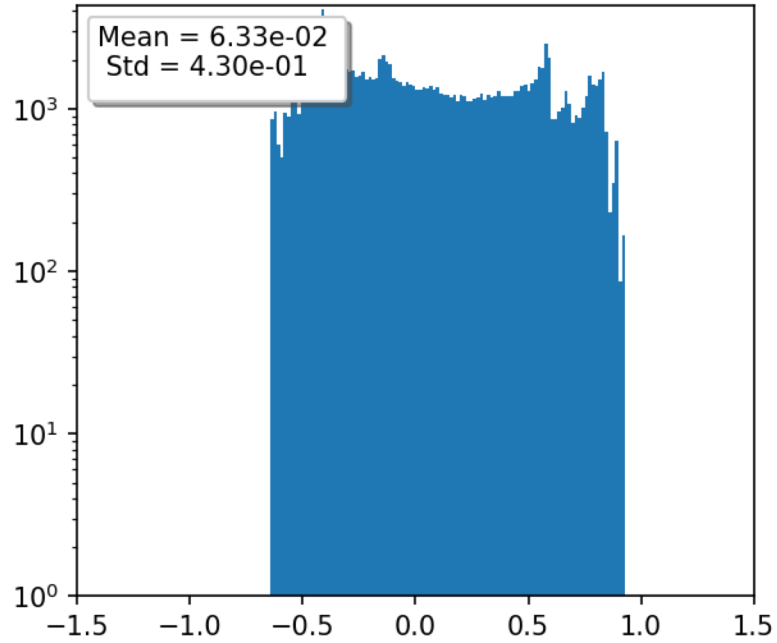
Mean fringing maps with

- $700 < \lambda < 900$ nm
  sky by steps of 0.1 nm
- $d = 25$ µm
- $r = 0.5$
- $n_{\mathrm{Si}} = 3.6$





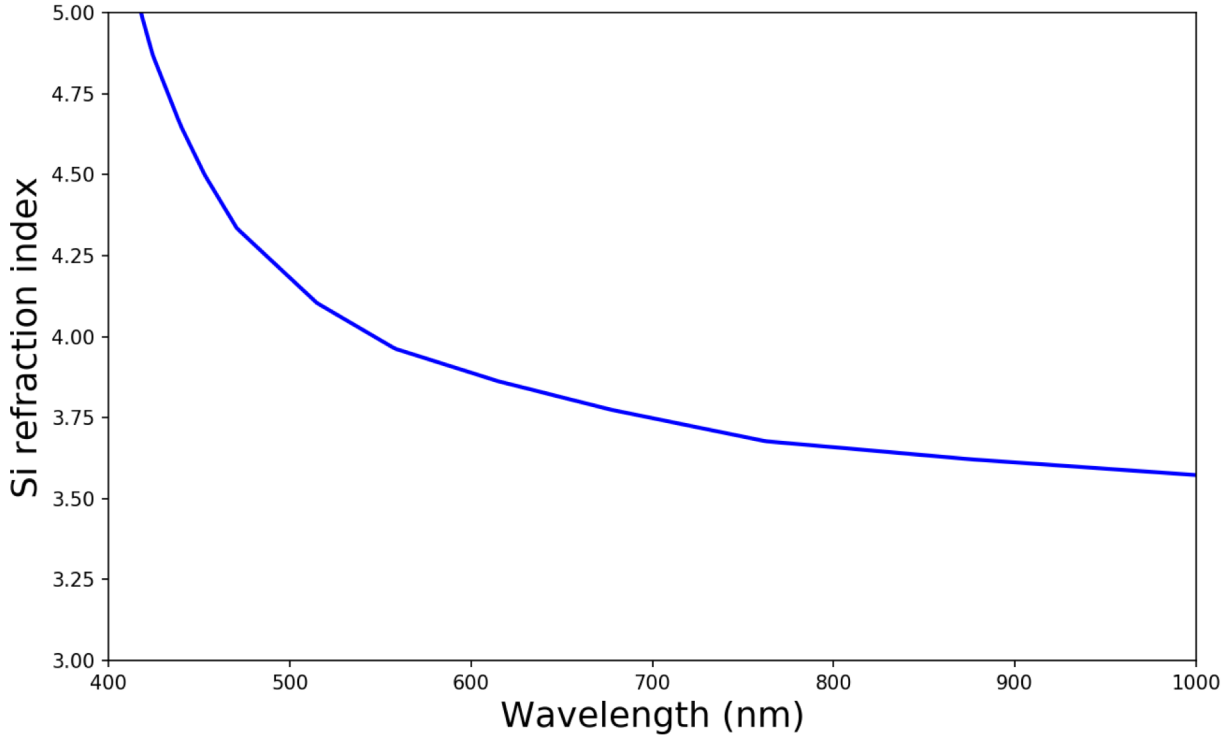


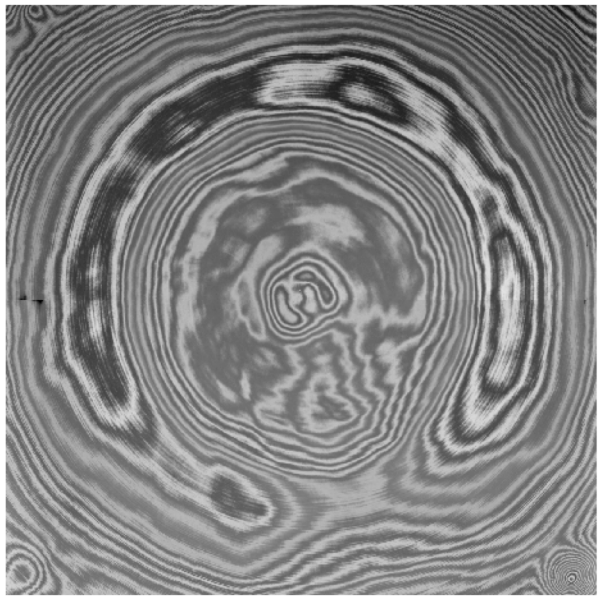


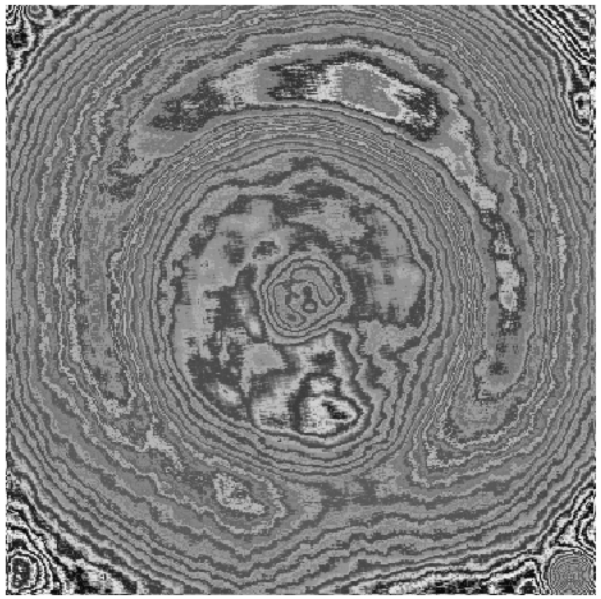
Results with silicon refractive index dispersion relation

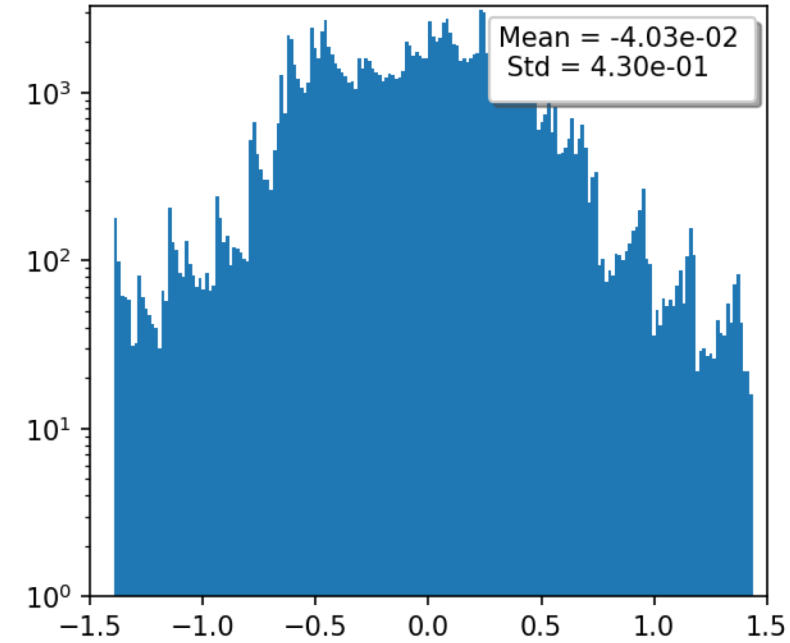
Mean fringing maps with

- $700 < \lambda < 900$ nm sky by steps of 0.1 nm
- $d = 25$ µm
- $r = 0.5$
- $n_{\mathrm{Si}} = n(\lambda)$





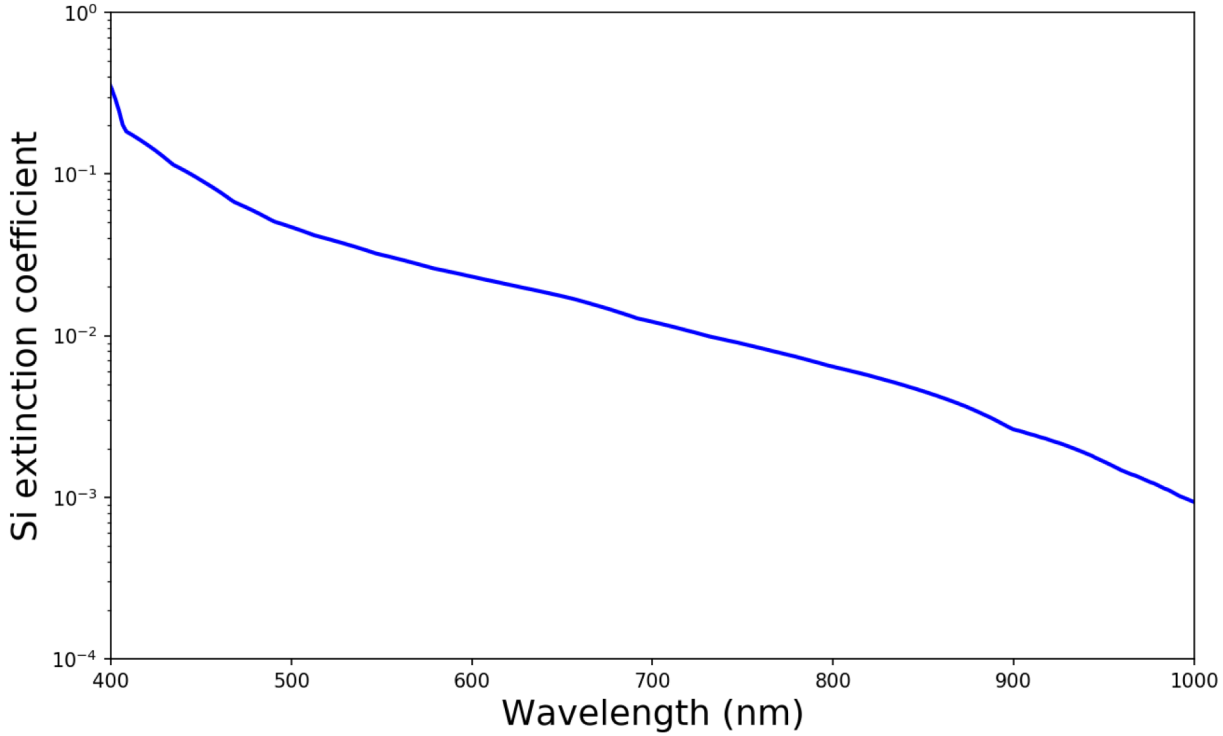


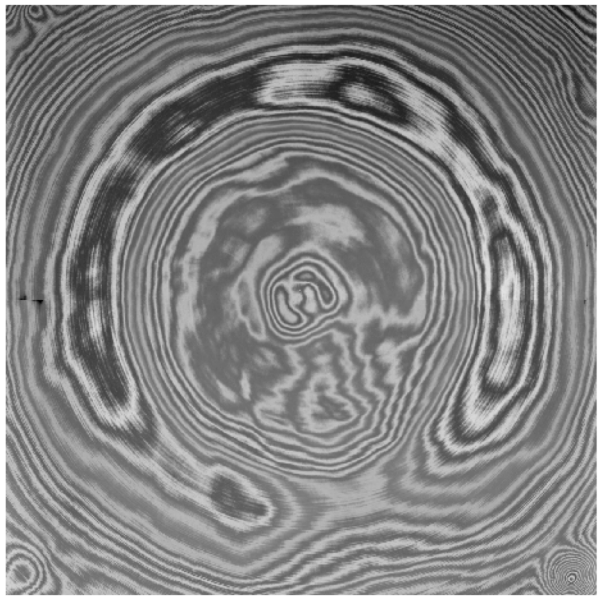


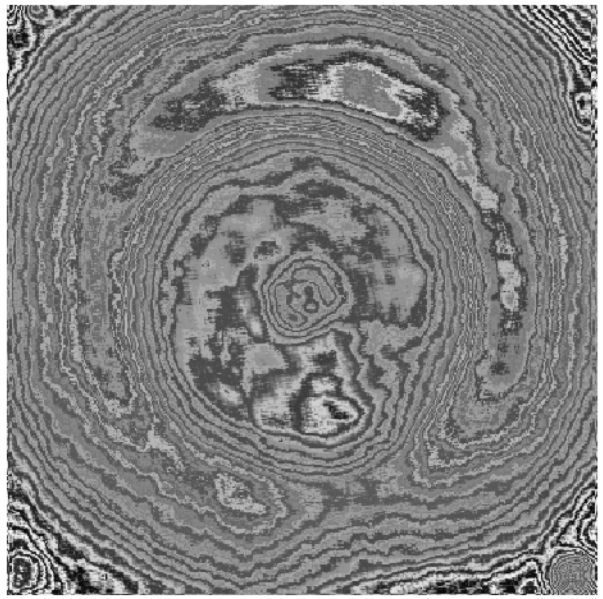
Results with silicon extinction coefficient

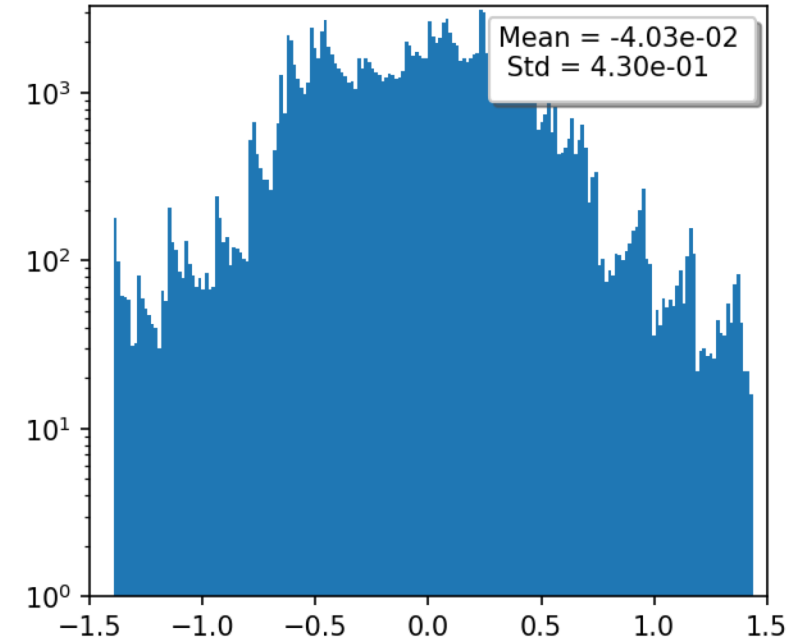
Mean fringing maps with

- $700 < \lambda < 900$ nm sky by steps of 0.1 nm
- $d = 25$ µm
- $r = 0.5$
- $n_{\mathrm{Si}} = n(\lambda)$
- $k_{\mathrm{Si}} = k(\lambda)$









Forward modelling with extinction coefficient

Transmitted intensity through a thin film: $\frac{c}{v} = n - i\,k$

$$I = I_0 \frac{(1-r)^2}{1 + r^2 - 2\,r\cos\Delta\phi} \xrightarrow{\text{with extinction coefficient } k} I = I_0 \frac{a(1-r)^2}{1 + a^2 r^2 - 2\,a\,r\cos\Delta\phi}$$

with $I_0 =$ incident light intensity

$r = 0.5 =$ interface reflexion coefficient

$$\Delta\phi = \frac{4\pi}{\lambda} n_{\mathrm{Si}} d \cos\beta$$

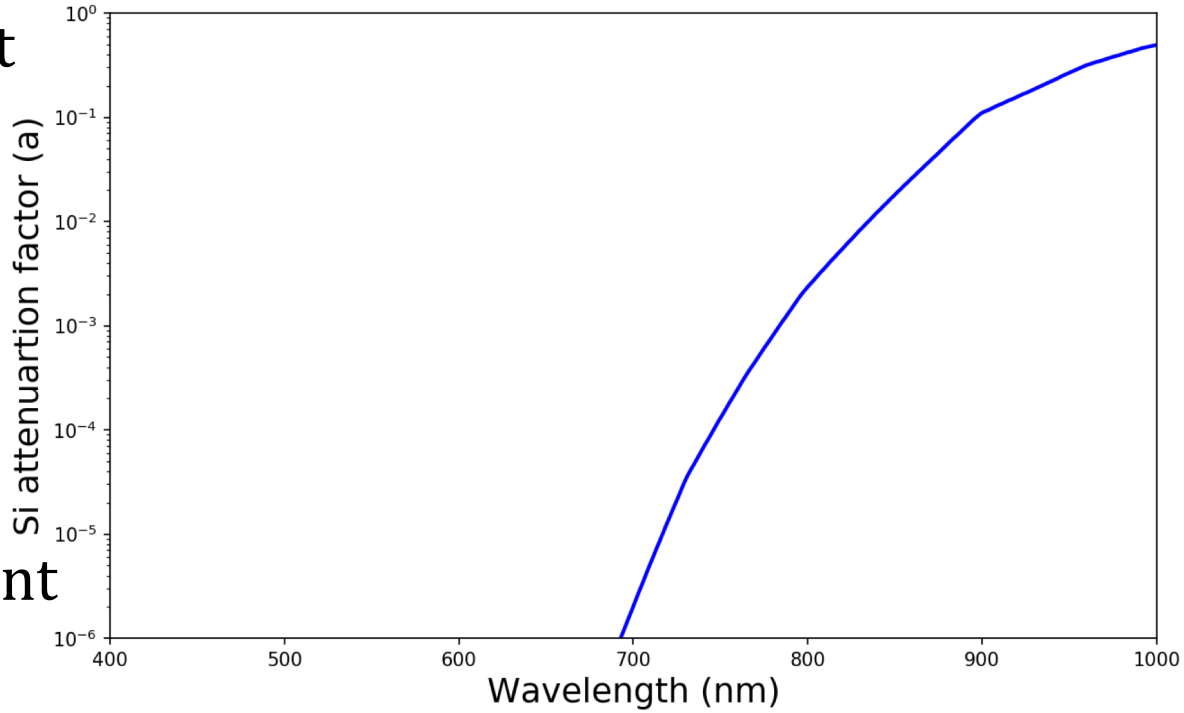
$$\mathrm{a} = \exp\left(-\frac{4\pi}{\lambda}\frac{k_{\mathrm{Si}} d}{\cos\beta}\right)$$

$d = 30\ \mu\mathrm{m} =$ thickness

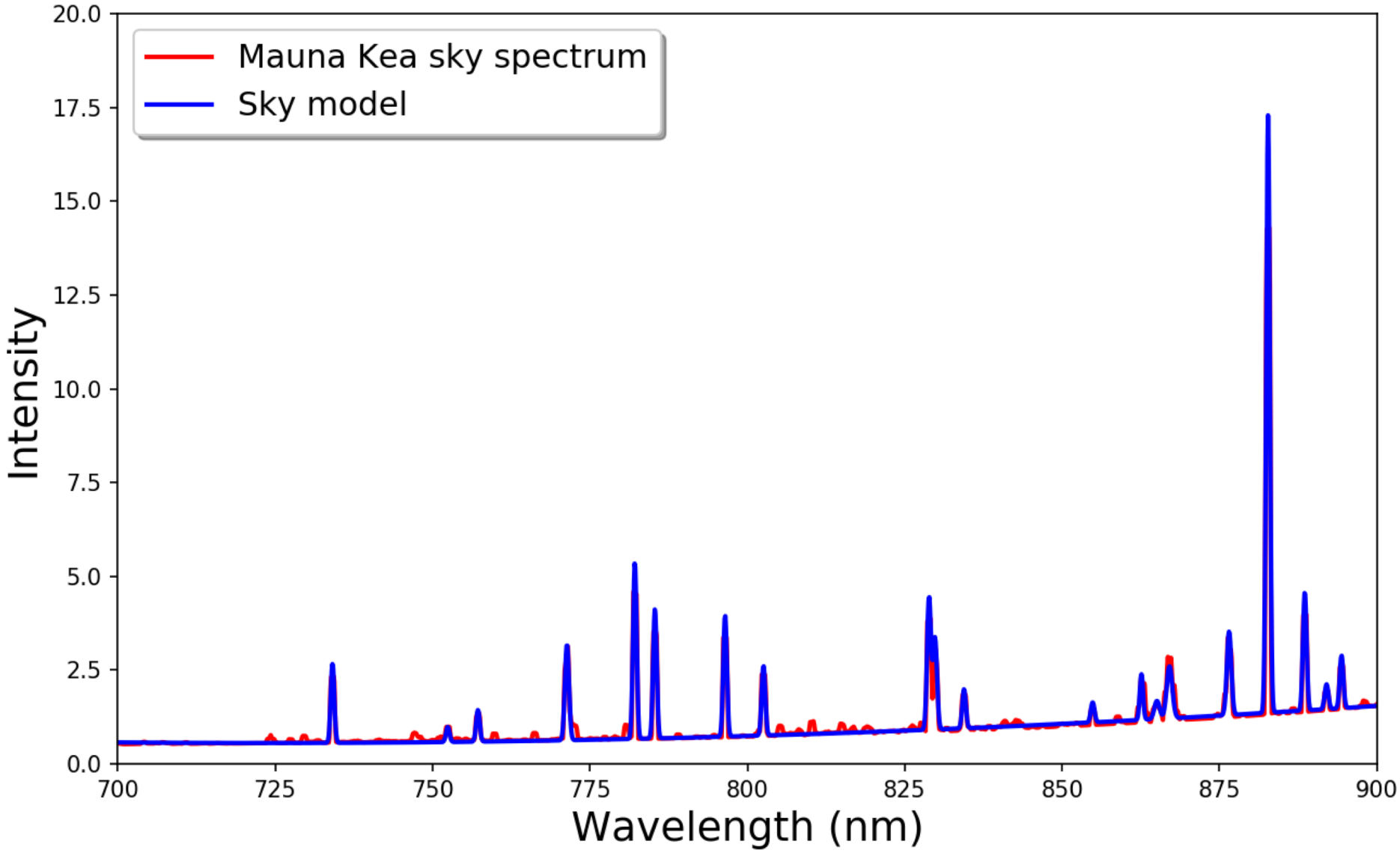
$n_{\mathrm{Si}} = n(\lambda) =$ Silcon refractive index

$k_{\mathrm{Si}} = k(\lambda) =$ Silcon extinction coefficient

$\beta = 0 =$ angle of refraction



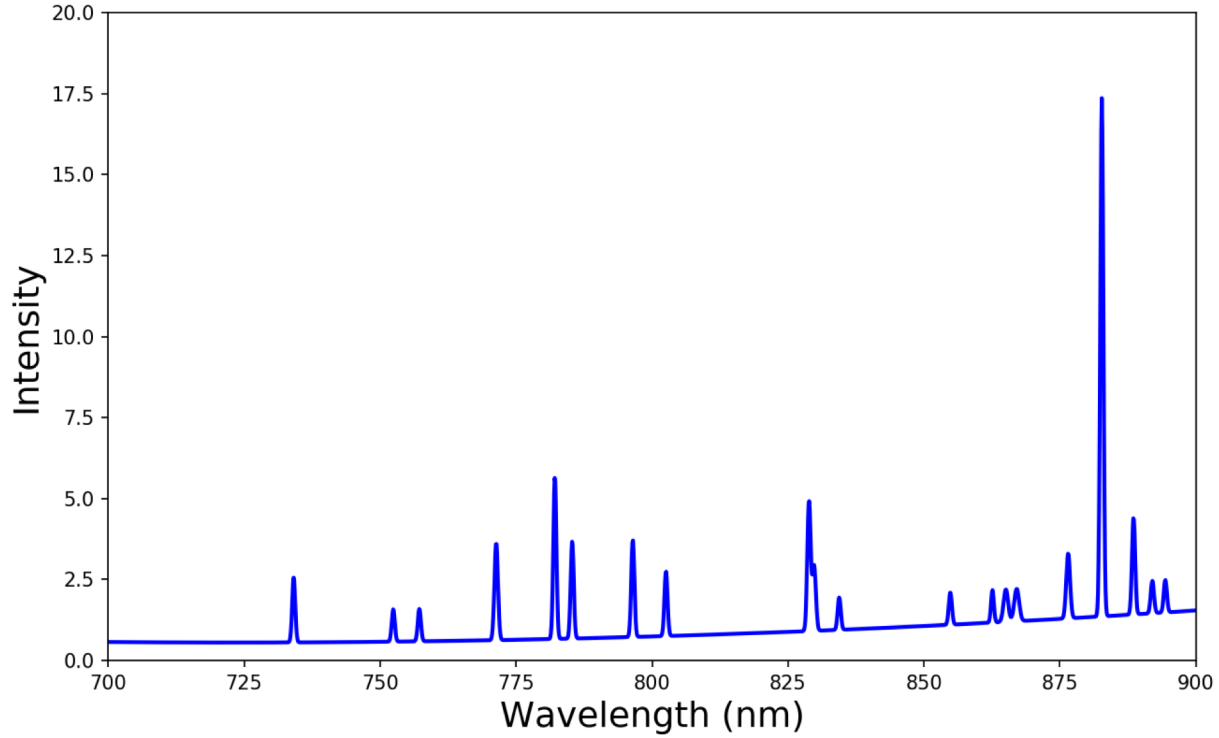
Sky spectrum model

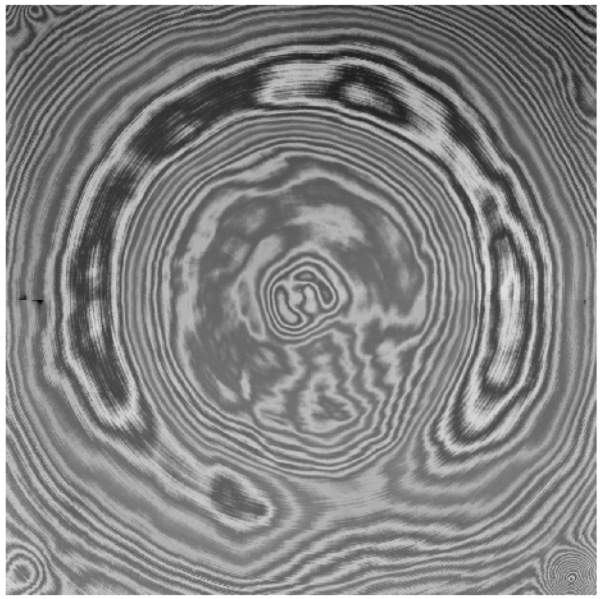


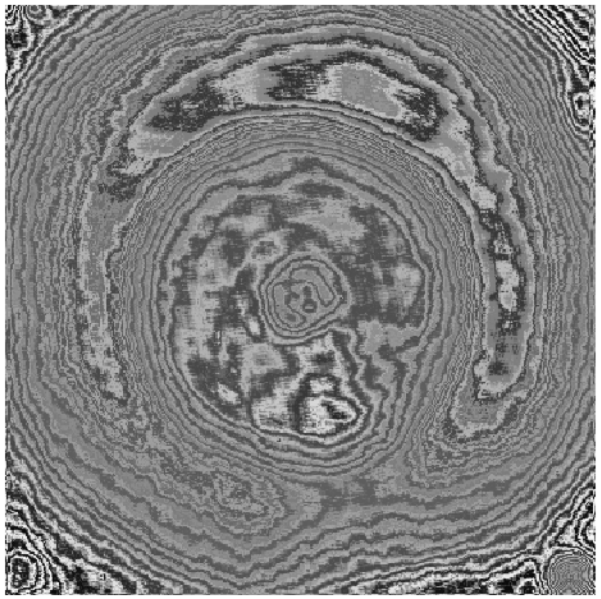
Sky model 1

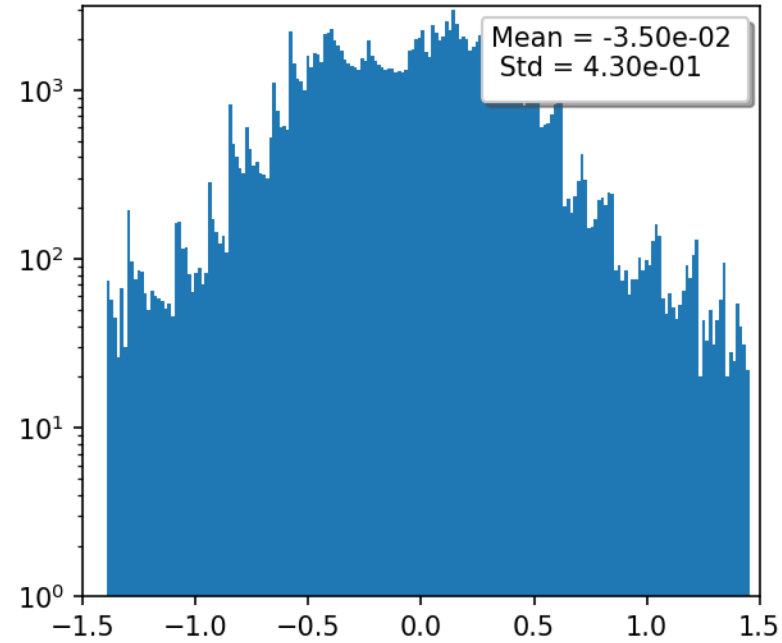
Mean fringing maps with

- $700 < \lambda < 900$ nm sky by steps of 0.1 nm
- $d = 25$ µm
- $r = 0.5$
- $n_{\mathrm{Si}} = n(\lambda)$
- $k_{\mathrm{Si}} = k(\lambda)$





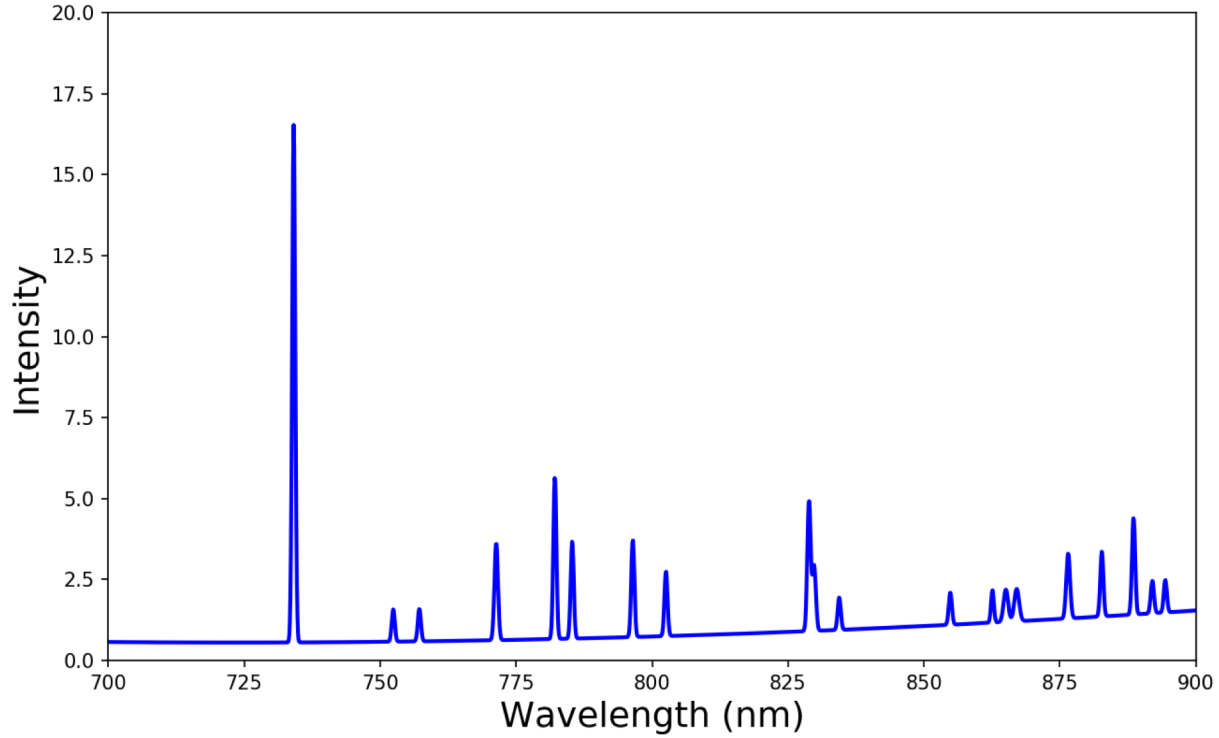


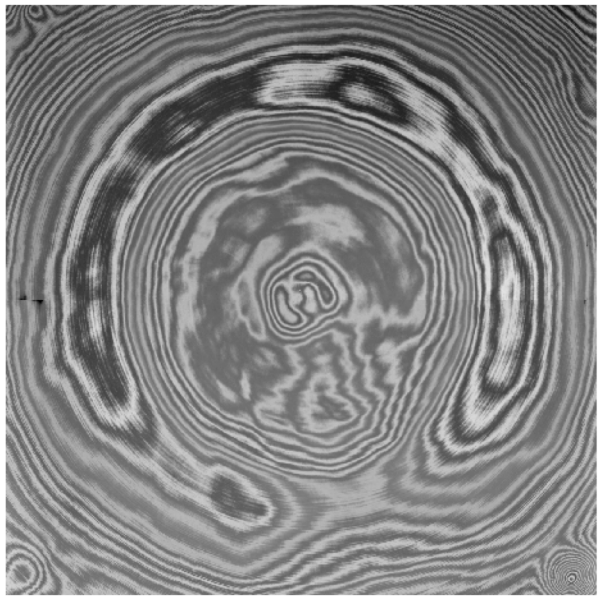


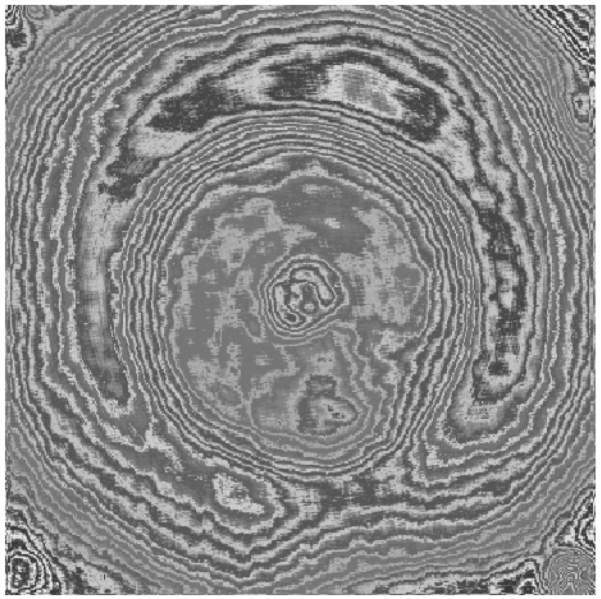
Sky model 2

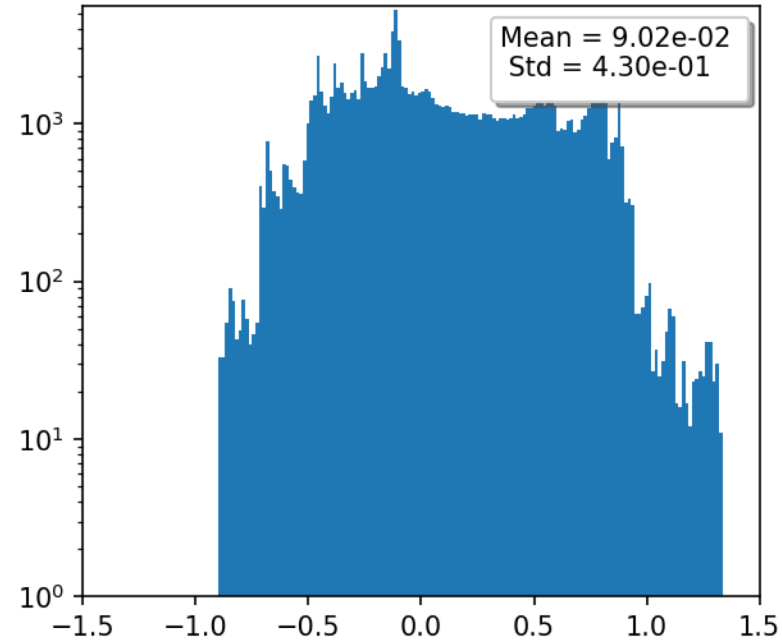
Mean fringing maps with

- $700 < \lambda < 900$ nm sky by steps of 0.1 nm
- $d = 25$ µm
- $r = 0.5$
- $n_{\mathrm{Si}} = n(\lambda)$
- $k_{\mathrm{Si}} = k(\lambda)$









Horizontal profile comparison