Speckle simulation at FCC ee

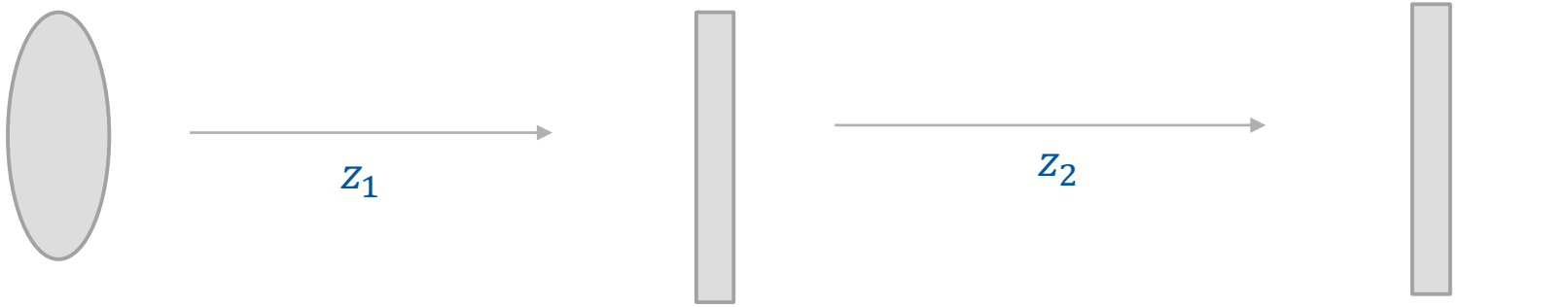
- Beam energy = 45.6 to 182.5GeV
- Bending radius = 10760m
- Arc dipole = 23.94 m, 14.1 to 56.6mT
- Used wavelength = 0.1nm
- Beam size = $\sigma_{x/y} = 5\mu m$

Variable setup

source

colloids

YAG



$\sigma_{source} = 5\mu m$

intensity

$\sigma_{col} = \frac{\lambda z_1}{2 \pi \sigma_1}$

coherence

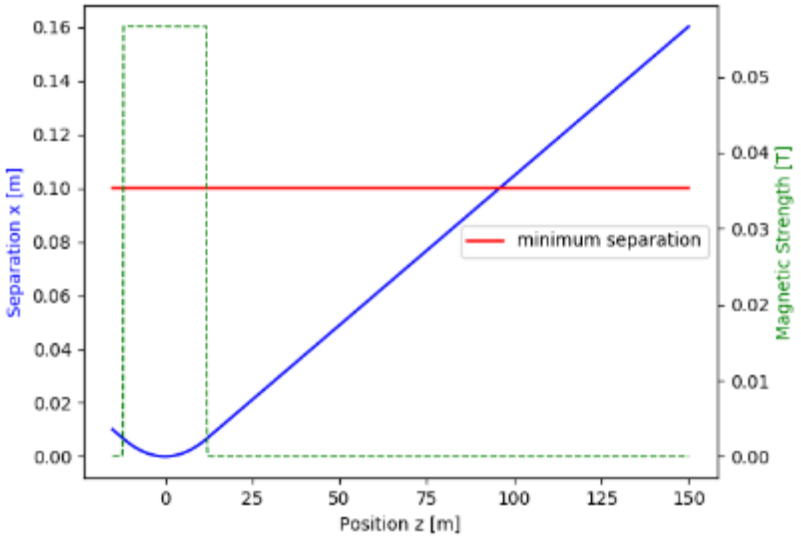
$\sigma_{YAG} = \frac{\lambda (z_1 + z_2)}{2 \pi \sigma_1}$

coherence

Constraints for z1

Estimation of minimum separation ~ 0.1m

Minimum of z1 ~ 100m



Parameter optimization

Expected speckle pattern (r) =

$$\sum_{r_i} \cos\left(k(R_{1+2} - R_2)\right) \exp\left(\frac{-(r - r_i)^2}{2\,\sigma_{YAG}^2}\right) H(\mathrm{r})$$

$$R_{1+2} = \sqrt{(r - r_i)^2 + (z_1 + z_2)^2}$$

$$R_{1+2} = \sqrt{(r - r_i)^2 + {z_2}^2}$$

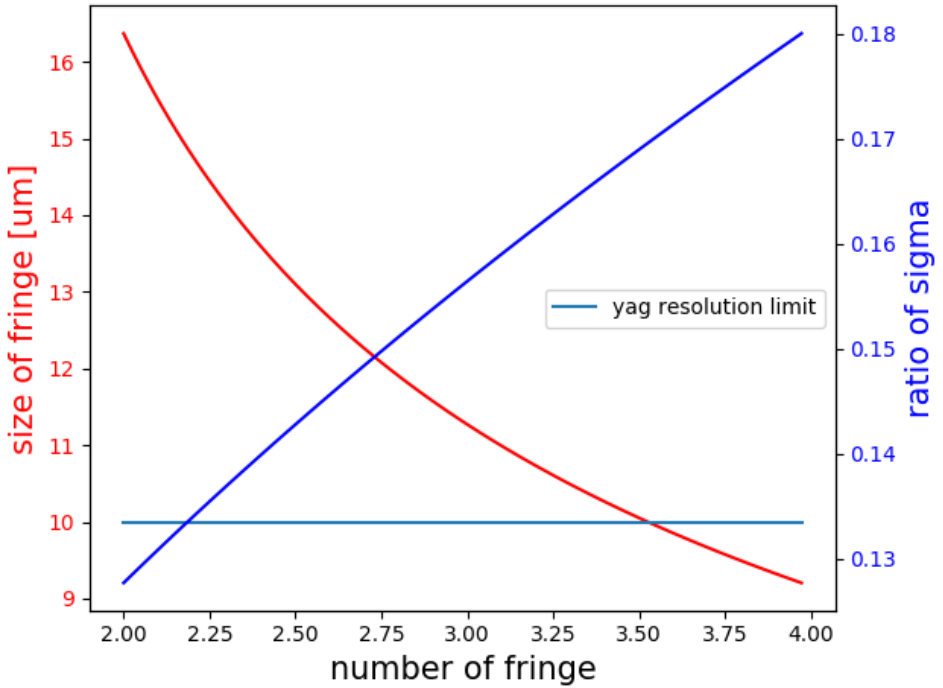
Main challenge of the optimization:

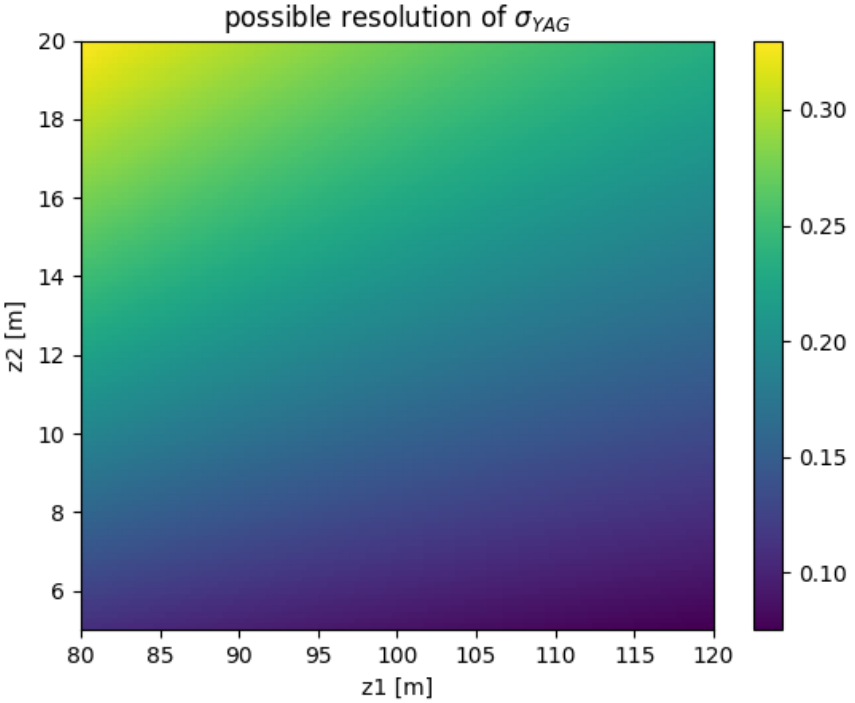
At a certain point the fringes are to small to be resolved with the H(r) transfer function.

This point should be at a high ratio of the σ_{YAG}

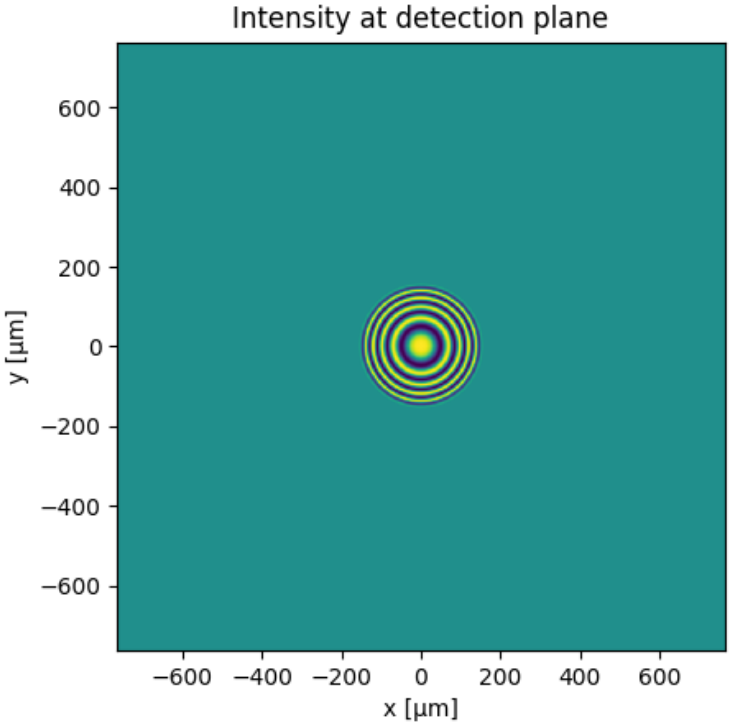
Visible σ_{YAG} optimization

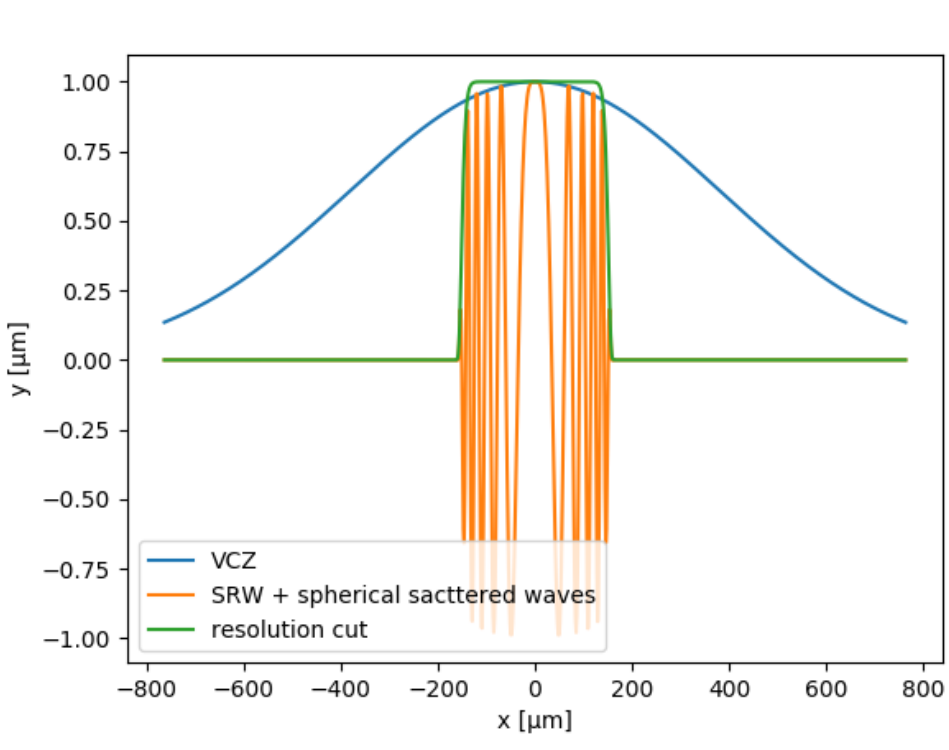
z1 = 100m, z2 = 10m, 0.157 σ_{YAG} resolvable



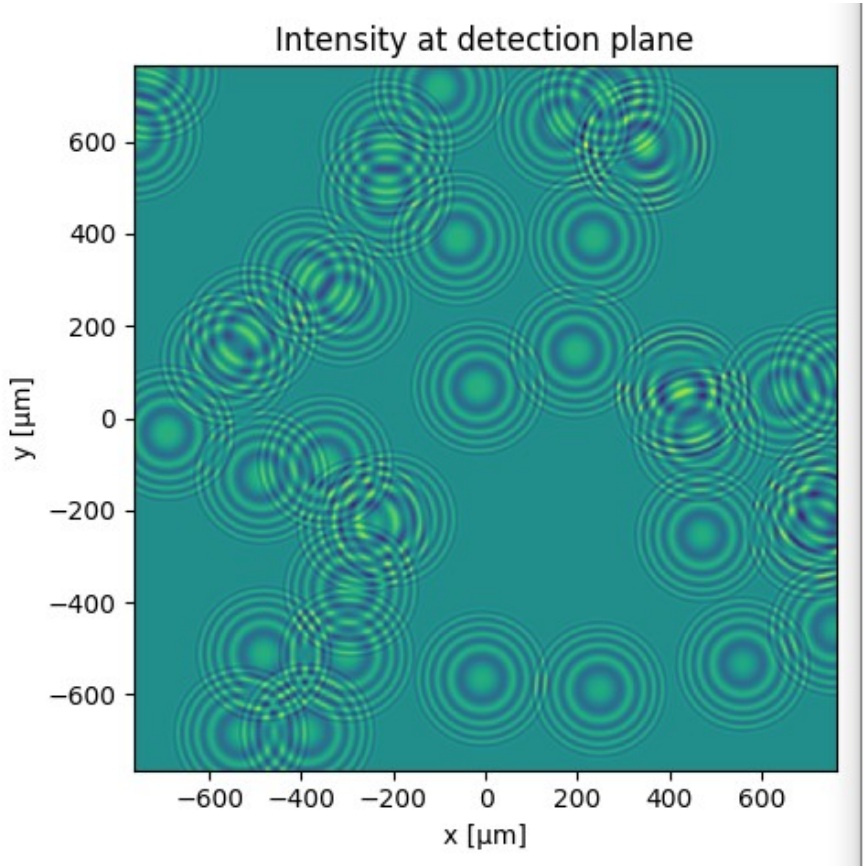


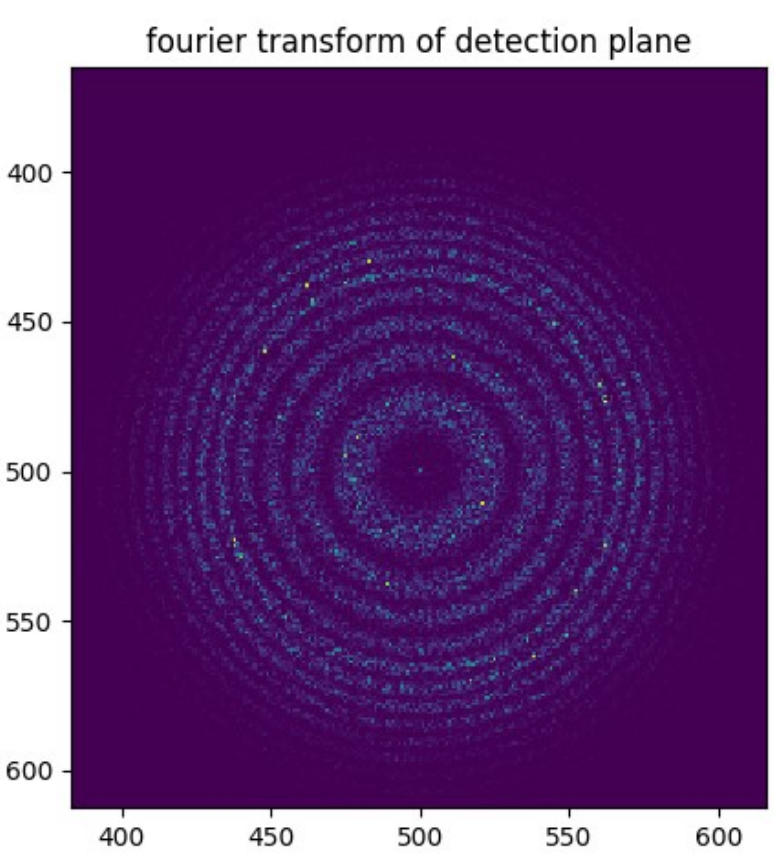
z1 = 100m, z2 = 20m, extension = $4\sigma_{YAG}$, with a single scattering particle in the center





z1 = 100m, z2 = 20m, extension = $4\sigma_{YAG}$, with multiple scattering particles





Spatial frequency at radial average