# Design Parameter, Answers to Q1, Q2, Q3, Q6

Target coordinates: mom. fraction $p$, in-plane angle $\theta$, out-of-plane angle $\phi$, target position $y$
Focal plane coordinates: dispersive $x'$, $\phi'$, non-dispersive $y'$,$\theta'$, origin central ray

- Magnification $M = -0.77$
- First order imaging of *central ray*, $(p, \theta, \phi, y)^t = J \cdot (x', \phi', y', \theta')^t$:

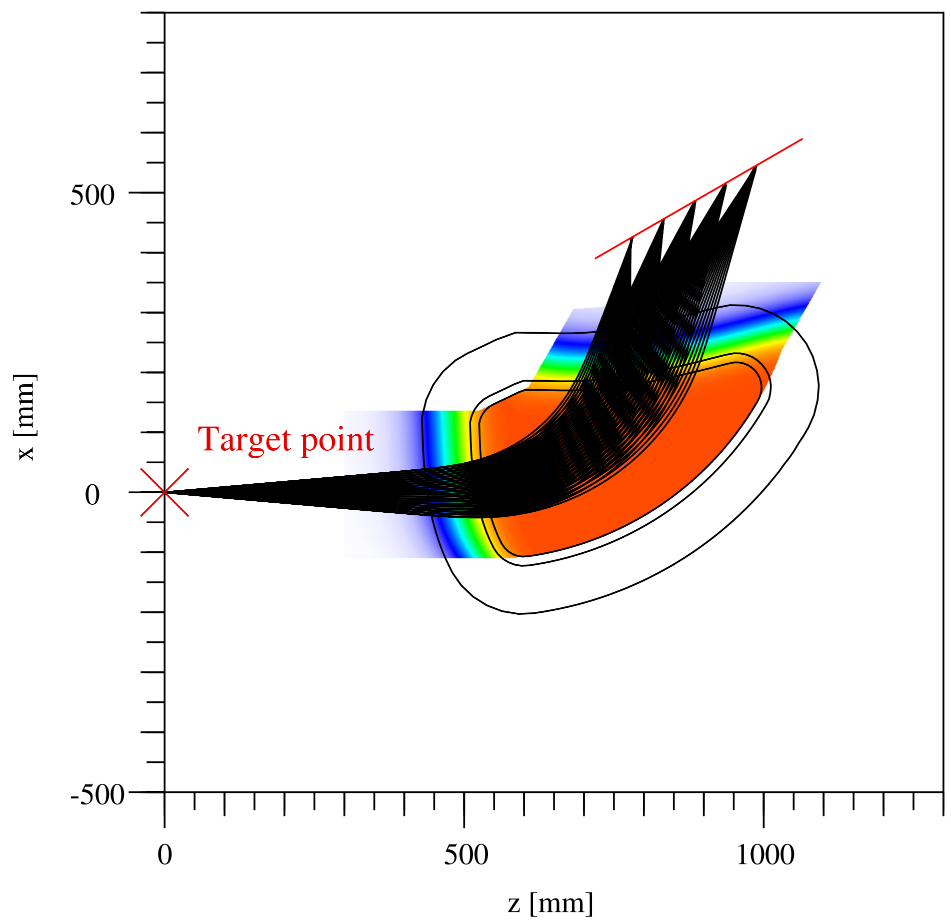
$$J = \begin{pmatrix} \partial_{x'} p & \partial_{\phi'} p & \partial_{\theta'} p & \partial_{y'} p \\ \partial_{x'} \phi & \partial_{\phi'} \phi & \partial_{\theta'} \phi & \partial_{y'} \phi \\ \partial_{x'} \theta & \partial_{\phi'} \theta & \partial_{\theta'} \theta & \partial_{y'} \theta \\ \partial_{x'} y & \partial_{\phi'} y & \partial_{\theta'} y & \partial_{y'} y \end{pmatrix} = \begin{pmatrix} 0.00172 & 0.00028 & 0 & 0 \\ 0.02856 & 0.50404 & 0 & 0 \\ 0 & 0 & 1.16717 & -0.06810 \\ 0 & 0 & 24.07773 & -2.21014 \end{pmatrix}$$

| | | | | | |
|---|---|---|---|---|---|
| Assumed Detector Resolutions: | beam size | = | 1.00 | mm | |
| | $\sigma_{x'}$ (disp.) | = | 0.10 | mm | |
| | $\sigma_{y'}$ | = | 0.10 | mm | |
| | $\sigma_{\phi'}$ (disp.) | = | 3.49 | mrad | = 0.2° |
| | $\sigma_{\theta'}$ | = | 3.49 | mrad | = 0.2° |
| Target Resolutions: | $\sigma_p$ | = | 0.00134 | | |
| | $\sigma_\phi$ | = | 1.80197 | mrad | = 0.10325° |
| | $\sigma_\theta$ | = | 2.05093 | mrad | = 0.11751° |
| | $\sigma_y$ | = | 2.44801 | mm | |

- Acceptance:

$$6^\circ \times 6^\circ \quad \Rightarrow \quad \Delta\Omega = 11.0\,\mathrm{msr}, \quad \frac{\Delta p}{p} = 30\%$$

# Edge shape, Answers to Q4, Q5




Polynomials (numerical optimized):

Entrance: $x\left(0.1807 - 0.2937\frac{x}{250\,\text{mm}} + 0.2510\left(\frac{x}{250\,\text{mm}}\right)^2 - 0.2143\left(\frac{x}{250\,\text{mm}}\right)^3 + 0.3102\left(\frac{x}{250\,\text{mm}}\right)^4\right)$

Exit: $x\left(0.9460 - 0.1477\frac{x}{250\,\text{mm}} - 0.2213\left(\frac{x}{250\,\text{mm}}\right)^2 + 0.1913\left(\frac{x}{250\,\text{mm}}\right)^3 - 0.1011\left(\frac{x}{250\,\text{mm}}\right)^4\right)$

# Remaining Questions

Q7: Focal plane angle: see CAD files

Q8: Focal plane: nearly linear, a small compromise has to be taken to improve the coupling with the in-plane angle. Beam spot size dominates error, so it's not worth to further improve this.

Q9: The big problem: out-of-plane angle introduces the largest error.
This can't be avoided with a single dipole!
Perhaps we have to restrict the out-of-plane acceptance.

Q10: Are we really expecting to be dominated by unrelated $e^+e^-$ background?????
Then we are dead already...

Summary

- Intrinsic resolution better than needed
- Missing angular detection seriously restricts mass-resolution
- Image of beam spot larger than detector resolution, limited by available space
- Final mass resolution has to be determined by simulation
- Aim: same size as multiple scattering in target