

M. Steck et al, Electron cooling experiments at the ESR, NIM A 532 (2004) 357-365:

- using 3 MeV/u, 10^5 bare Uranium
- cooler: e^- current = 5 mA, e^- energy = 1.65 keV
 - ⇒ $\epsilon_x = 5 \cdot 10^{-7} m$
 - ⇒ $\delta p/p = 10^{-4}$ (2 σ -values)

Derivation of beam parameters

- Emittance: $\epsilon_x = X \cdot A \approx \epsilon_y = Y \cdot B [m \cdot rad \cdot \pi]$, where:
 - ⇒ X, Y = initial position distribution
 - ⇒ A, B = angular distribution
 - ⇒ \approx is assumed, because only ϵ_x is given
 - ⇒ π is already defined into the units, do not multiply with it!
- twist parameter = $\frac{X}{A} [\frac{mm}{mrad}]$,
characteristic for the ring ⇒ don't change the ratio!

$$x = \sqrt{\text{twist}_x \cdot \epsilon_x}$$

$$A = x / \text{twist}_x$$

- energy spread = $\Delta E / E$
connection to momentum spread:

$$E = \frac{p^2}{2m}$$
$$\Delta E = \frac{2p\Delta p}{2m} = E 2 \frac{\Delta p}{p}$$
$$\frac{\Delta E}{E} = 2 \frac{\Delta p}{p}$$

$$E = E_0 \left(1 + \frac{\cancel{E_0} + \text{max}E}{100}\right) = E_0 + E_0 \frac{\text{max}E}{100}$$
$$\Rightarrow E_0 \frac{\text{max}E}{100} = \Delta E \Rightarrow \cancel{E_0} \frac{\text{max}E}{100} = 2 \frac{\Delta p}{p} \cancel{E_0}$$
$$\text{max}E = 2 \cdot \frac{\Delta p}{p} \cdot 100 [\%]$$

MOCADI input

- dimensions in MOCADI

- ⇒ $X, Y = [cm]$

- ⇒ $A, B = [mrad]$

- ⇒ $maxE = [％]$, eg. instead 10^{-4} write 10^{-2}

- an example input is given at

<https://web-docs.gsi.de/weick/mocadi/download/esr-exl-test.in>

- ⇒ $twist_x = X/A = 1,5 \frac{cm}{mrad} = 15 \frac{m}{rad}$

- ⇒ $twist_y = Y/B = 0,345725 \frac{cm}{mrad} = 3,45725 \frac{m}{rad}$

- parameters:

- ⇒ $X = \sqrt{15 \frac{m}{rad} \cdot 5 \cdot 10^7 m} = 0,27386 cm$

- ⇒ $Y = \sqrt{3,45725 \frac{m}{rad} \cdot 5 \cdot 10^7 m} = 0,131477 cm$

- ⇒ $A = 0,182573 mrad$

- ⇒ $B = 0,383186 mrad$

- ⇒ $maxE = 0,02$ for uniform beam distribution

- ⇒ $maxE = 0,01$ for gaussian beam distribution ($\frac{\Delta p}{p}$ is given for 2 sigma)

Example input for 6 AMeV ^{111}Sn beam

BEAM

1000000

6 , 0 , 110.8803121305 , 50

4

0.27386, 0.182573, 0, 0, 0

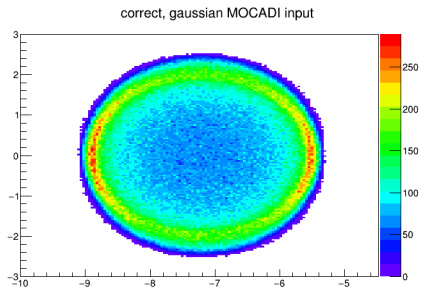
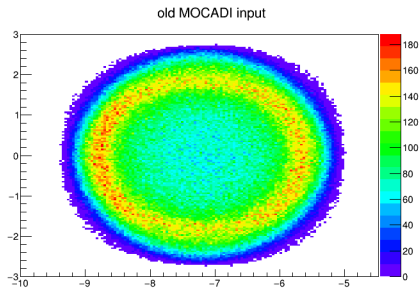
4

0.131477, 0.383186, 0, 0, 0

1

0.02, 0, 0, 0, 0

Example: 6AMeV - pn channel (only gs)



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