IC Local Meeting

TITUS DASCALU

MAY 1, 2020

- Replace solenoids with Gabor lenses (maintaining the same focusing strength)

  (1) 6x6 transfer matrix – calculated for 15MeV

The linearised Hamiltonian for the electrostatic cloud described above is

$$H_2 = \frac{p_x^2}{2} + \frac{p_y^2}{2} + \frac{\delta^2}{2\beta_0^2\gamma_0^2} + \frac{k}{2}(x^2 + y^2) + O(3)$$

$$B_{GL} = B_{sol}\sqrt{Z\frac{m_e}{m_{ion}}}$$

under the paraxial approximation $(p_x, p_y, x, y \ll 1)$ and under the condition $q\phi \ll cP_0$.

For the full relativistic case and ideal filling factor $\kappa = 1$, the linearised Hamiltonian gives a focusing strength k as

$$\frac{k}{2} = \frac{qn_e e}{4\epsilon_0\gamma_0 m_{ion}\beta_0^2 c^2}$$

$$\frac{k}{2} = \frac{1}{2}\frac{qe}{4\gamma_0 m_e m_{ion}\beta_0^2 c^2}B_{GL}^2$$

or, in terms of the solenoidal field

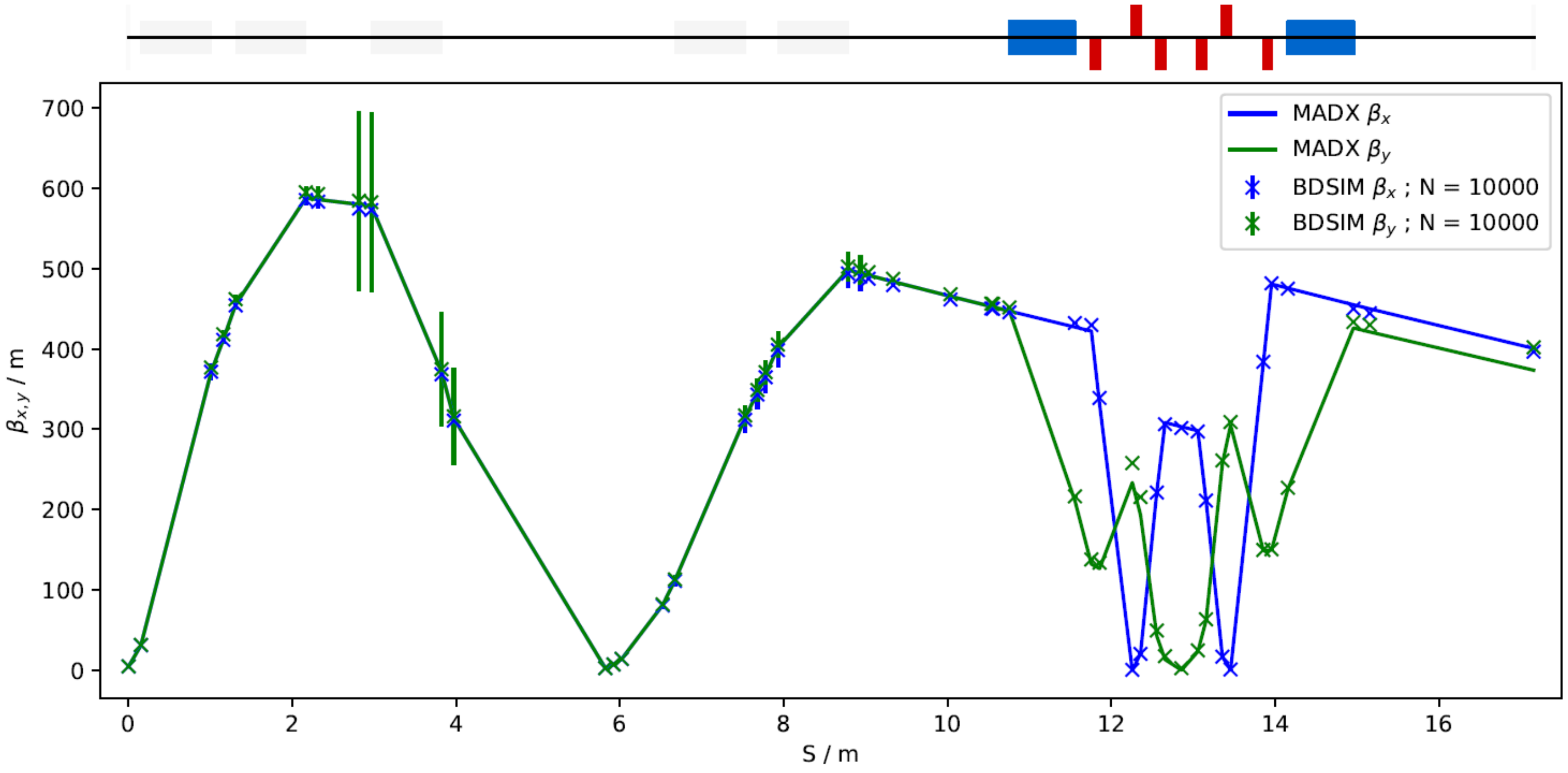
$$\frac{k}{2} = \frac{1}{2}\frac{Zqe}{4\gamma_0 m_{ion}^2\beta_0^2 c^2}B_{sol}^2$$

$$R_{GL} = \begin{pmatrix} \cos(\omega L) & \frac{\sin(\omega L)}{\omega} & 0 & 0 & 0 & 0 \\ -\omega\sin(\omega L) & \cos(\omega L) & 0 & 0 & 0 & 0 \\ 0 & 0 & \cos(\omega L) & \frac{\sin(\omega L)}{\omega} & 0 & 0 \\ 0 & 0 & -\omega\sin(\omega L) & \cos(\omega L) & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & \frac{L}{\beta_0^2\gamma_0^2} \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

$$\omega = \sqrt{k}.$$

- Replace solenoids with Gabor lenses (maintaining the same focusing strength)

  (1) 6x6 transfer matrix – not energy dependent



- Replace solenoids with Gabor lenses (maintaining the same focusing strength)

(2) Generate ideal E field – load into BDSIM

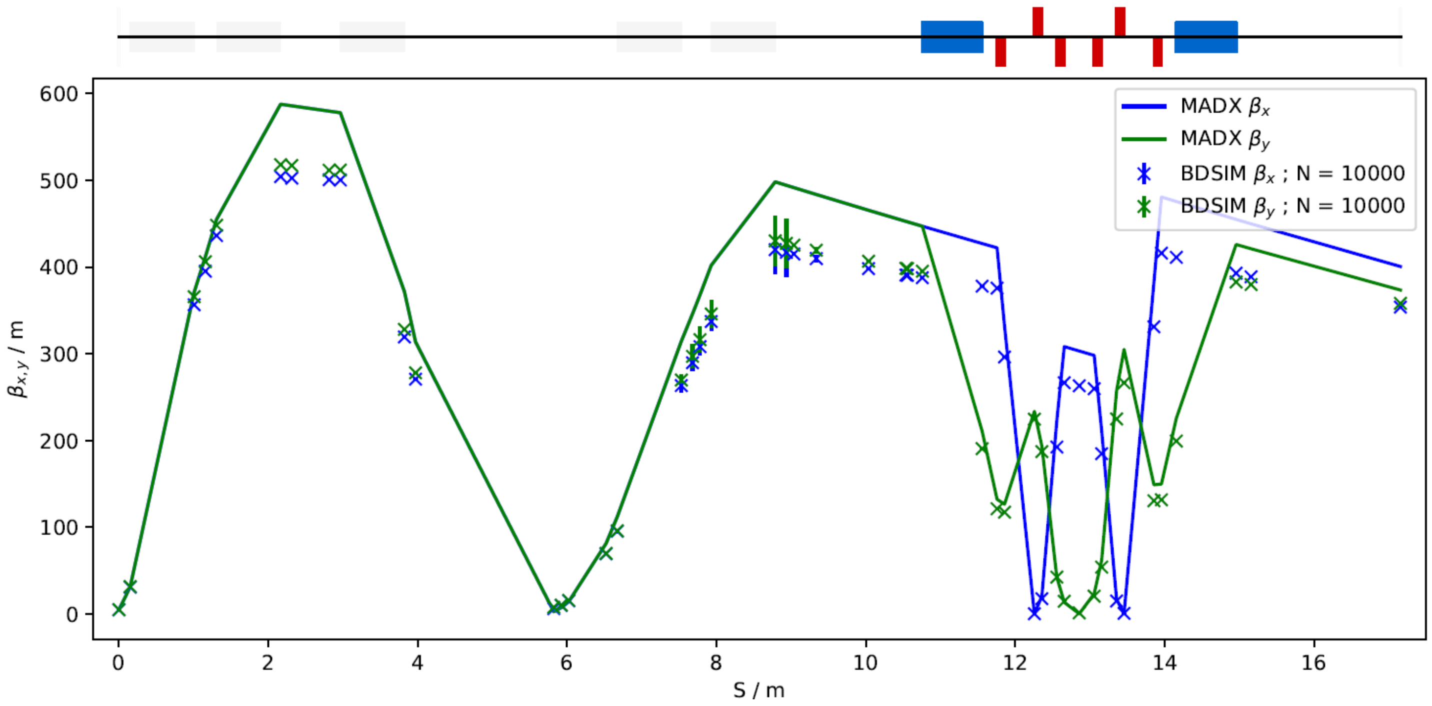
- Ideal E field from:

$$n_{e,max} = \frac{\epsilon_0}{2m_e} B_{GL}^2$$

$$B_{GL} = B_{sol}\sqrt{Z\frac{m_e}{m_{ion}}}$$

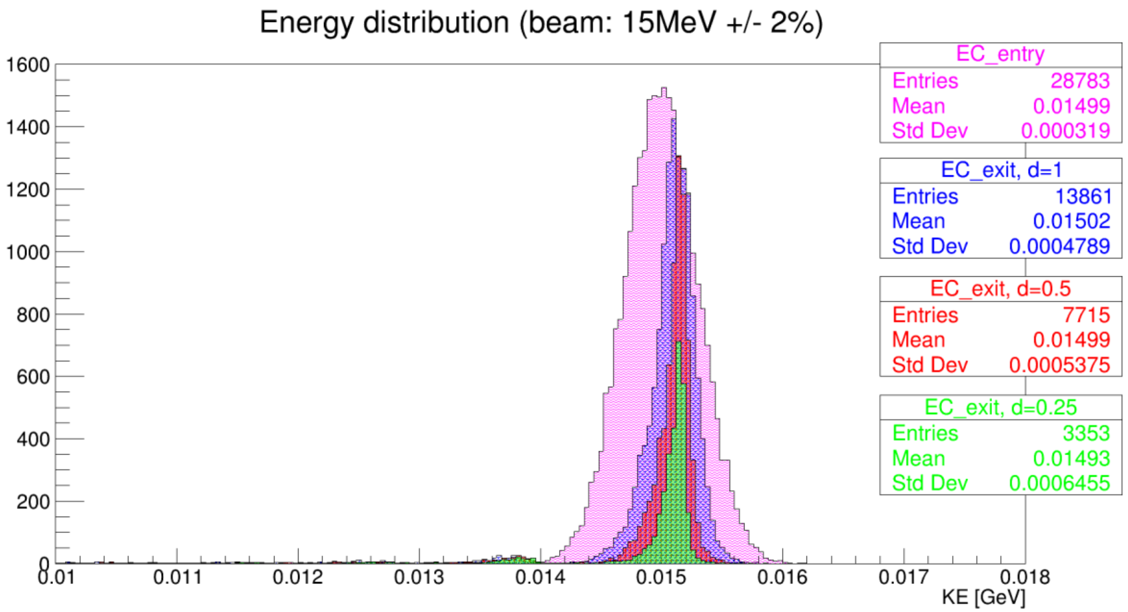
$$E_r = -\frac{en_e}{2\epsilon_0} r$$

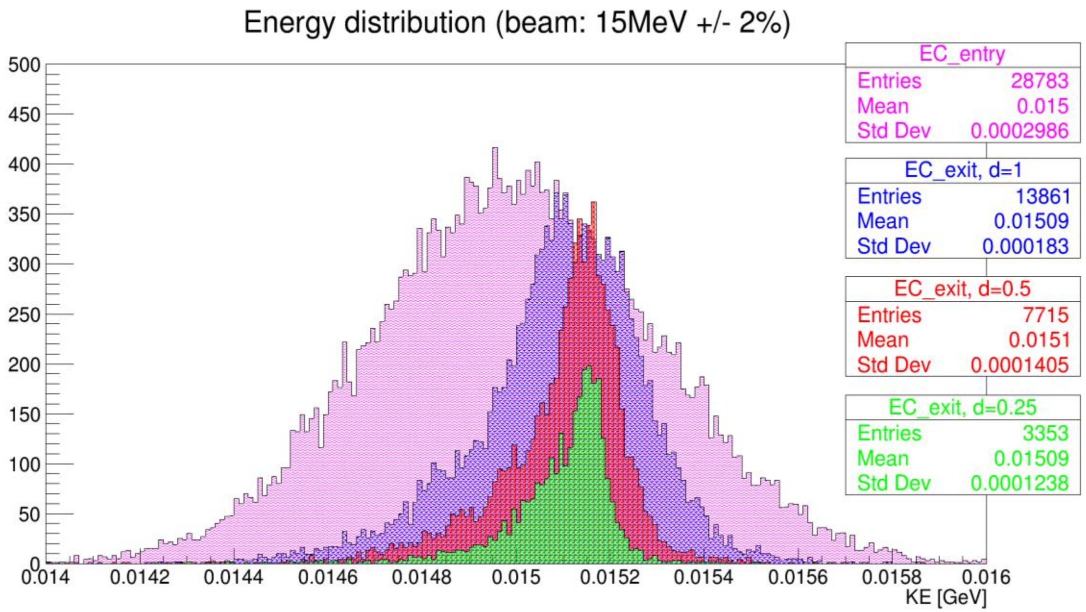
- BDSIM (with field maps) – gives slightly stronger focusing
- MADX (with transfer matrices)



Energy collimation – beam 1 (from Twiss)

- Collimator: circular, L=1cm, aperture d=1mm -> 0.5mm->0.25mm
- Place the collimator at theoretical focal length from 3rd Gabor lens
  - The central energy is slightly higher than 15MeV for the collimated beam



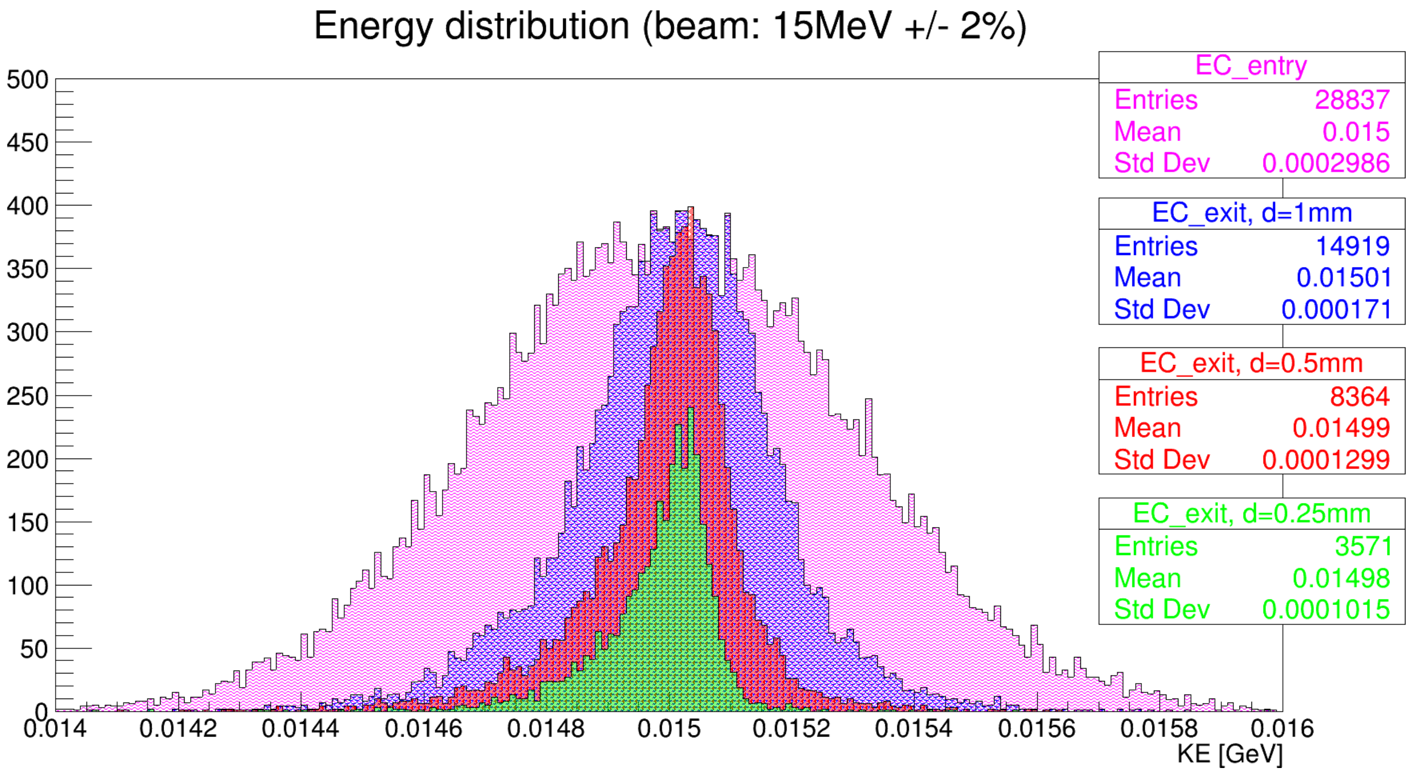


Zoom on peak

$N = 3 \times 10^4$ particles

Energy collimation – beam 1 (from Twiss)

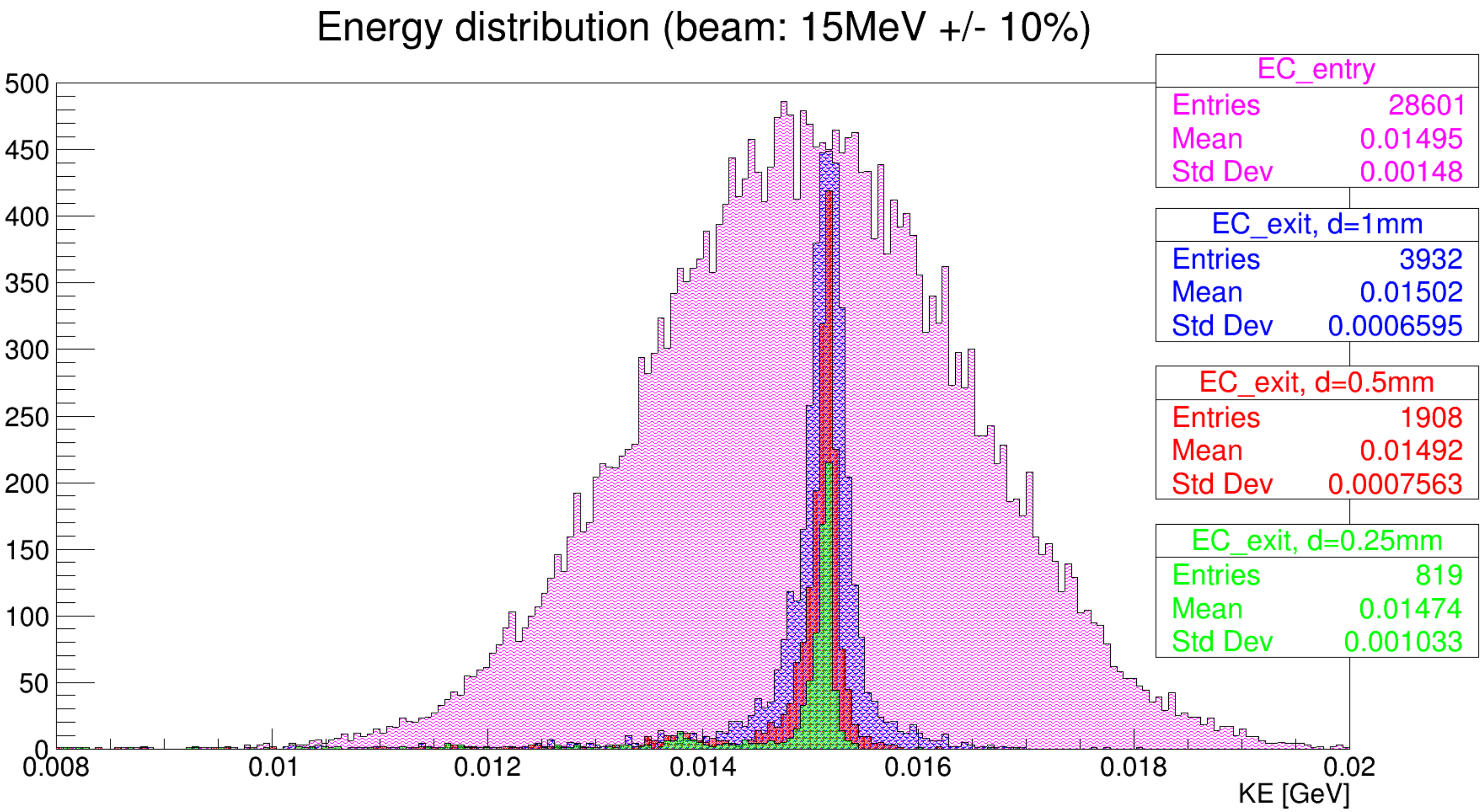
- Introduce an offset of 5cm (towards the 3rd lens)
  - Energy distribution is better centred at 15MeV
  - Also the collimator is placed approx. at the minimum of the beta functions



$N = 3 \times 10^4$ particles

Energy collimation – beam 2 (from Twiss)

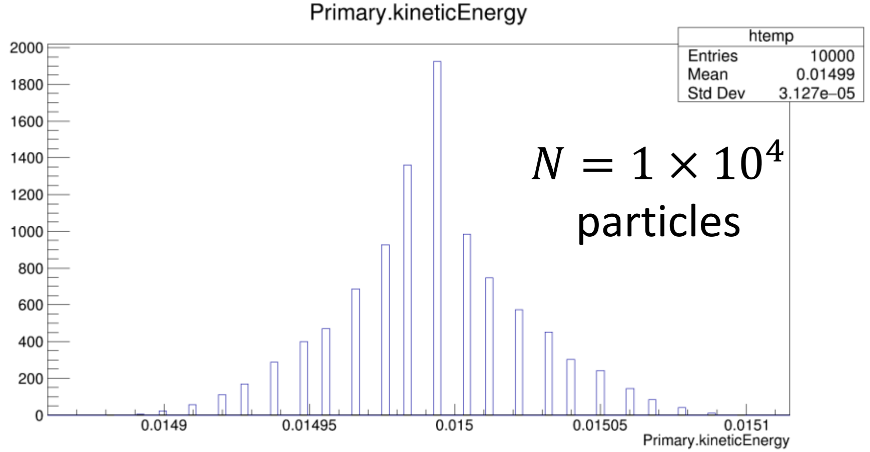
- Increase σ_E to 10%



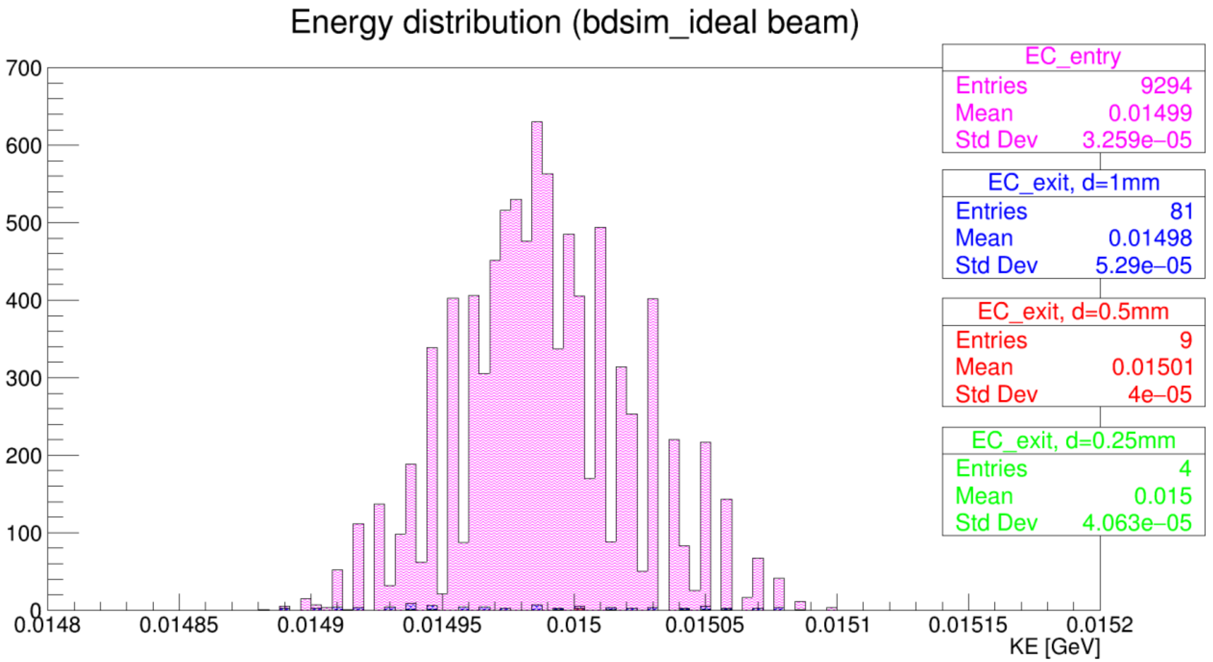
$N = 3 \times 10^4$ particles

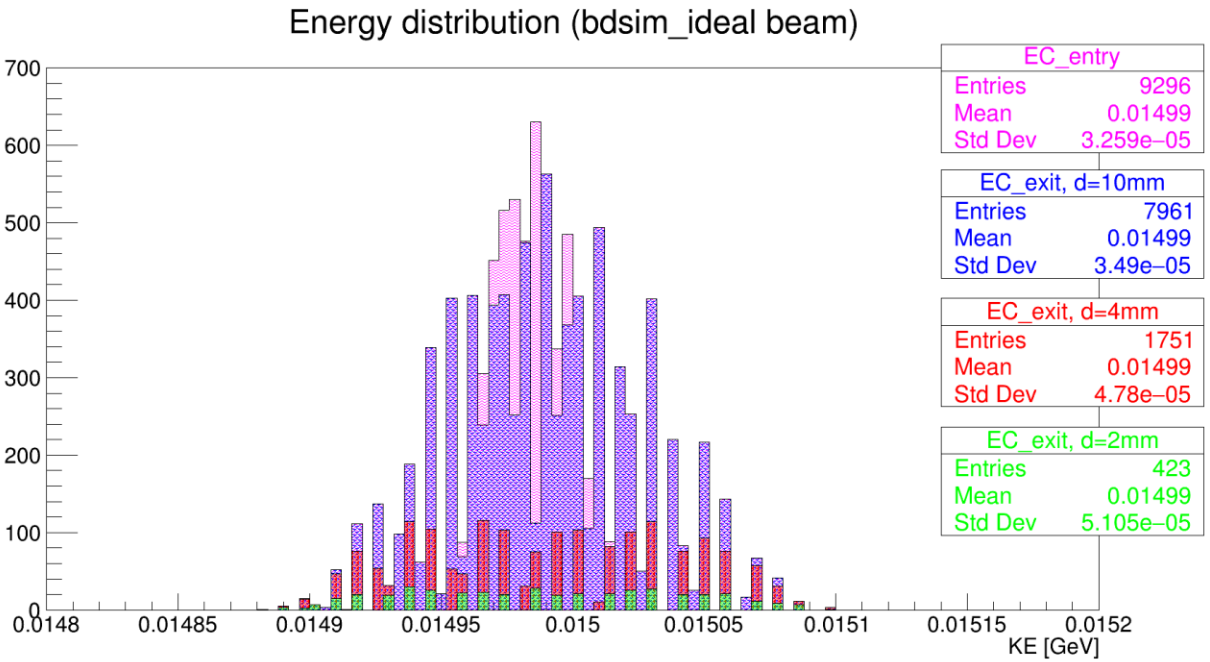
Energy collimation – beam 3 (from file, "Ideal")

- Choose larger diameters to see particles passing through



$N = 1 \times 10^4$ particles





Energy collimation – beam 4 (from file, "Physical")

- 200 particles left after 1st Gabor lens
- Virtually all particles lost up to exit of 2nd lens