

Interaction of particles with matter

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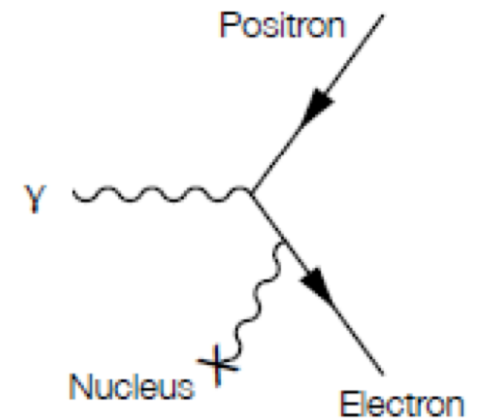
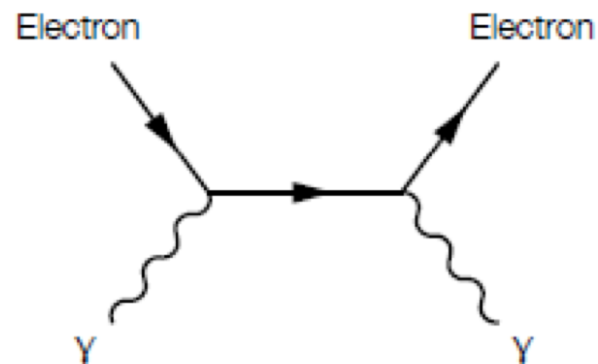
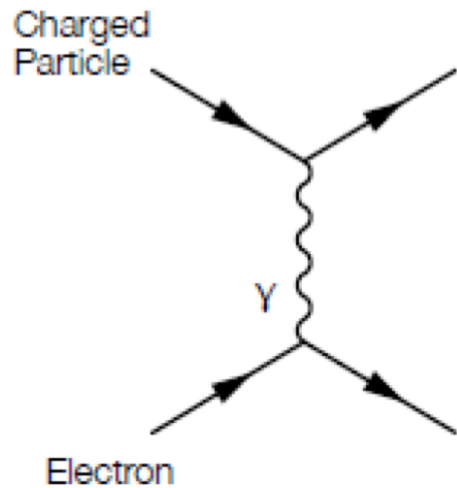
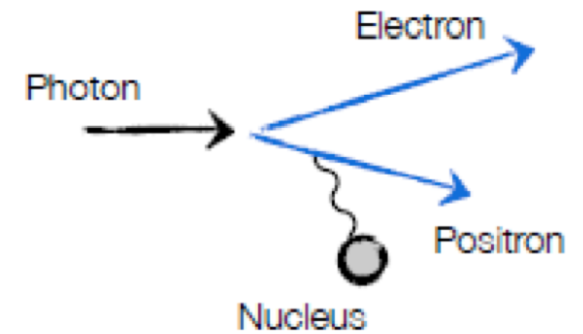
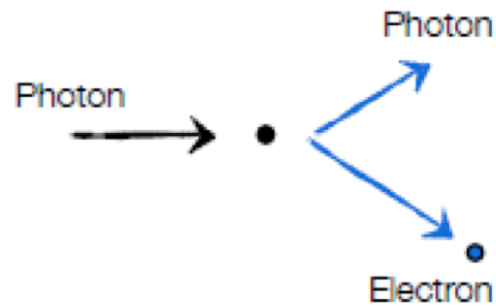
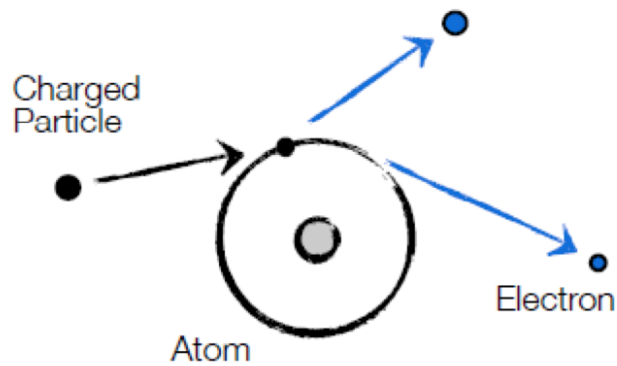
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Interactions with matter - 1

Mechanisms through which a particle interacts with the material it traverses, in a detector:

- **Charged particles:**
 - Ionization
 - Bremsstrahlung
 - Cherenkov radiation
 - Transition radiation
- **Hadrons:** nuclear interactions
- **Photons:**
 - Photo effect
 - Compton effect
 - Pair production
- **Neutrinos:** weak interaction

Interactions with matter - 2

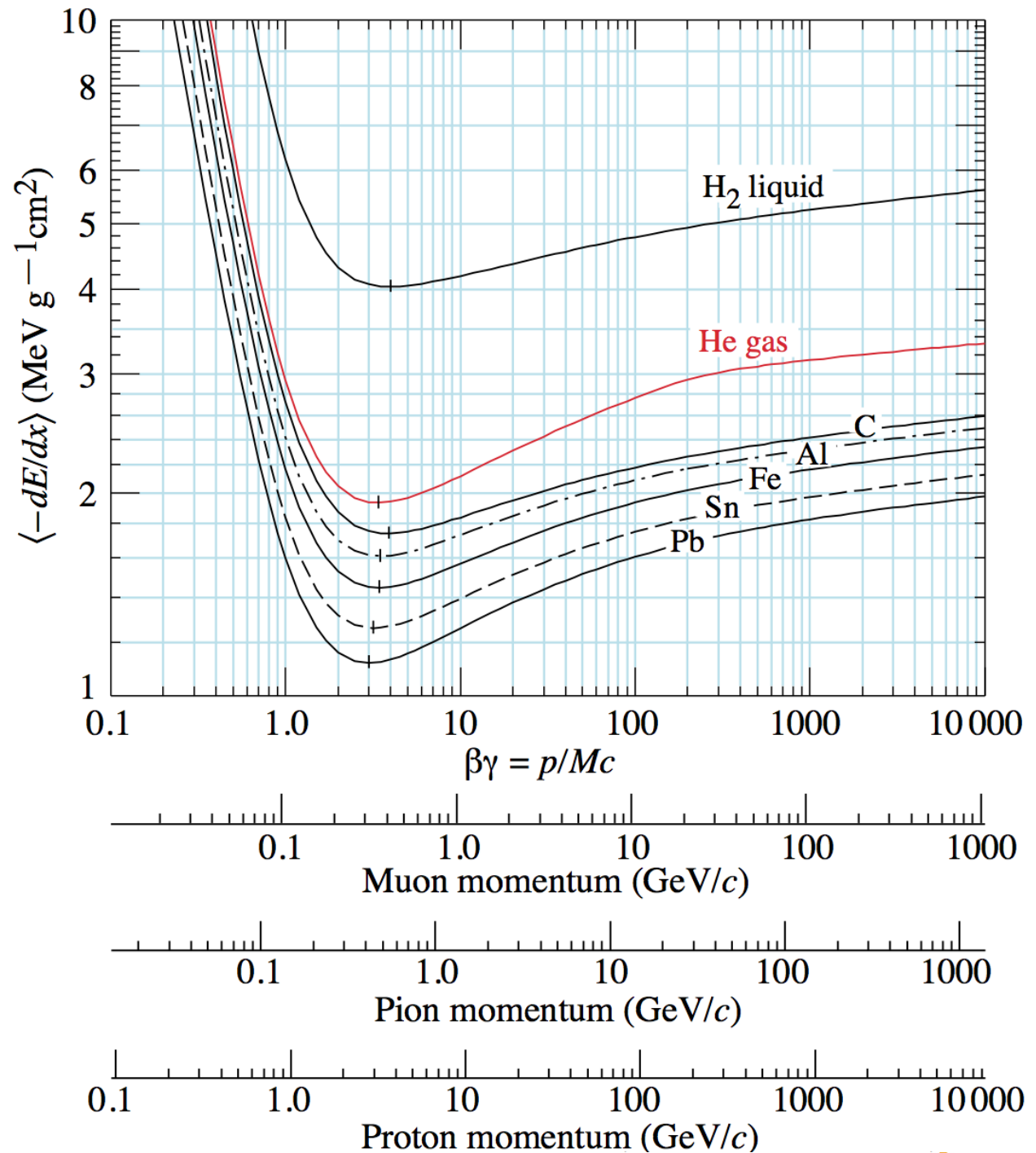


dE/dx

Particle Data Group:
pdg.lbl.gov/2015/reviews/rp2015-rev-passage-particles-matter.pdf

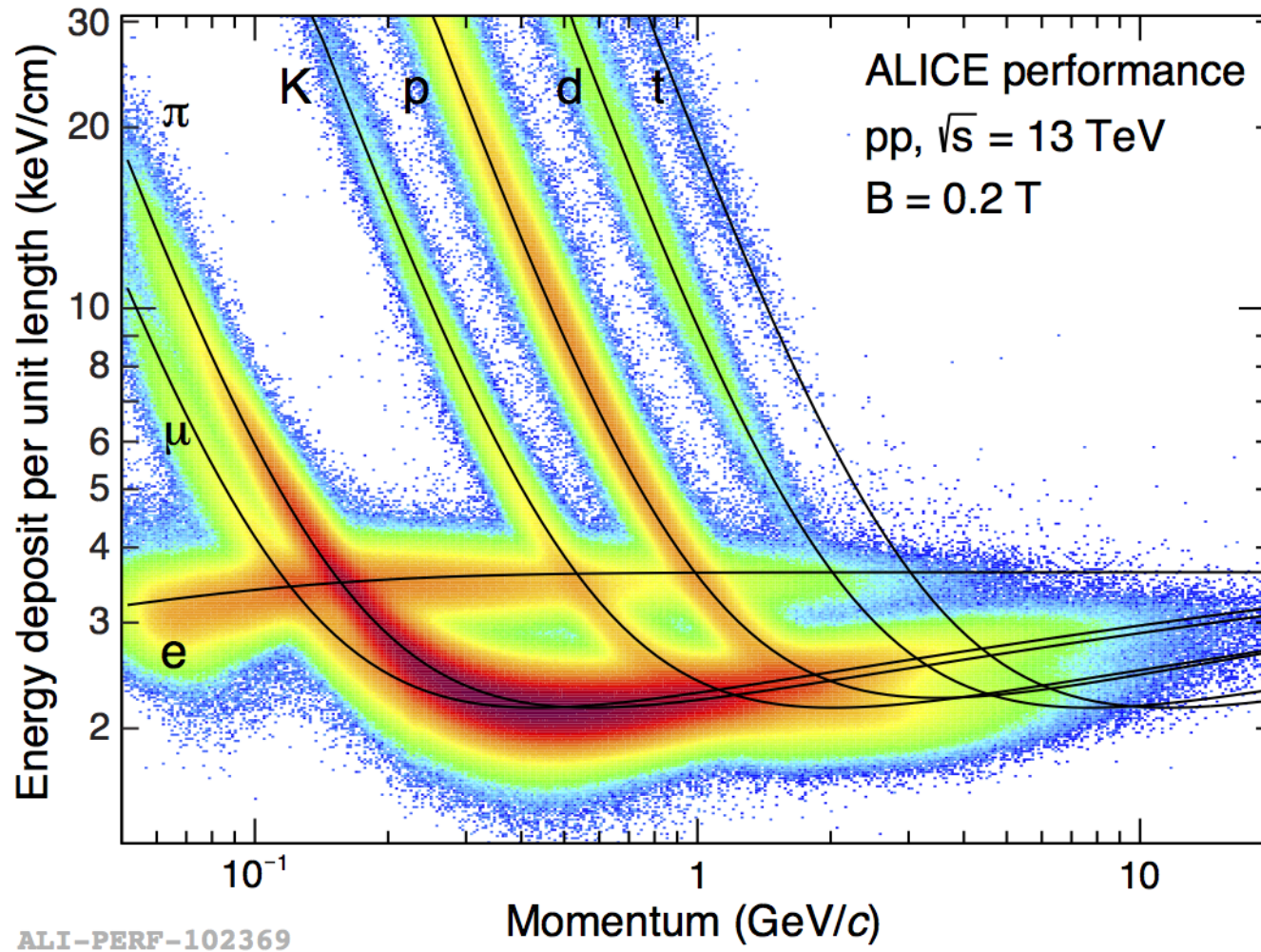
dE/dx depends on
 $\beta\gamma = p/(mc)$

→ at a given p , dE/dx is
different for particles
with different mass



dE/dx used in practice

the ALICE Time Projection Chamber



ALICE: A Large Ion Collider Experiment

Central barrel
 $|\eta| < 0.9$
L3 magnet: 0.5 T

Inner Tracking System

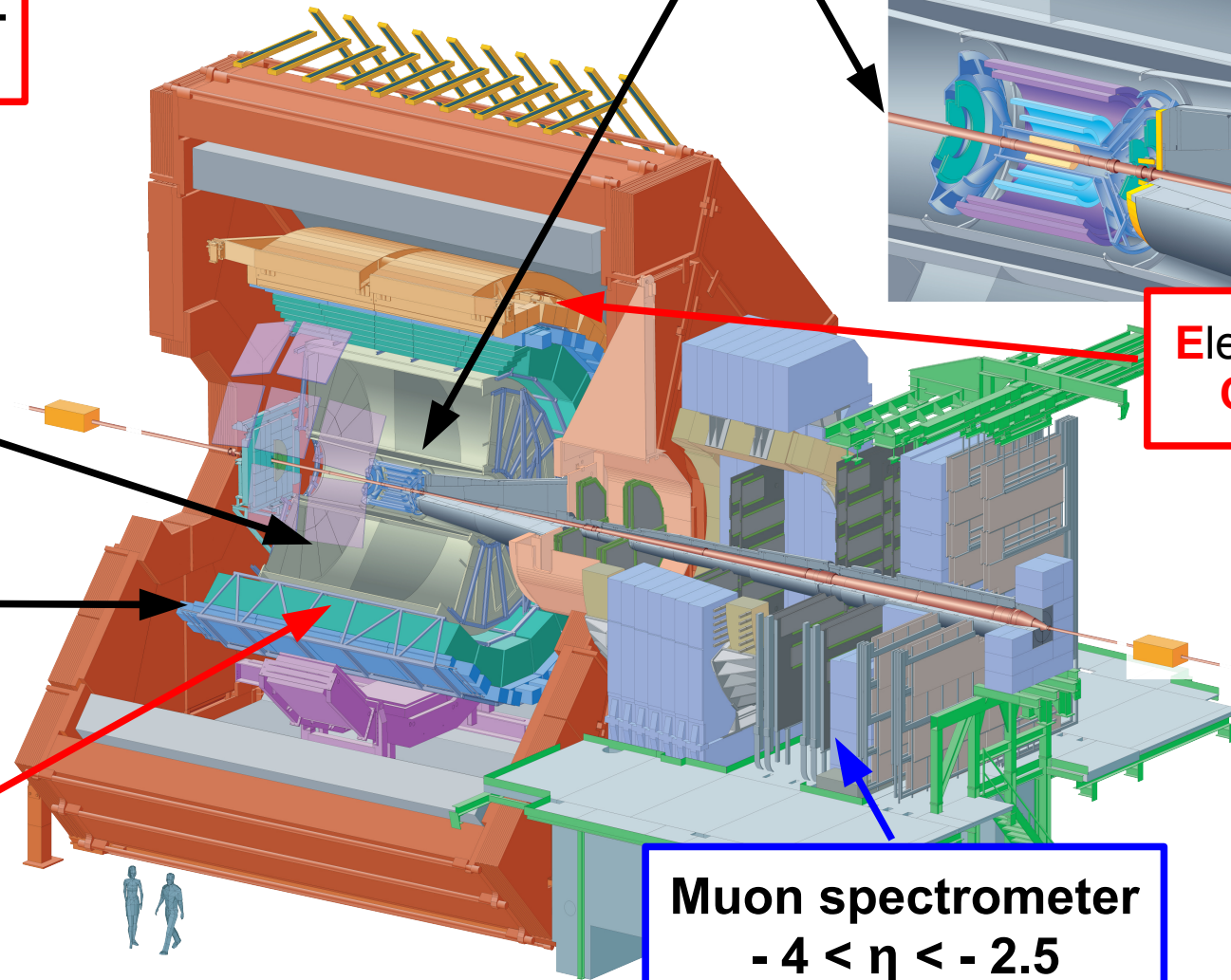
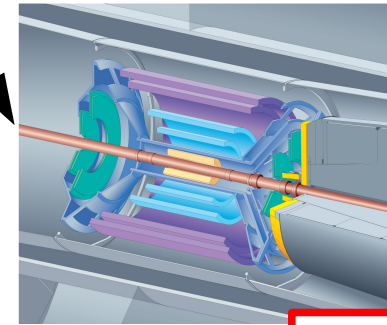
Time Projection Chamber

Time of Flight

Transition Radiation Detector

Electromagnetic Calorimeter

Muon spectrometer
 $-4 < \eta < -2.5$



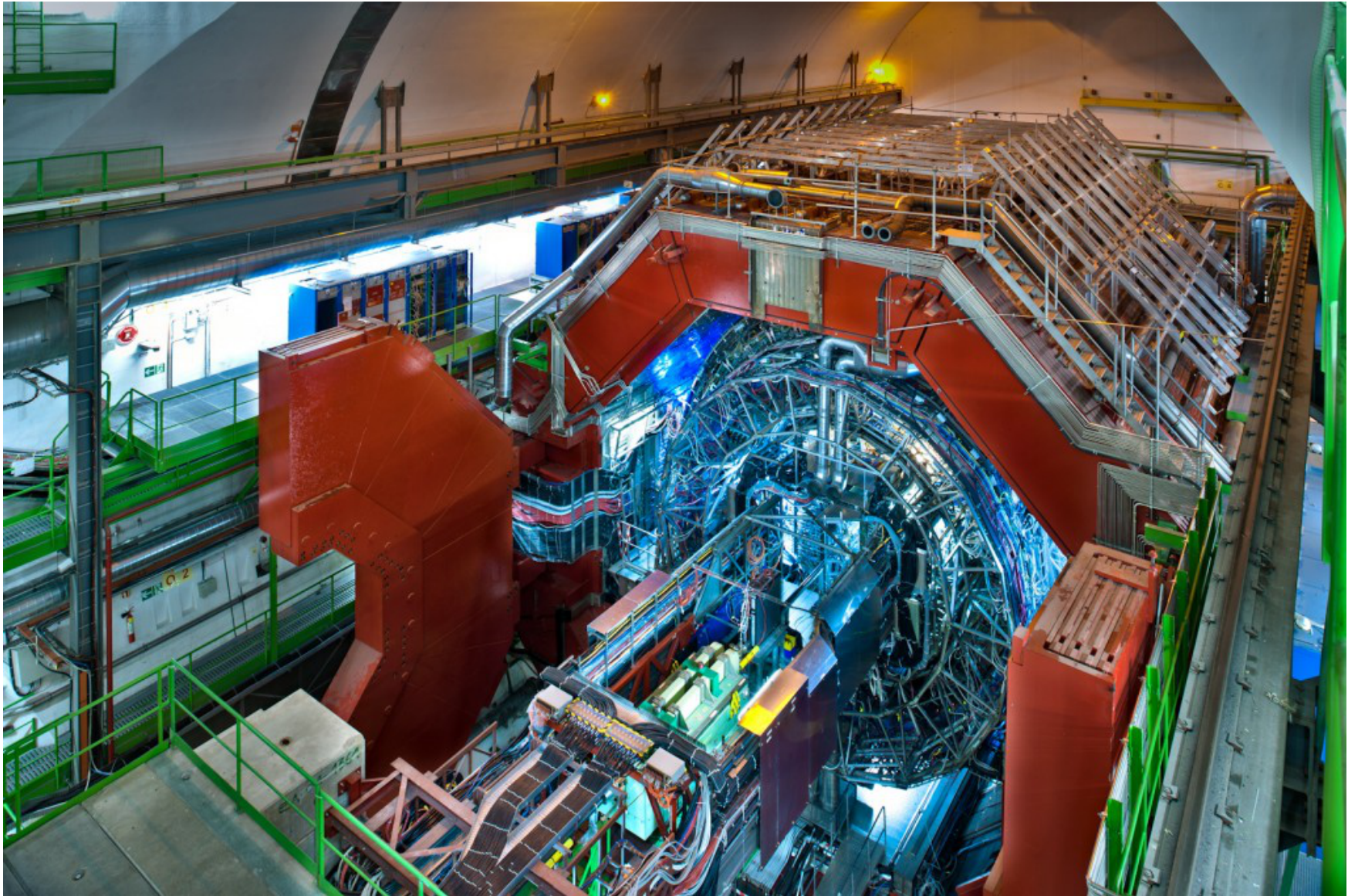
ALICE TPC



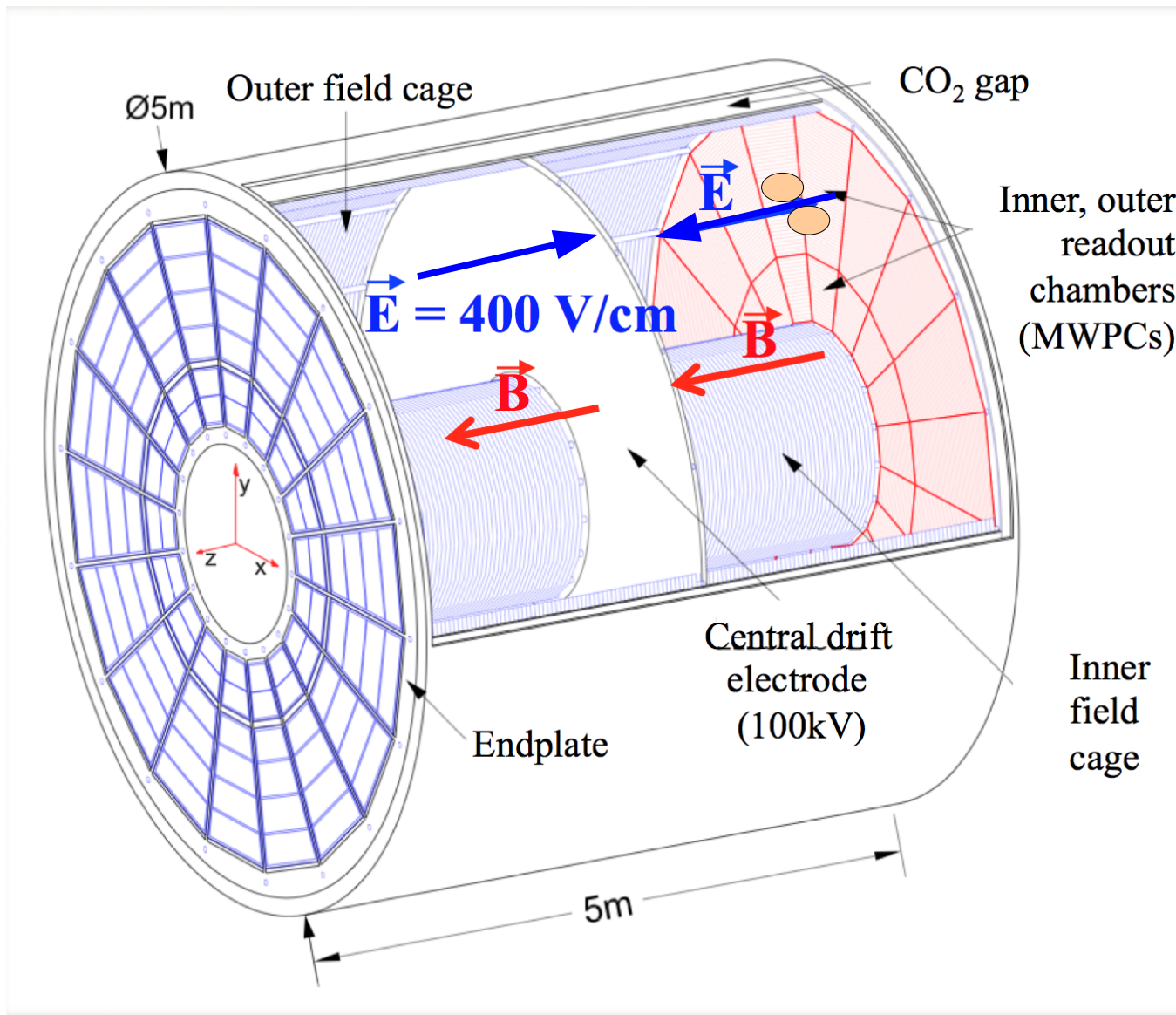
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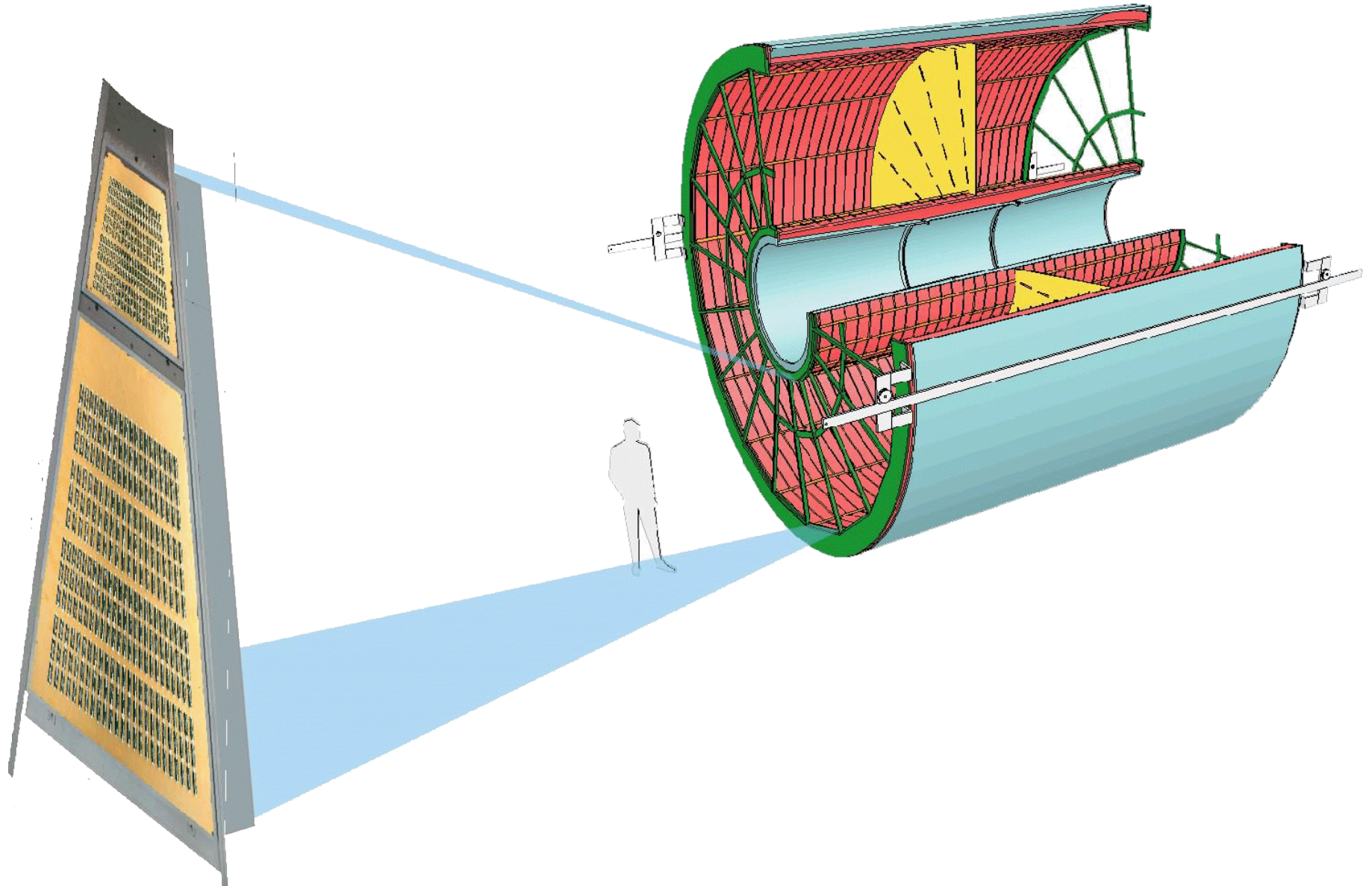
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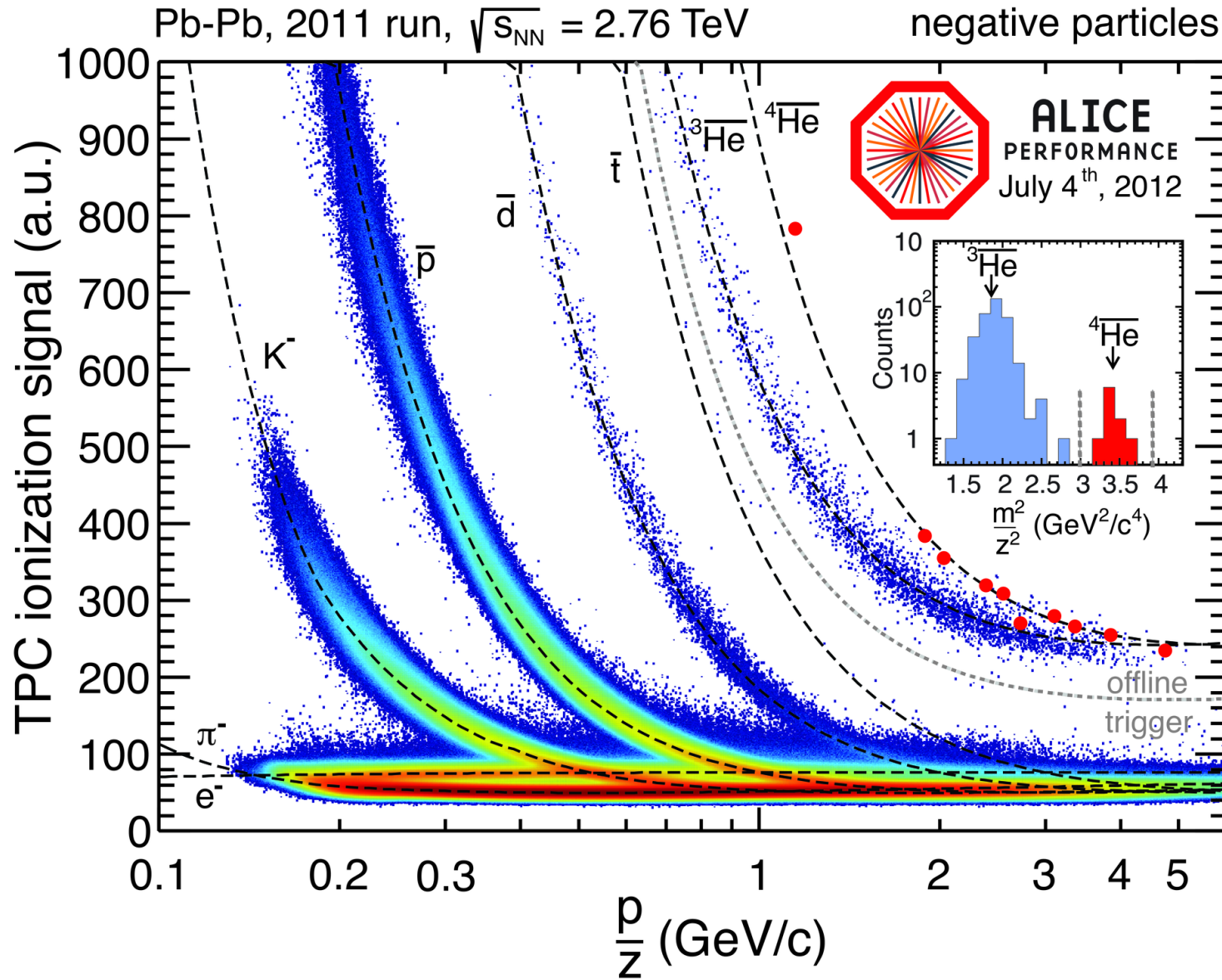
ALICE TPC



ALICE TPC



Measuring the heaviest anti-particles



ALI-PERF-36713

Bragg peak

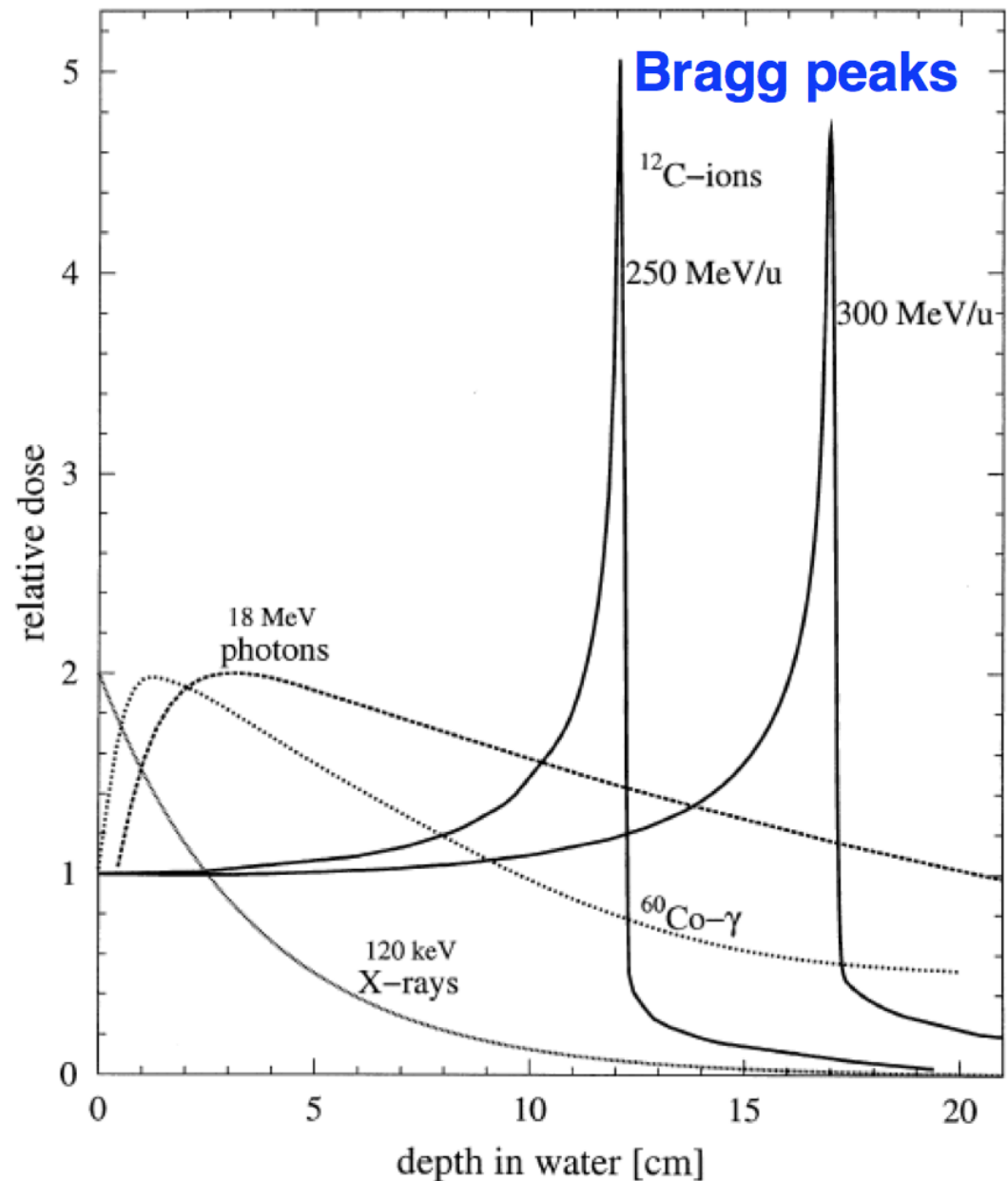
$\beta\gamma > 3.5$:

$$\left\langle \frac{dE}{dx} \right\rangle \approx \left. \frac{dE}{dx} \right|_{\min}$$

$\beta\gamma < 3.5$:

$$\left\langle \frac{dE}{dx} \right\rangle \gg \left. \frac{dE}{dx} \right|_{\min}$$

- **application:
tumor therapy**
- **possibility to
deposit a dose at a
well defined depth
by variation of the
beam energy**



Heidelberg Ion-beam Therapy Center (HIT)

