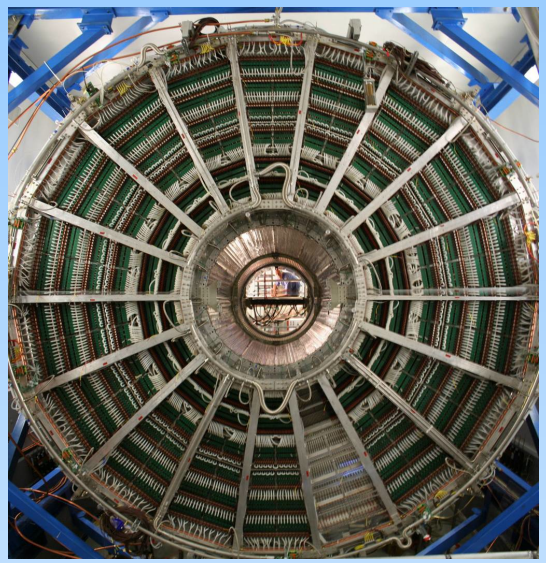

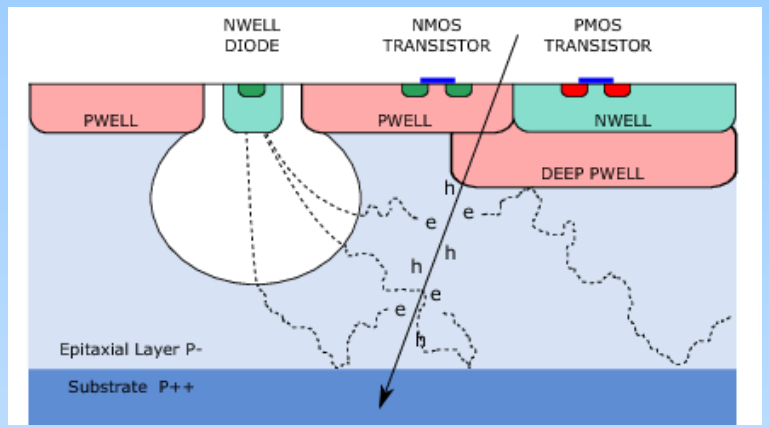

Interaction of particles with matter - 2

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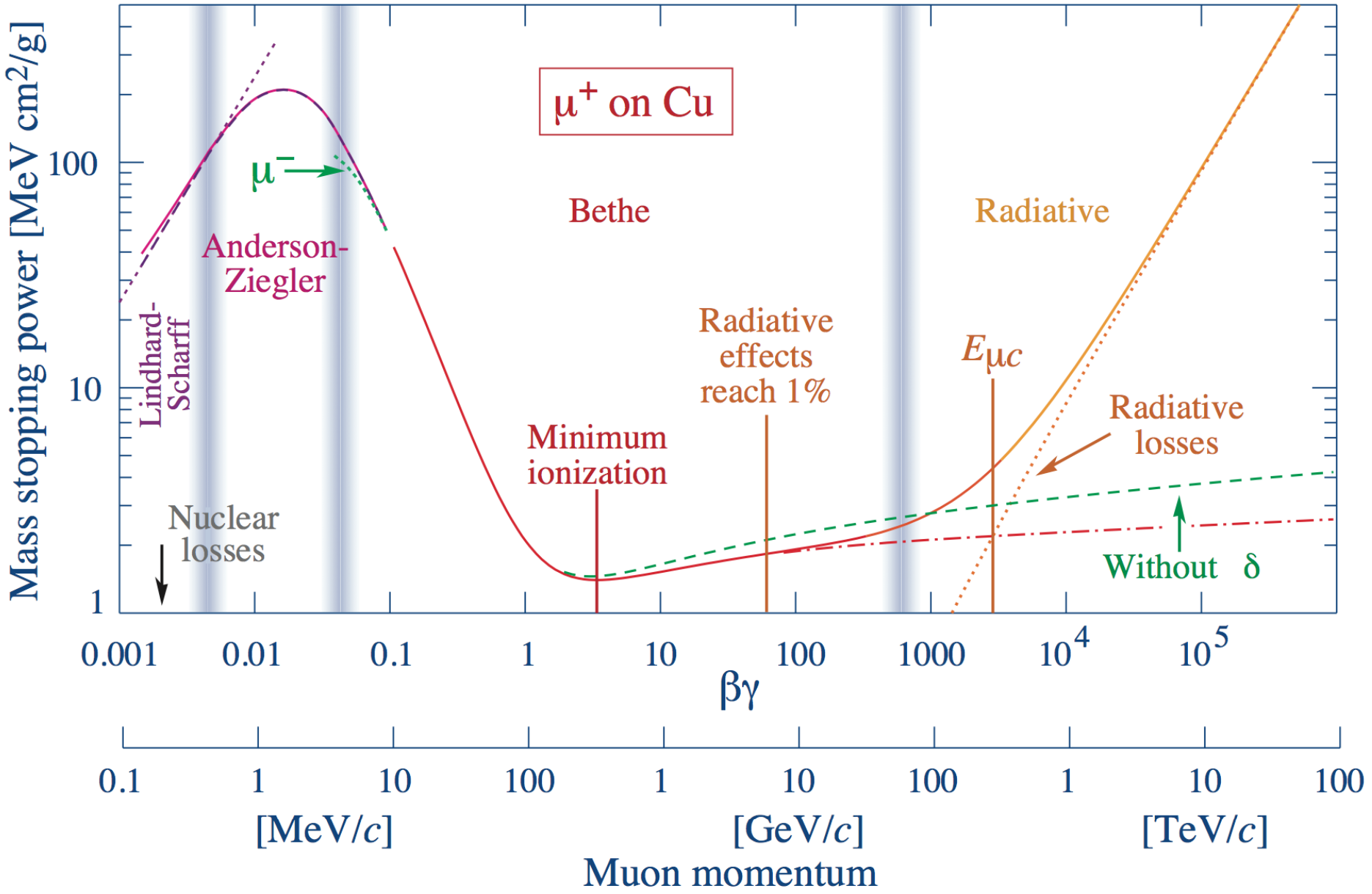
Interactions with matter

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

dE/dx for muons



dE/dx and Bethe-Bloch

- Range of validity:

  $0.05 < \beta\gamma < 500$
- Muons above: muon Bremsstrahlung becomes relevant → radiative losses

  → muon critical energy $E_{\mu c}$

- $\beta\gamma < 0.05$:
  - Bethe-Bloch no longer valid because based on the assumption that the electrons of the atoms of the detector are stationary wrt the incident particle
  - There are only phenomenological fitting models describing the behavior
  - Incident particle can pick up electrons for part of the time → lower effective charge
  - For protons below several hundred eV, non-ionizing nuclear recoil energy loss dominates