

## Vorlesung:

# Teilchenphysik I (Particle Physics I)

## Summary 03: Interactions of particles with matter

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# Summary: passage of particles through matter

## ■ Charged Particles:

- ionization along trace in matter → free charges  
→ visible light from de-excitation  
falling  $\sim \beta^2$  below minimum at  $\beta\gamma \approx 4$ , slow rise above,
- Bremsstrahlung dominant process for  $E > E_{\text{crit}}$ , relevant scale radiation length  $X_0$
- multiple scattering limits position resolution
- Cherenkov light: above threshold  $\beta > 1/n$ , cherenkov cone  $\cos(\varphi) = 1/(\beta n)$
- transition radiation proportional to  $\gamma$

## ■ Photons:

- photo effect dominant below 0.1 MeV
- Compton effect dominant between 0.1 and 1 MeV
- pair production dominant above 1 MeV, relevant scale  $9/7 X_0$

## ■ hadrons

- hadronic interactions with nucleons produce mostly pions and photons from decay of neutral pions, scale is the hadronic interaction length  $\lambda_{\text{int}}$

Interplay of photon radiation and pair production leads to electromagnetic shower  
hadronic shower from hadron; satellites due to neutral hadrons,  
electromagnetic component from  $\pi^0$  decays