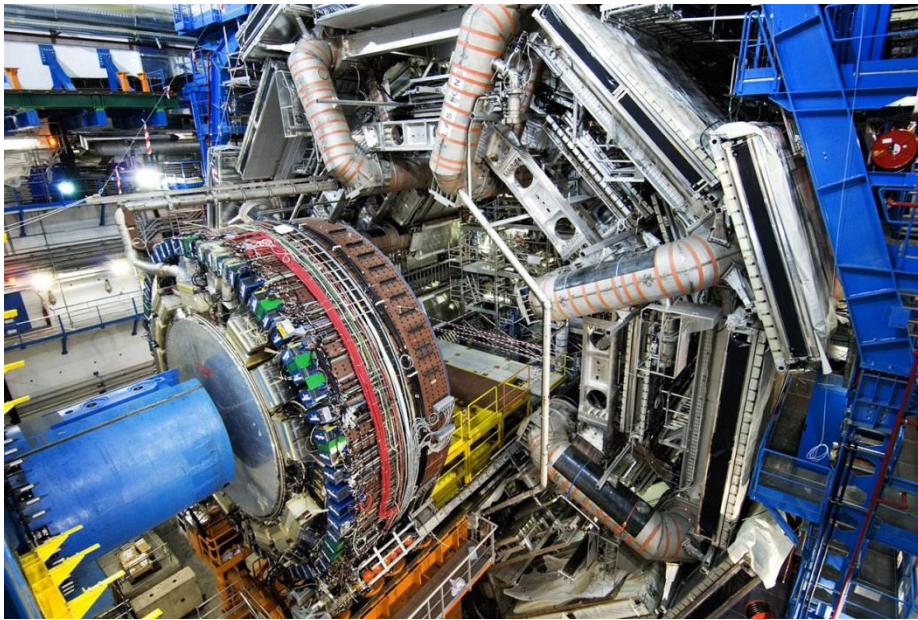


# Mesurer l'infiniment petit et observer l'infiniment grand

stefano.panebianco@cea.fr



Détecteur ATLAS - CERN



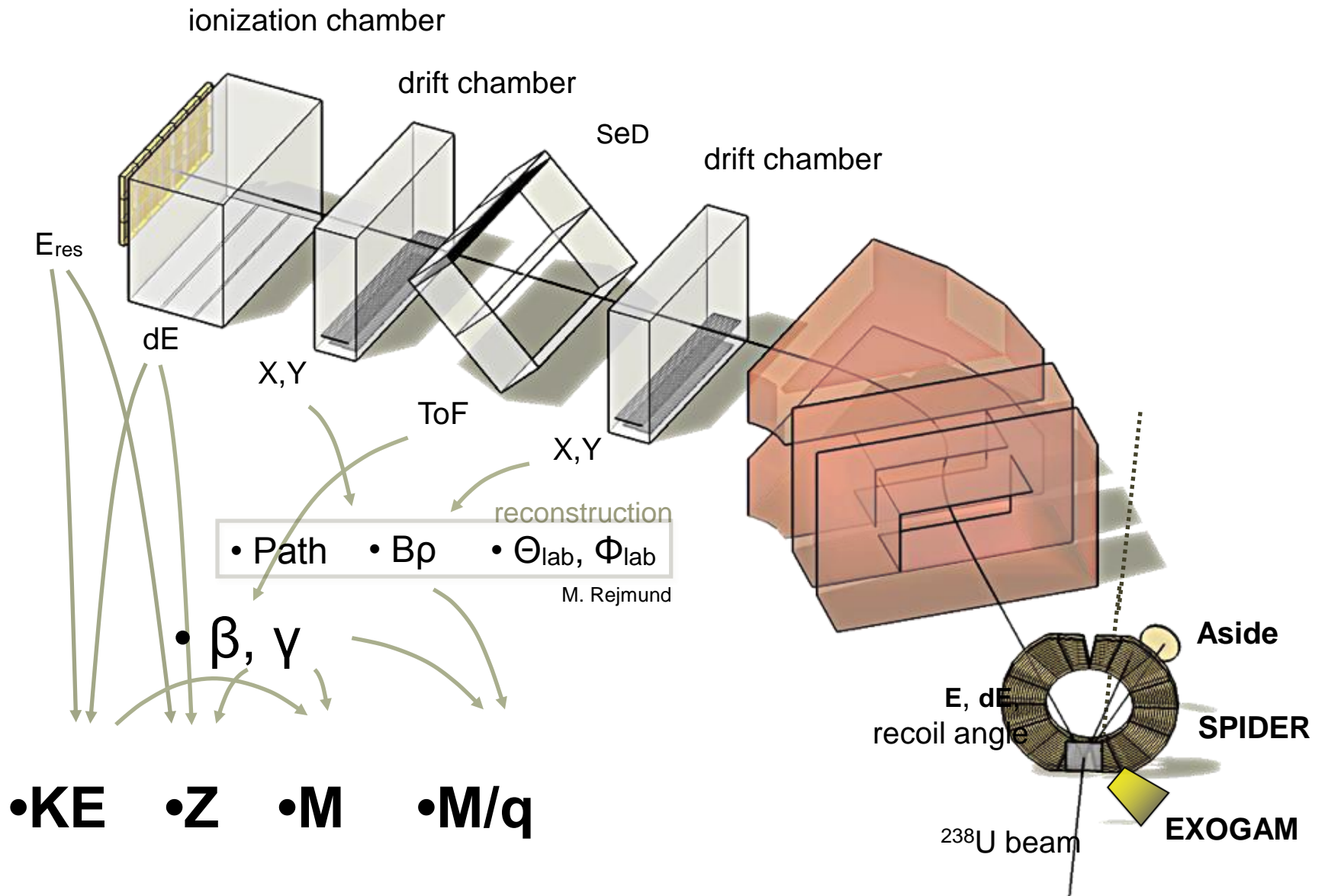
Détecteur GRD- KAGUYA

# Plan des cours

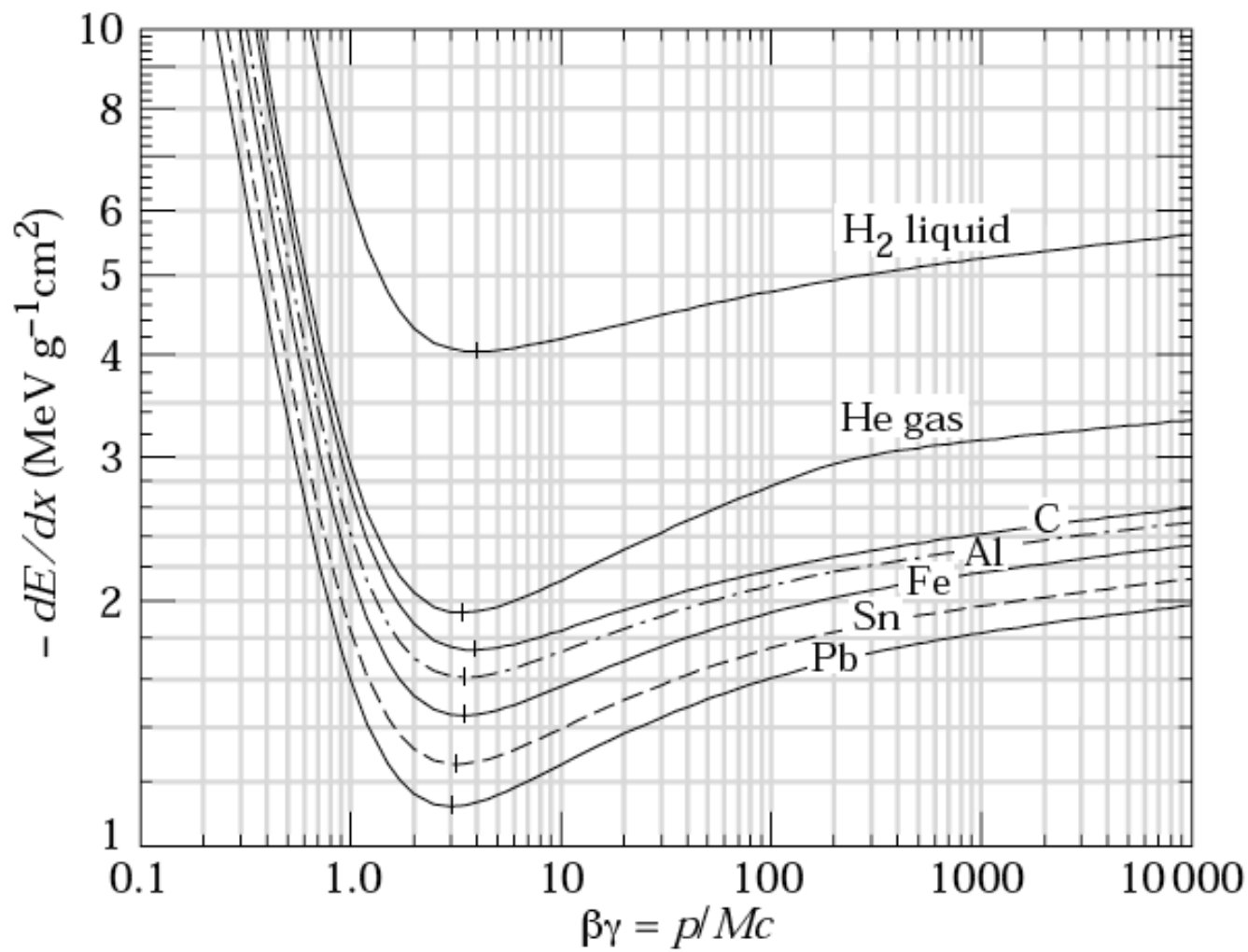
- 1<sup>er</sup> cours
  - Comment mesurer des particules subatomiques?
  - Comment ces particules interagissent-elles avec la matière?
- 2<sup>ème</sup> cours
  - Les détecteurs à ionisation
    - Les détecteurs gazeux
    - Les détecteurs semi-conducteurs
- 3<sup>ème</sup> cours
  - Les détecteurs à scintillation
  - L'électronique de lecture

# Plan des cours

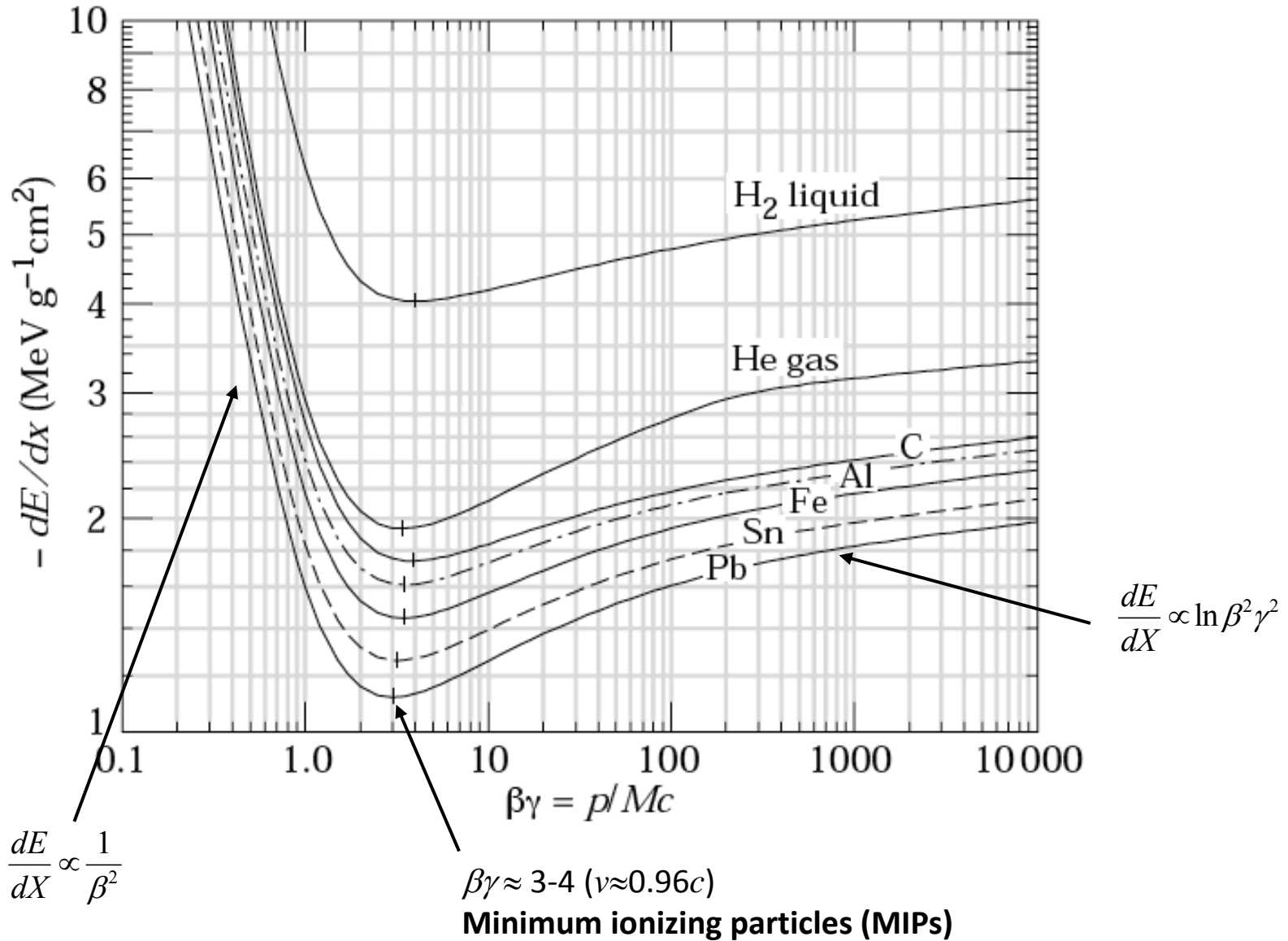
- 1<sup>er</sup> cours
  - Comment mesurer des particules subatomiques?
  - Comment ces particules interagissent-elles avec la matière?
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  - Les détecteurs à ionisation
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    - Les détecteurs semi-conducteurs
- 3<sup>ème</sup> cours
  - Les détecteurs à scintillation
  - L'électronique de lecture

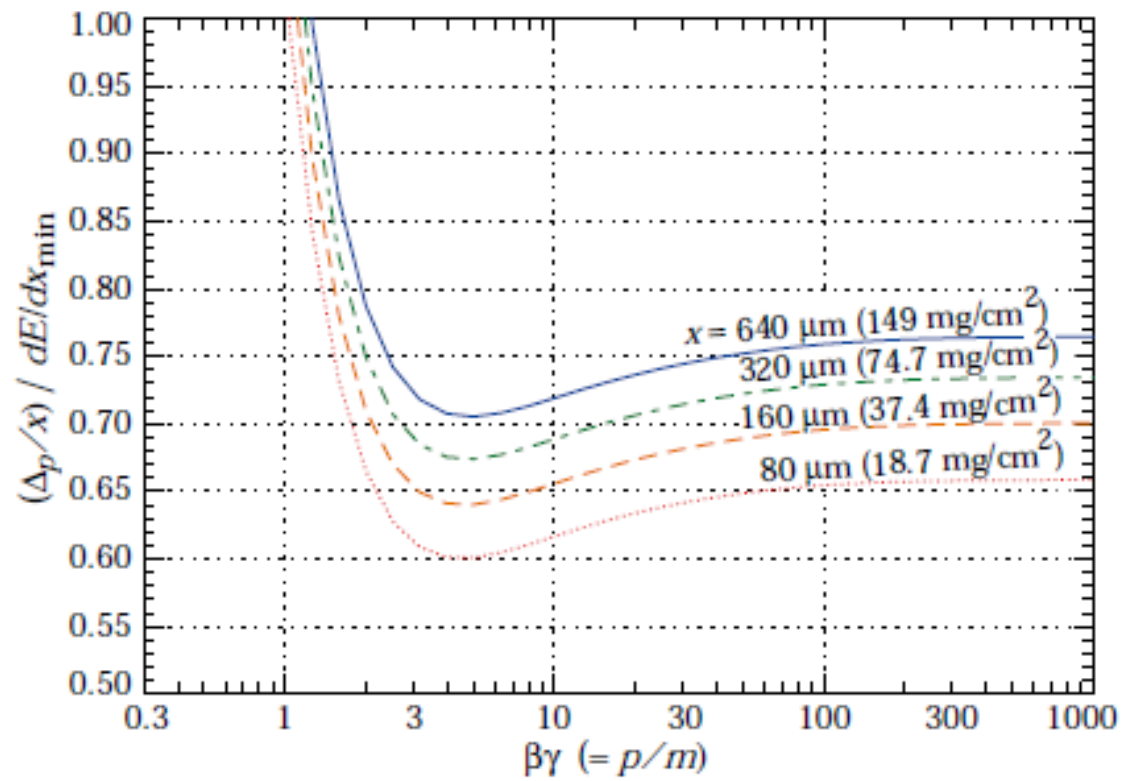


# Interaction des particules chargées

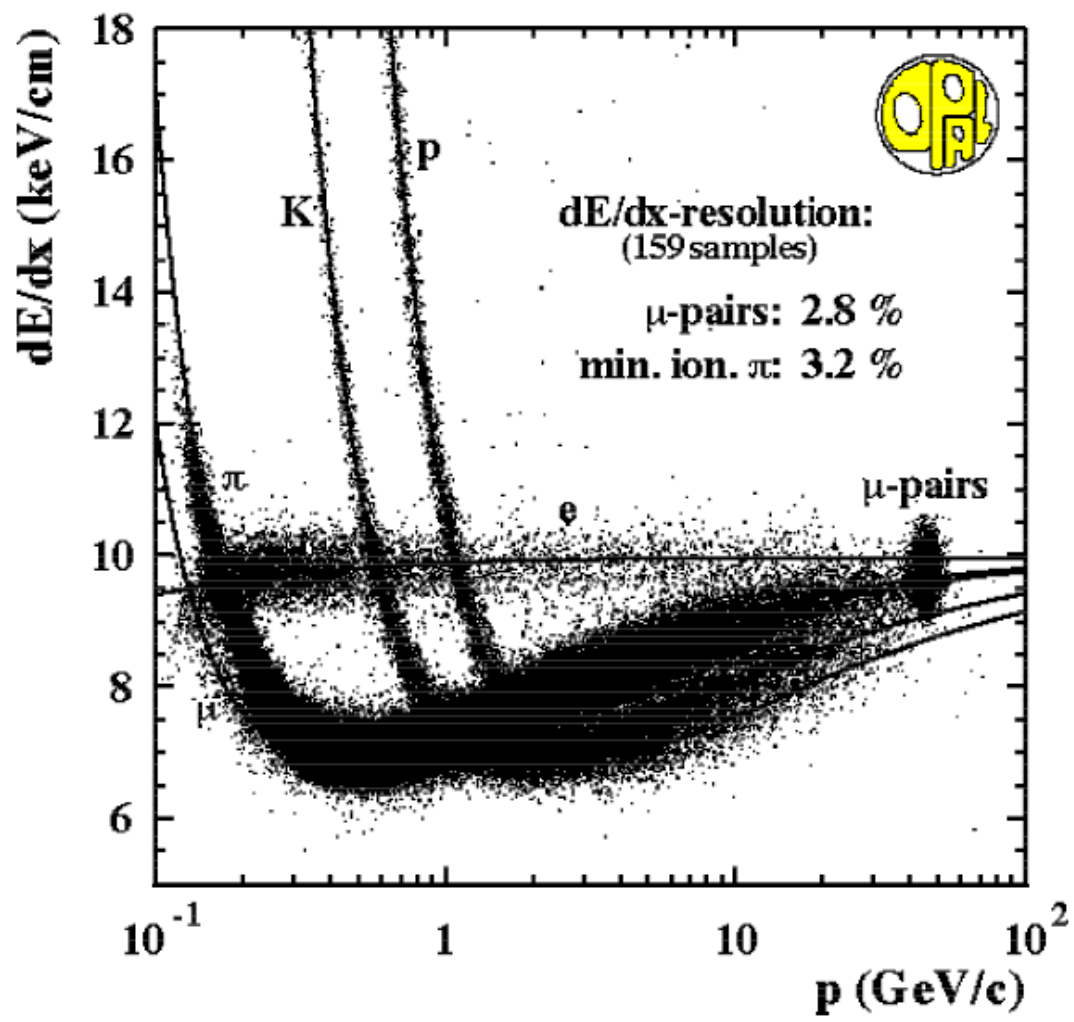


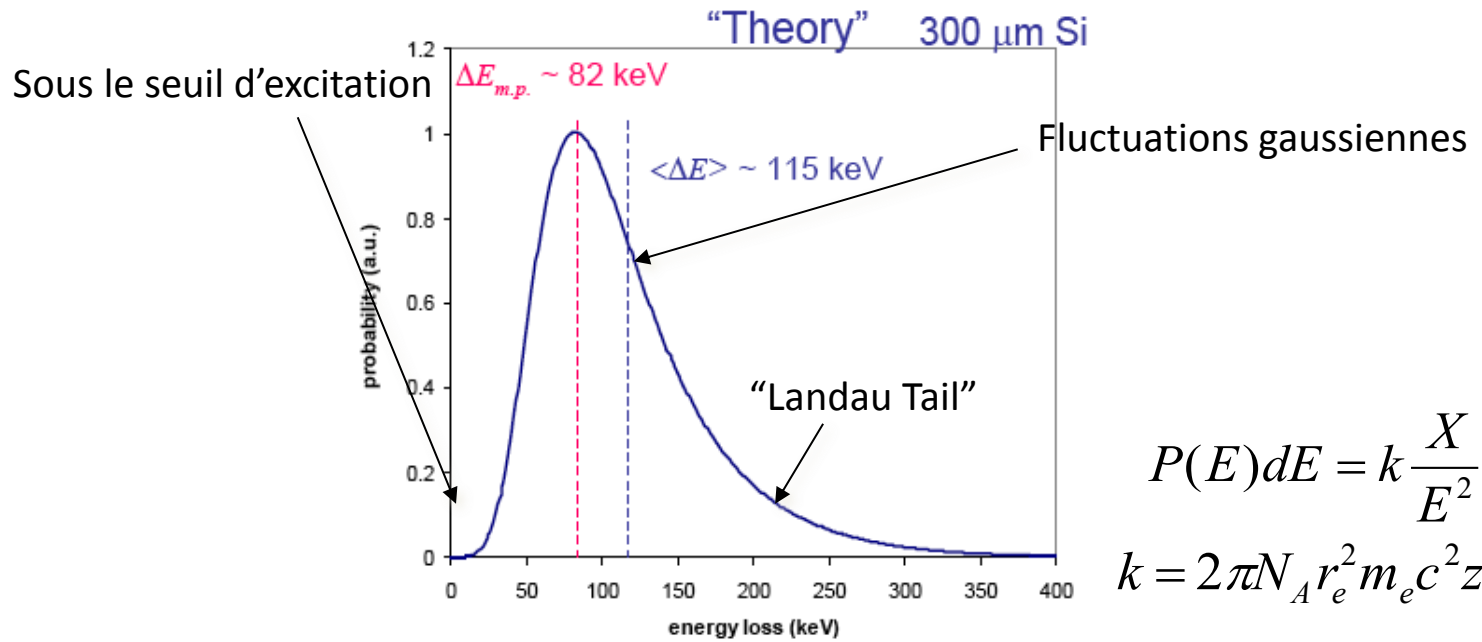
$$-\frac{dE}{dX} = 4\pi N_A r_e^2 m_e c^2 z^2 \frac{Z}{A} \rho \frac{1}{\beta^2} \left[ \frac{1}{2} \ln \frac{2m_e c^2 \gamma^2 \beta^2 T_{\max}}{I^2} - \beta^2 - \frac{\delta}{2} - \frac{C}{Z} \right]$$





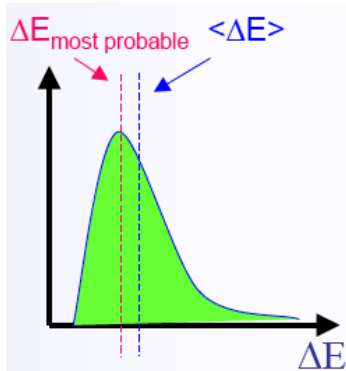




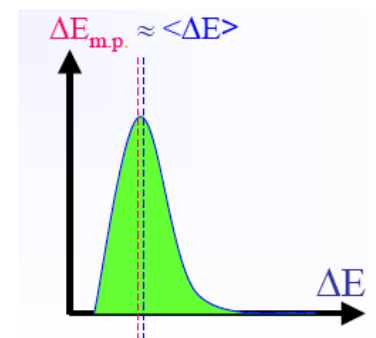


$$P(E)dE = k \frac{X}{E^2} dE$$

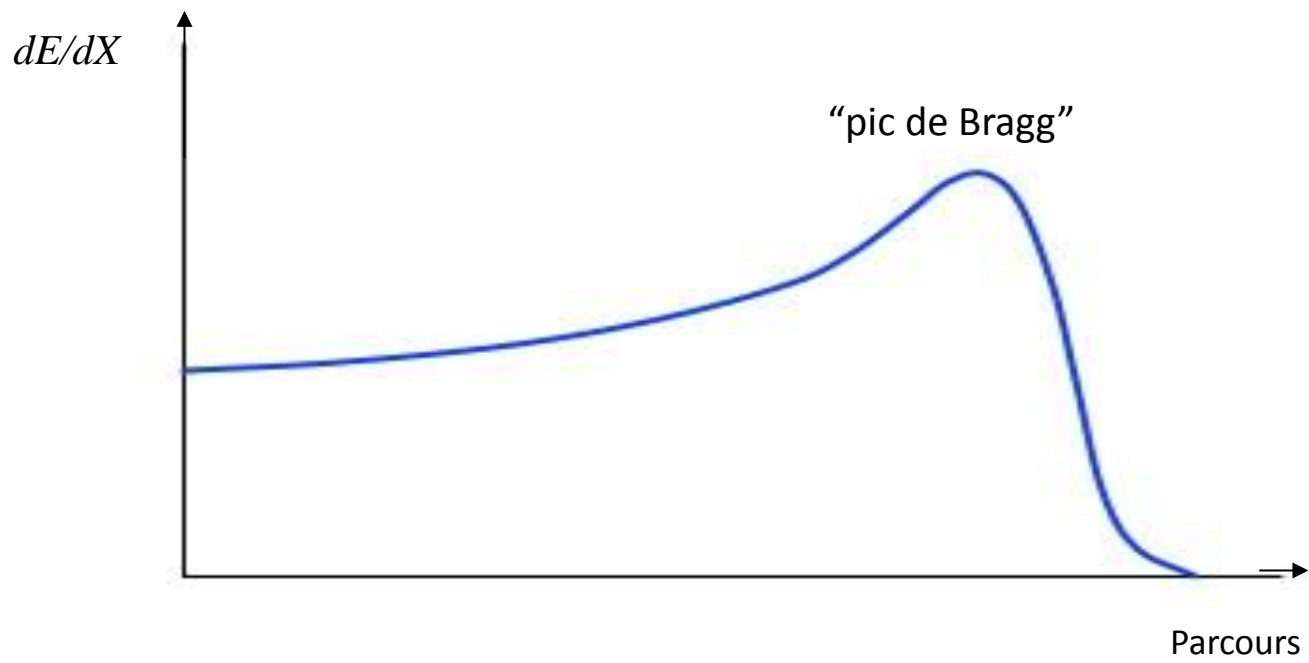
$$k = 2\pi N_A r_e^2 m_e c^2 z^2 \frac{Z}{A} \frac{1}{\beta^2}$$

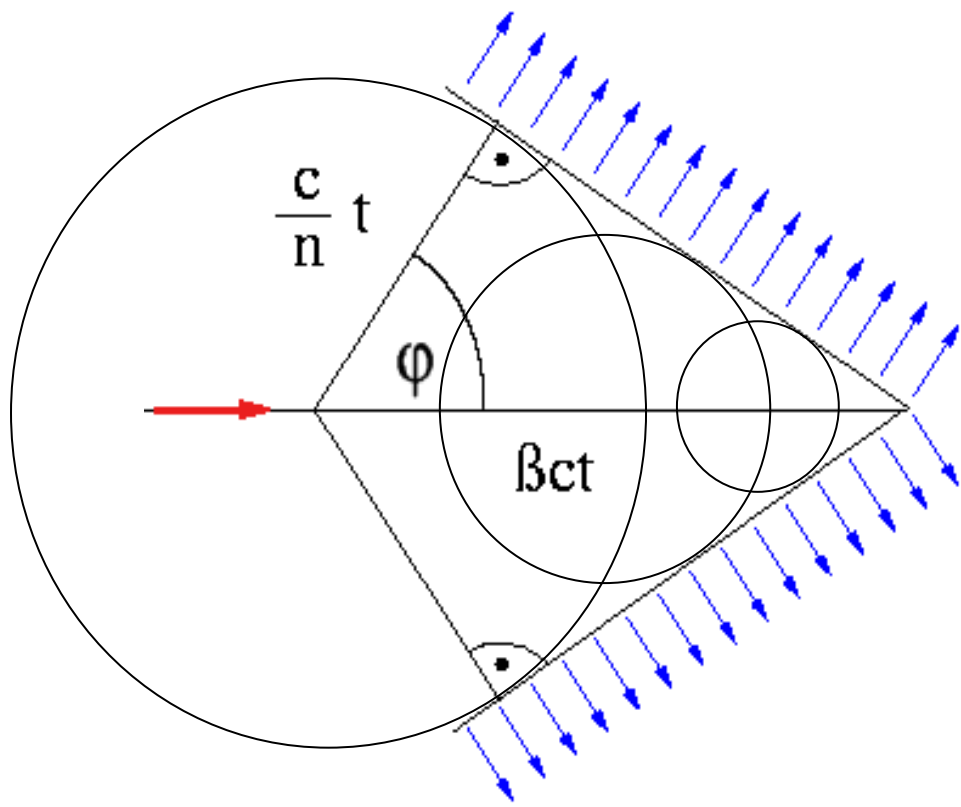


Matériau fin



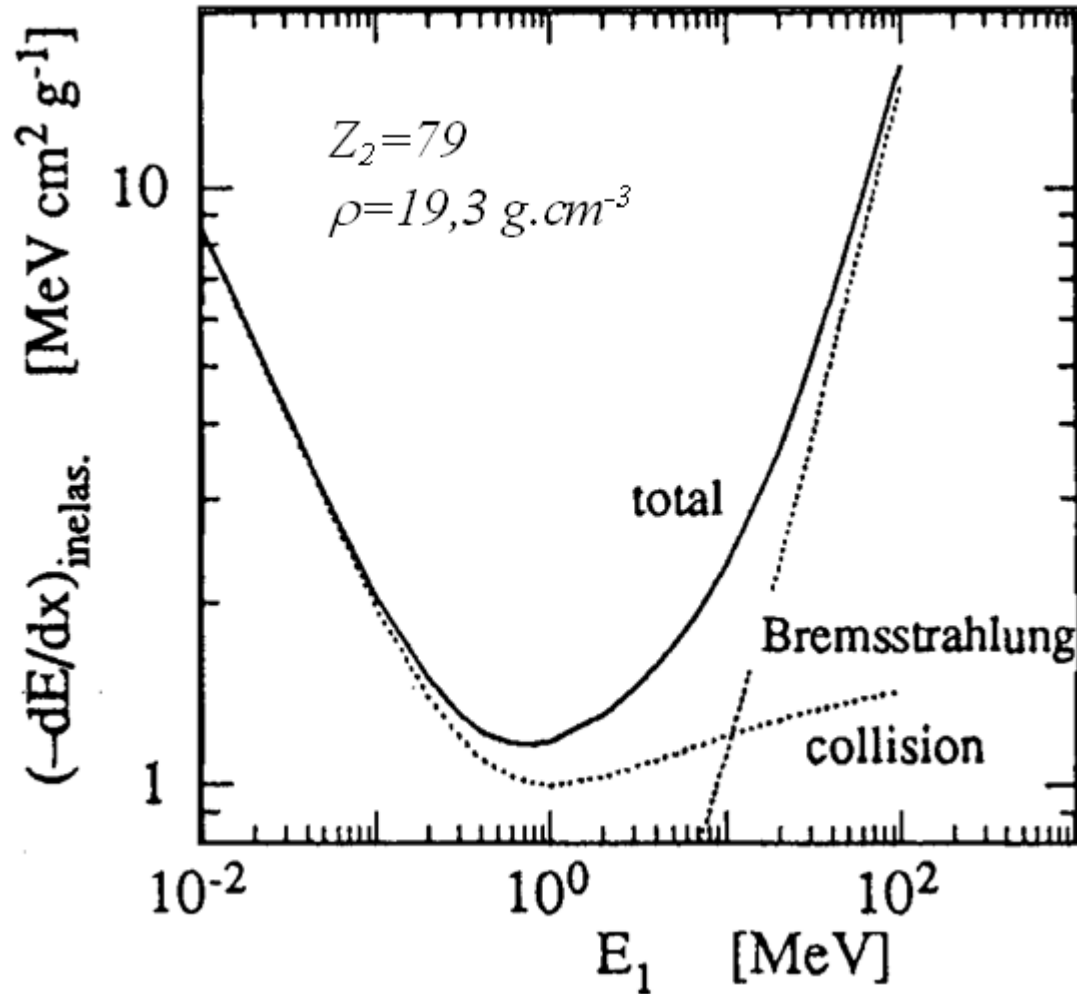
Matériau épais

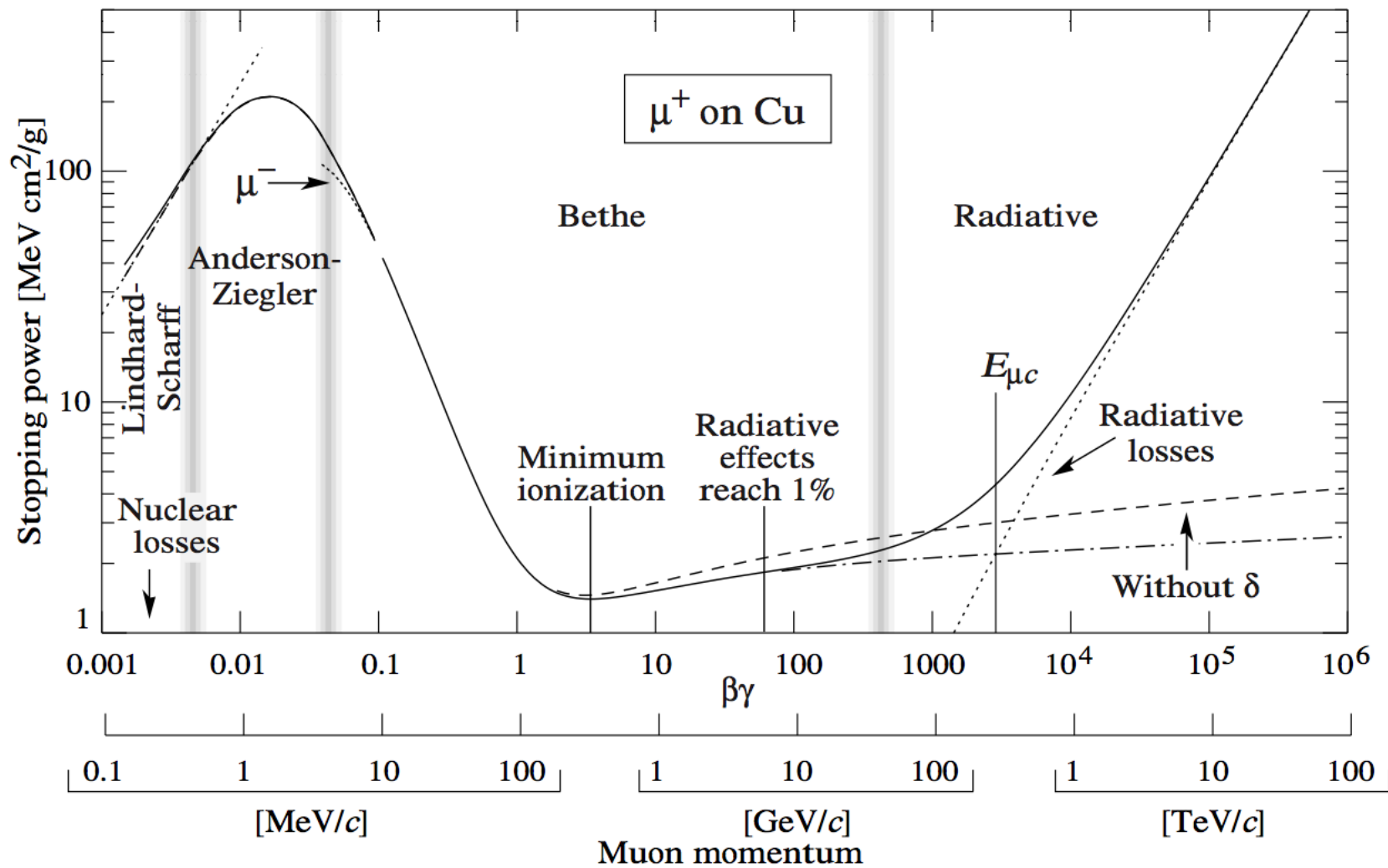




$$\left. \frac{dE}{dX} \right|_{tot} = \left. \frac{dE}{dX} \right|_{rad} + \left. \frac{dE}{dX} \right|_{ion}$$

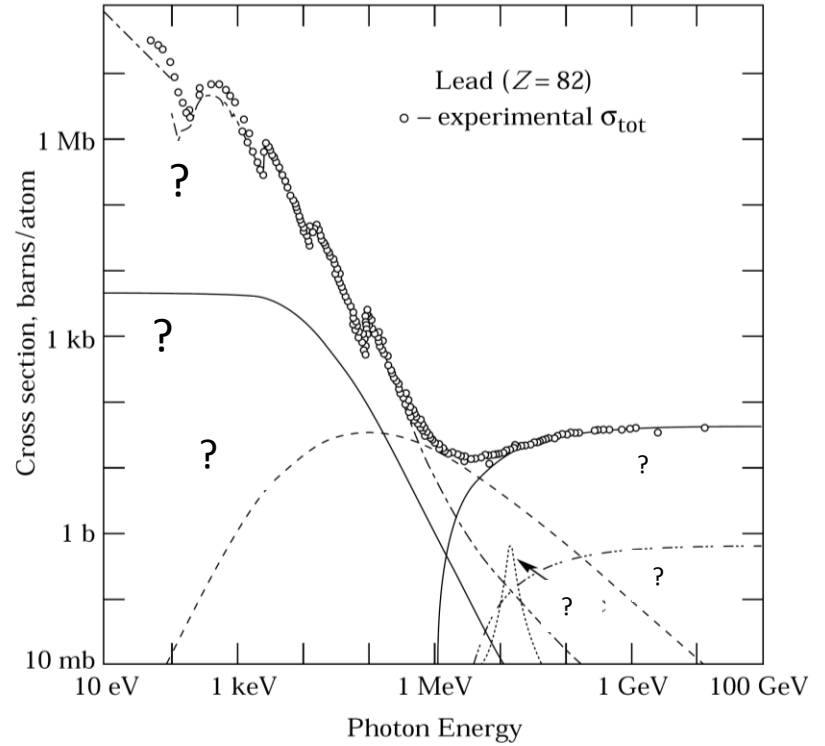
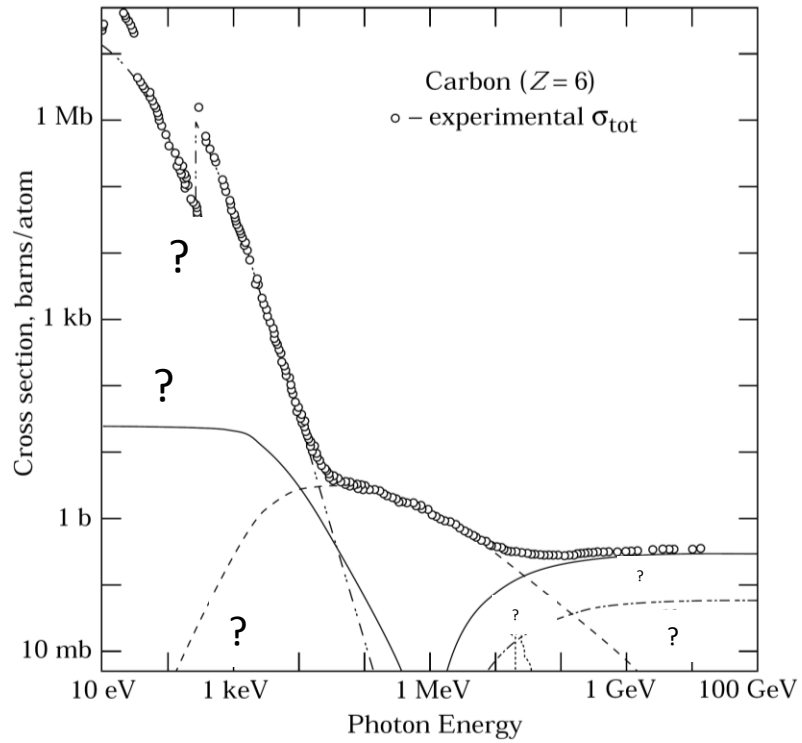
$$-\left. \frac{dE}{dX} \right|_{rad} = 4\alpha N_A r_e^2 \frac{Z^2}{A} E \ln \frac{183}{Z^{1/3}}$$





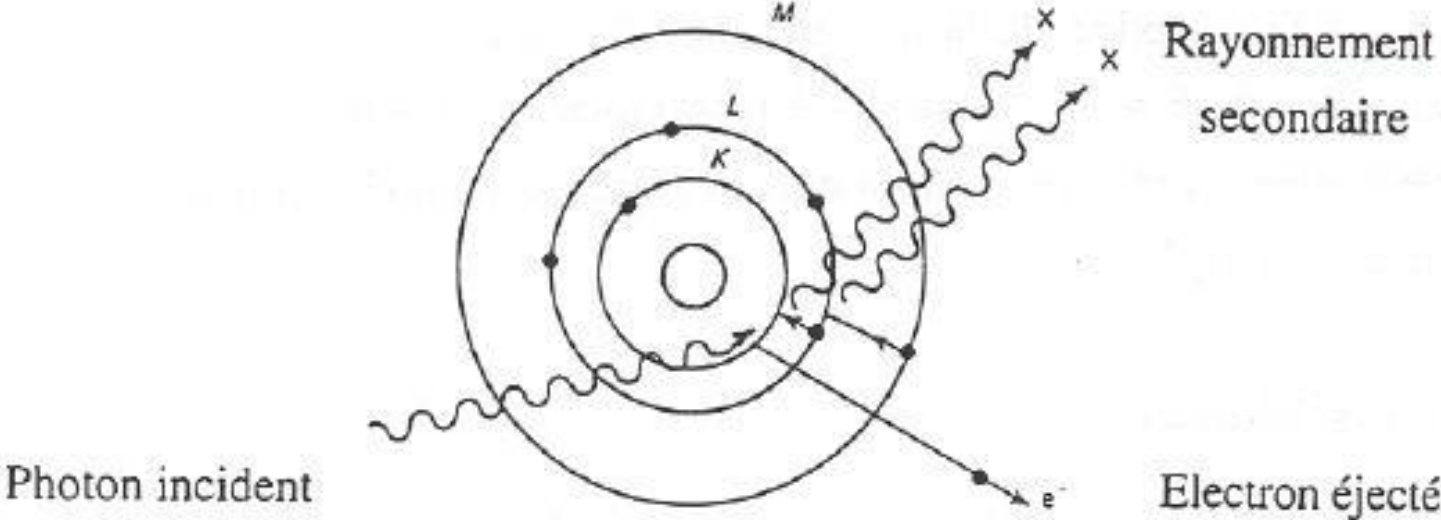
# Interaction des photons

# Section efficace d'interaction des photons

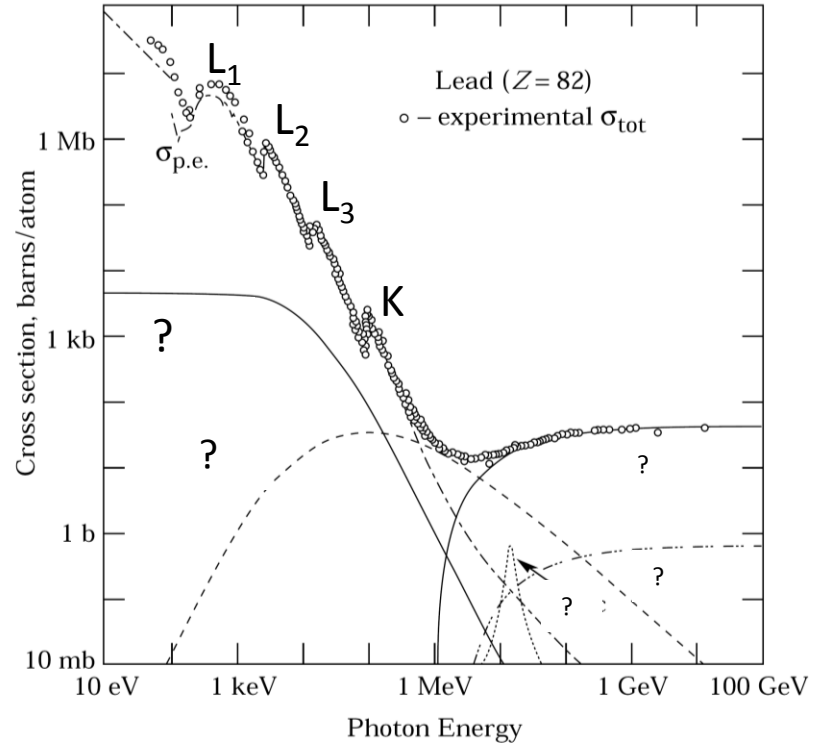
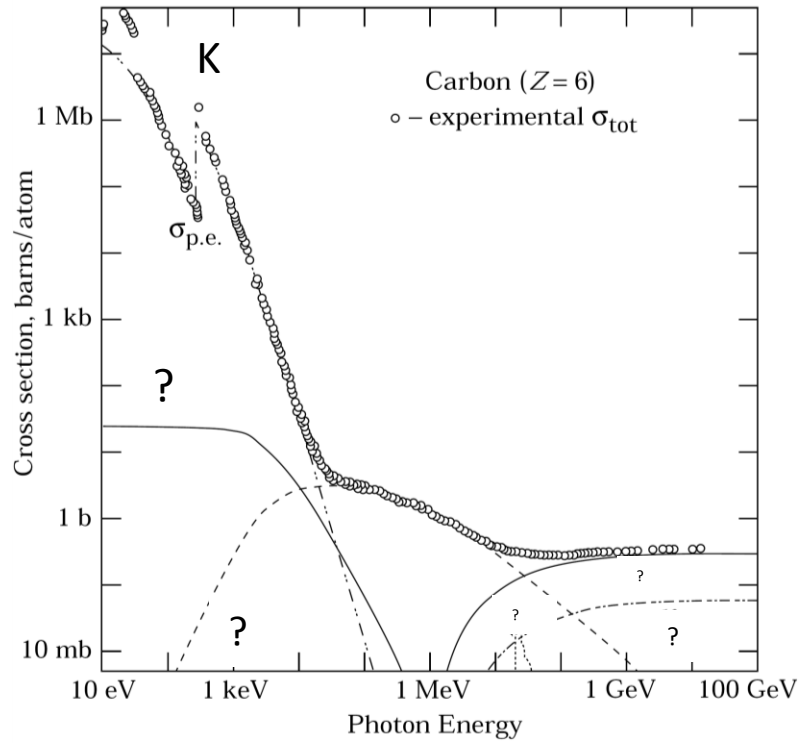




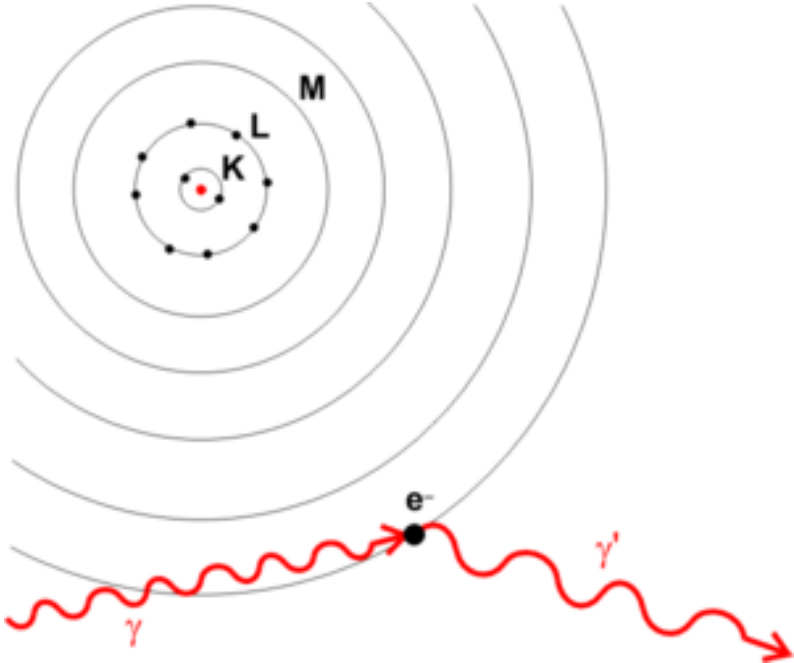
# Effet photoélectrique



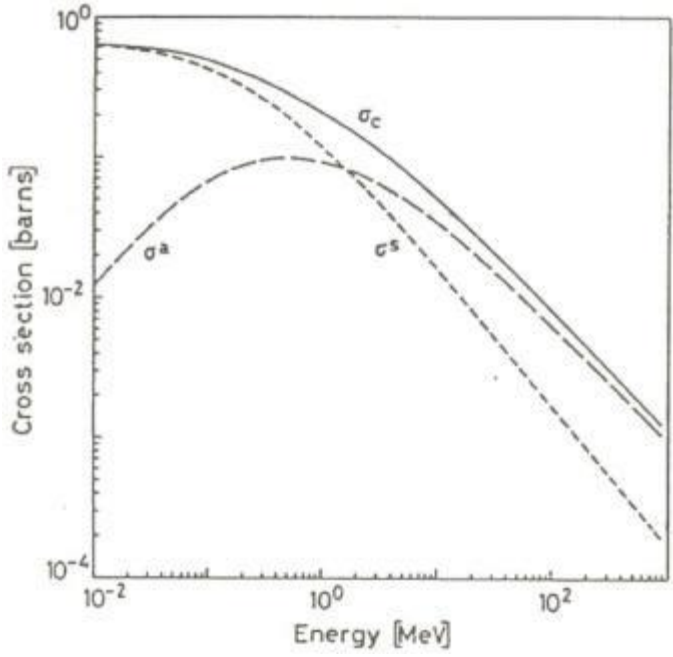
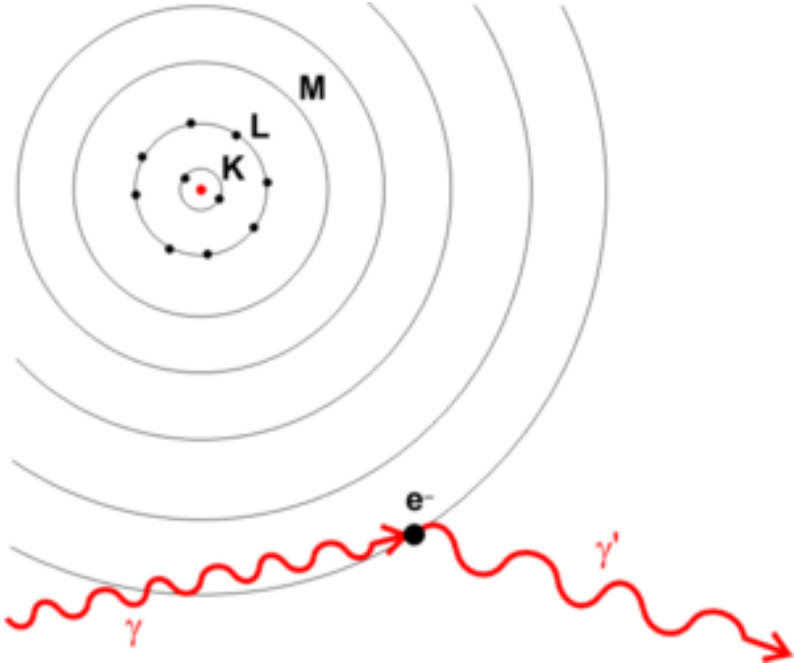
# Section efficace d'interaction des photons



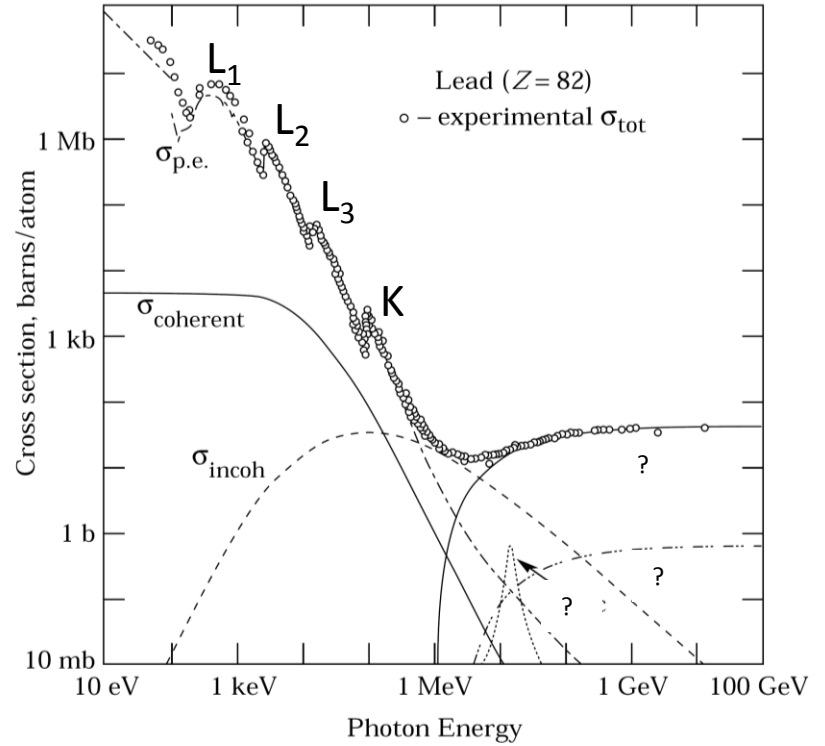
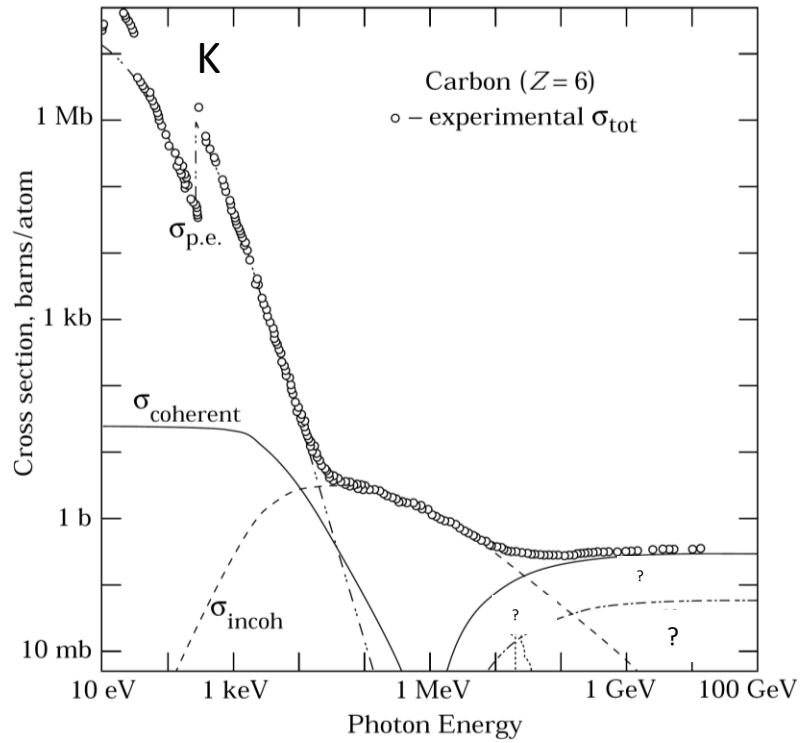
# Effet Compton



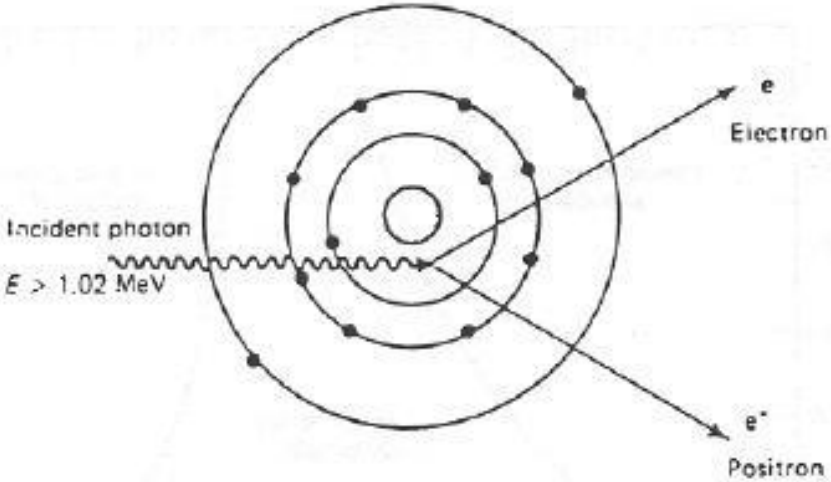
# Effet Compton



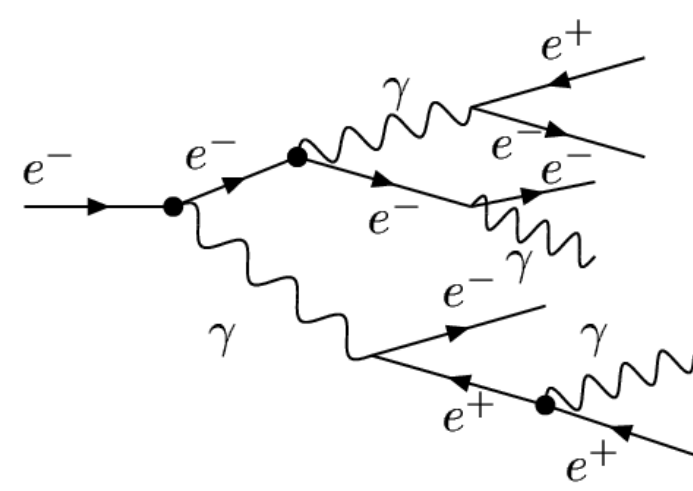
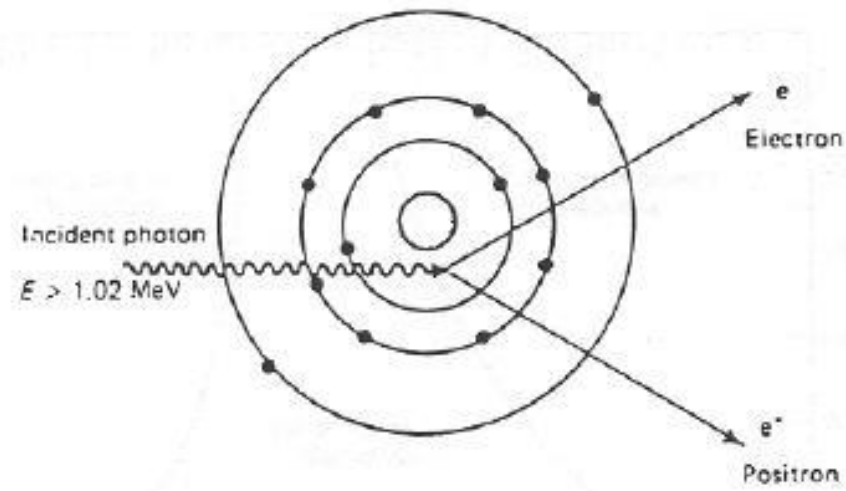
# Section efficace d'interaction des photons



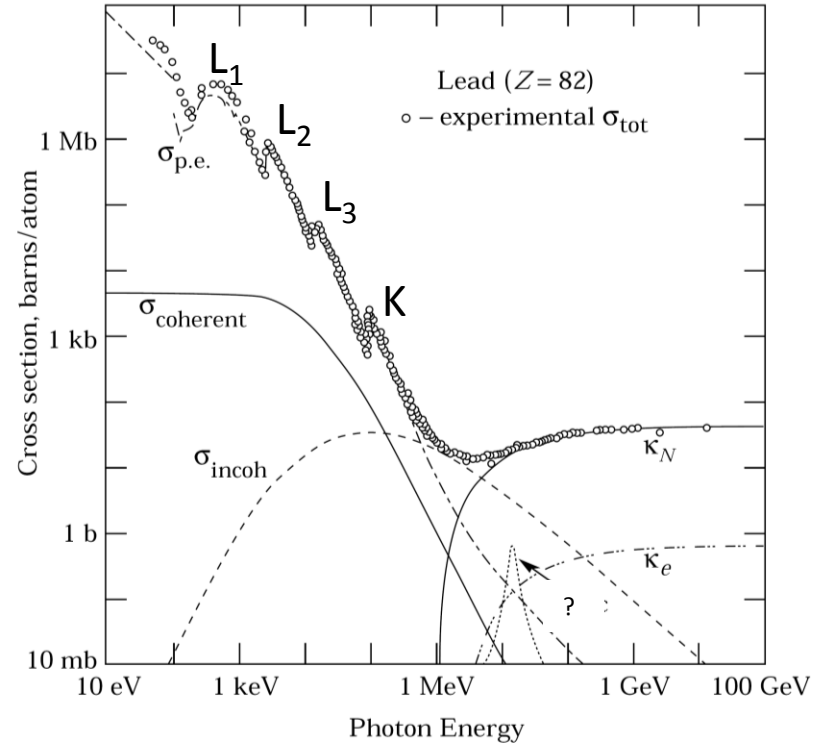
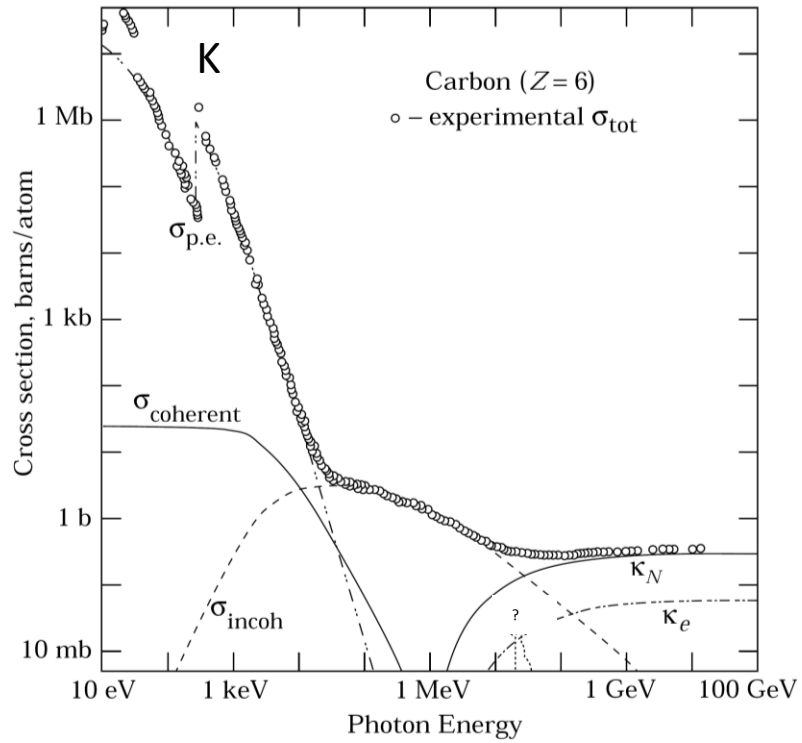
# Production de paires



# Production de paires

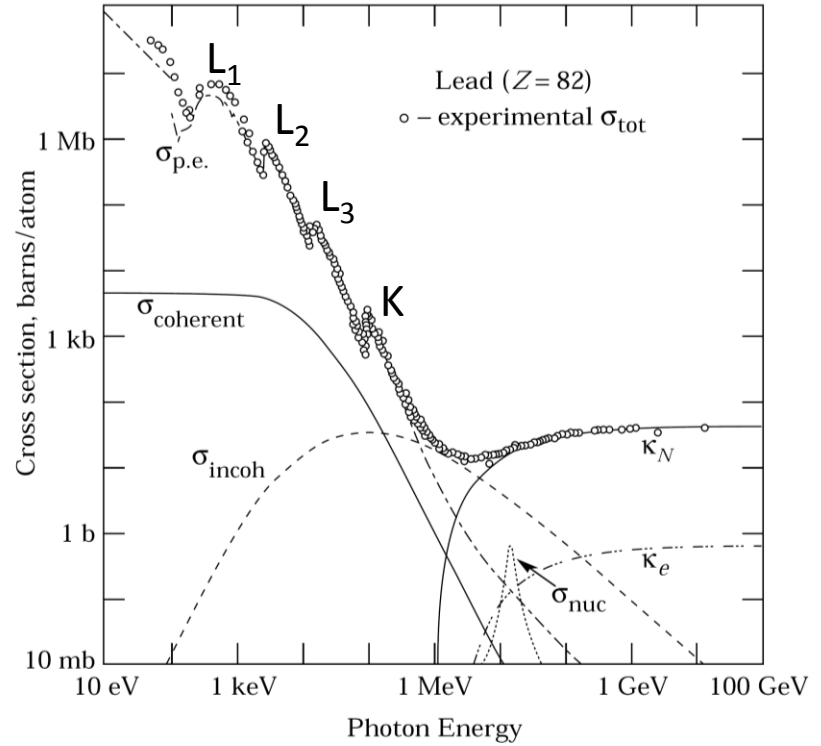
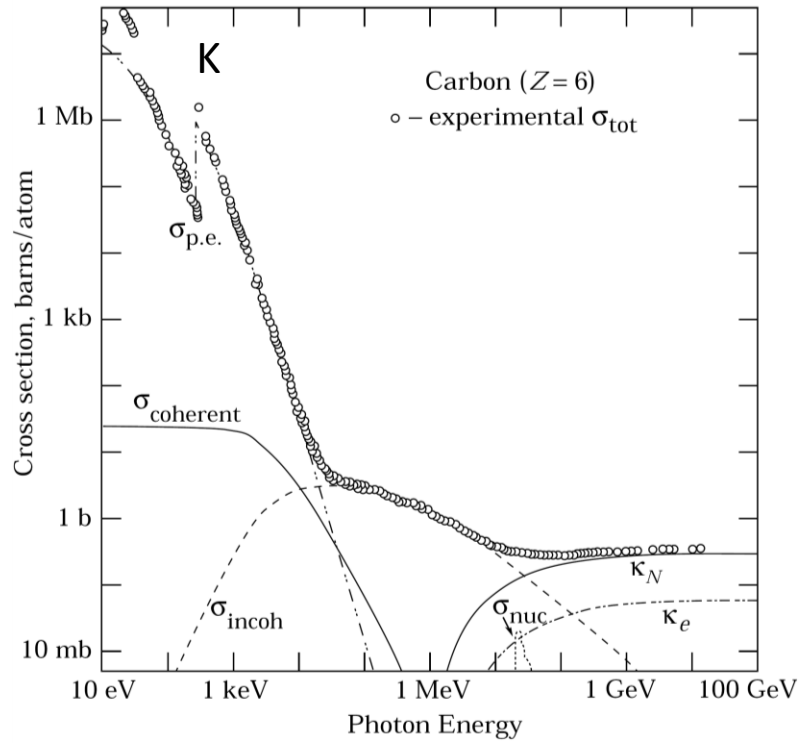


# Section efficace d'interaction des photons



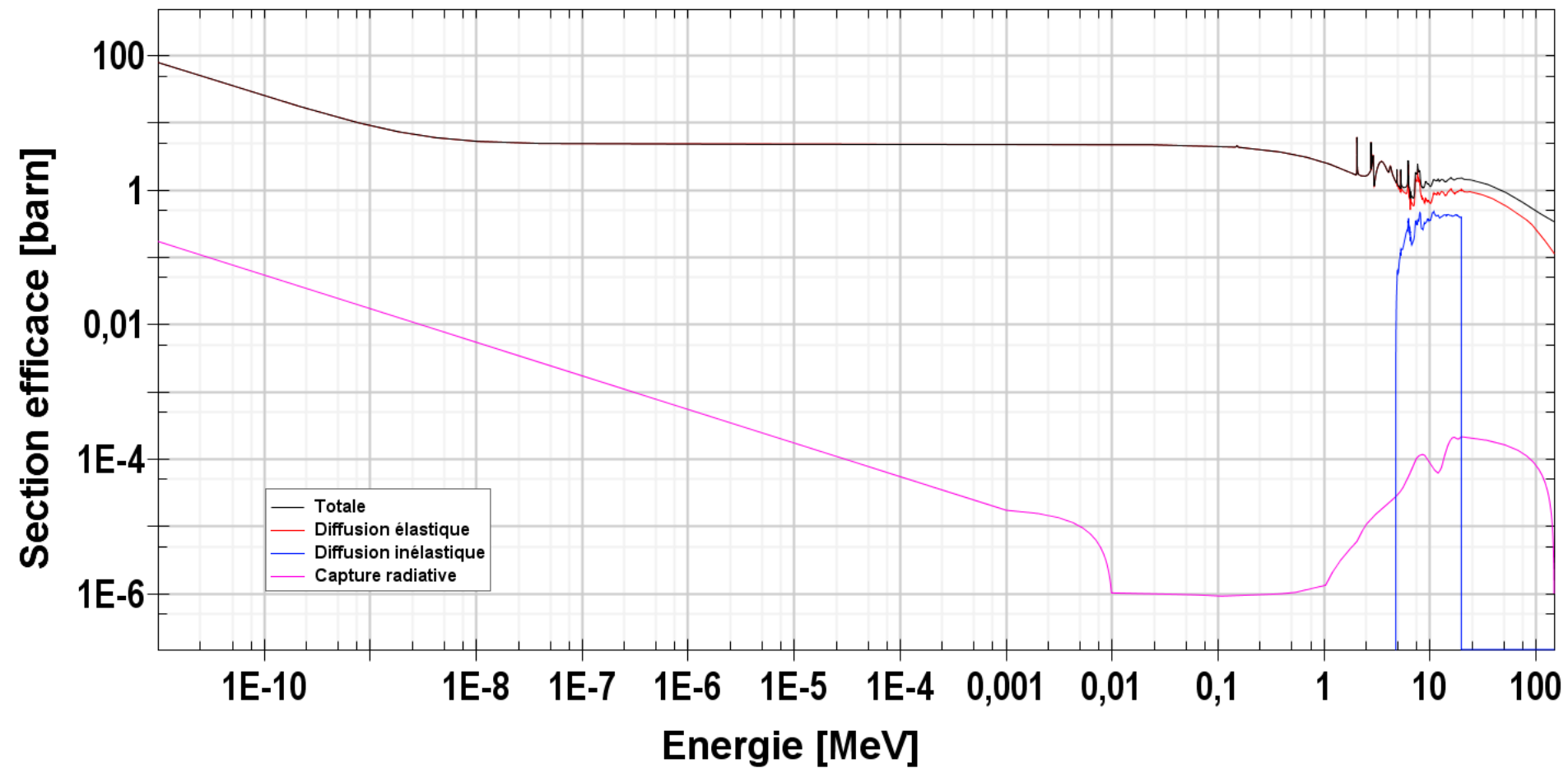


# Section efficace d'interaction des photons

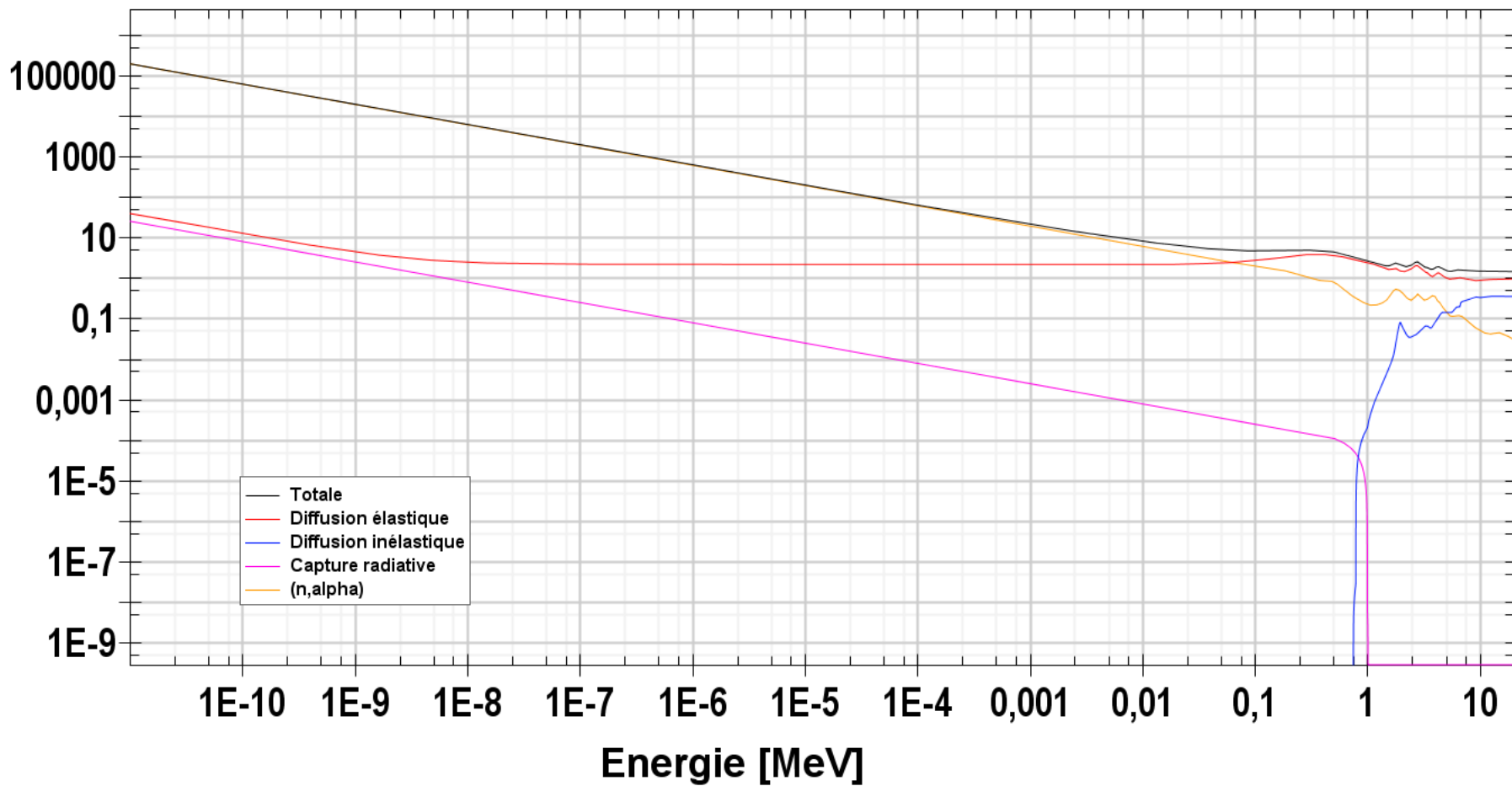


# Interaction des neutrons

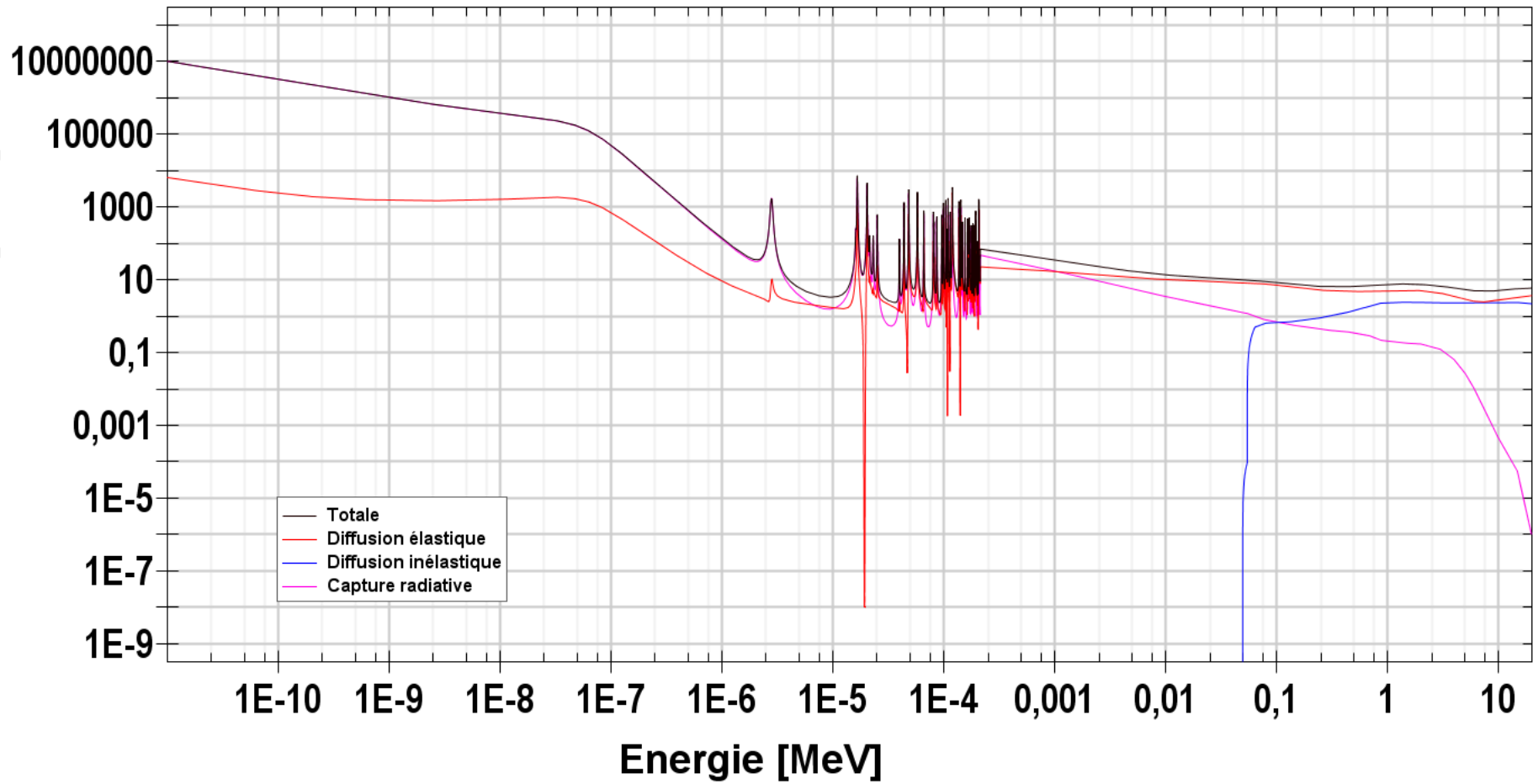
### Section efficace neutronique du C-nat



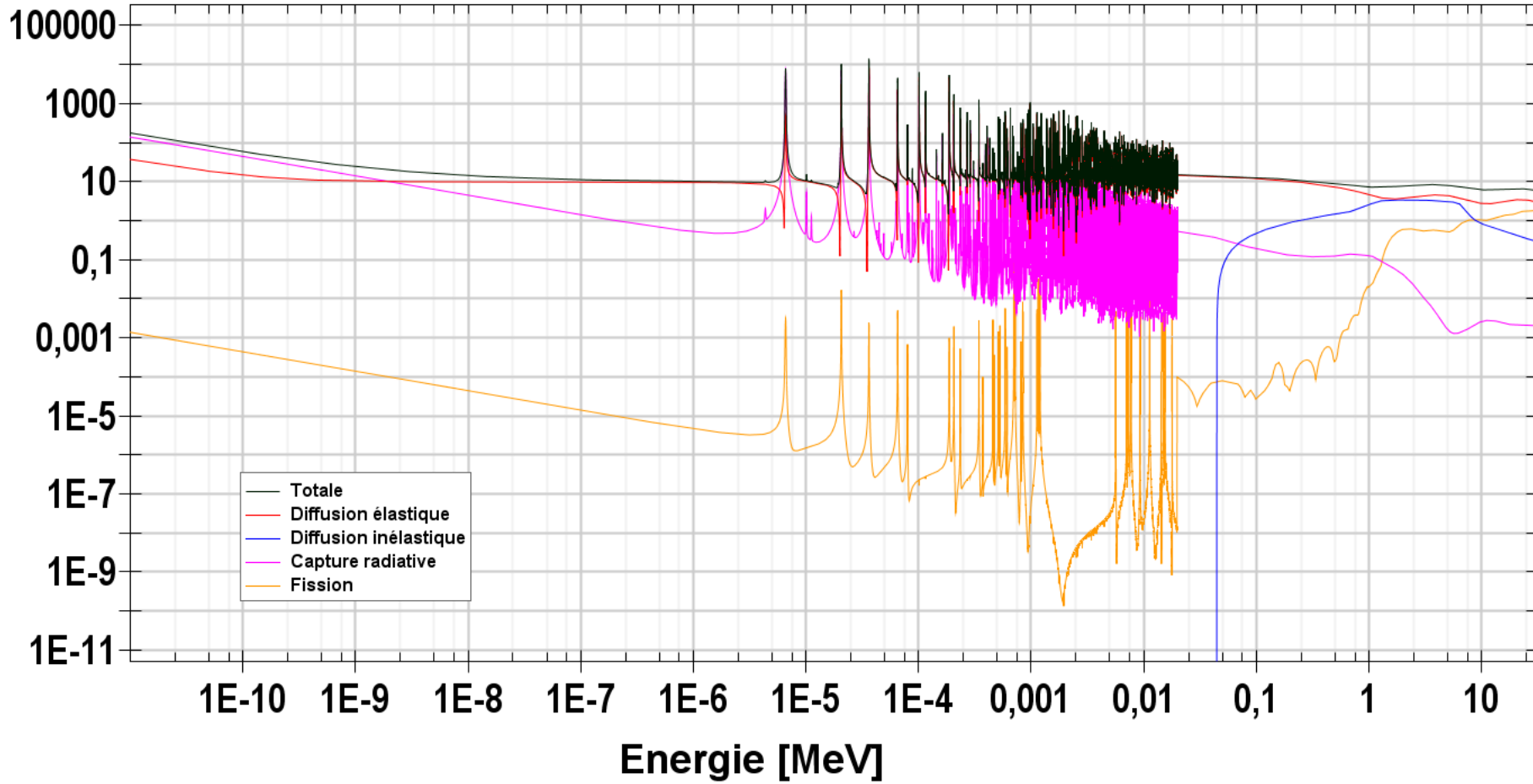
### Section efficace neutronique du B-10



### Section efficace neutronique du Gd-157



### Section efficace neutronique de l'U-238



### Section efficace neutronique de l'U-235

