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Exercises for the lecture in particle detectors:

1) Classical derivation of the Bethe Bloch formula using the hints given in the lecture: $-\frac{dE}{ds} = -\int_0^\infty \frac{dE}{db} db = \frac{4\pi z^2 e^4 k^2}{m_e v_0^2} n_e \ln\frac{b_{\max}}{b_{\min}}; \quad b_{\min} = \frac{z \cdot e^2 k^2}{\gamma m_e v_0^2}; \quad b_{max} = \gamma v_0 \overline{T}$
2) Kinematics of Compton scattering: $h\nu' = \frac{h\nu}{1+\varepsilon(1-\cos\theta_{\gamma'})}; \ \varepsilon = h\nu / m_e c^2$
3) Using the photon attenuation curves for NaI given in the lecture to estimate the total efficiency of a NaI standard detector in a given geometry as specified in the lecture II (p74-76), why is your result different from the value quoted?
4) In Water the refractive index is *n*=1.333. Calculate the minimal energy in keV of an electron to produce Cerenkov light. Where do the electrons come from?
5) Derive the expression for the momentum resolution of a tracker in a magnetic field: $\frac{dS}{S} = \frac{dp_\perp}{p_\perp} = \frac{80}{3 \cdot z} \frac{1}{BL^2} p_\perp dS; \ [B] = Tesla; \ [L] = m; [p_\perp] = GeV / c$
6) Estimate the nuclear interaction length of protons in Iron (Fe, A=56; density r=7.8 g/cm^3)
7) The number of particles in an elm shower is proportional to the Energy. If we can measure the number of particles in a shower, how will the energy resolution scale with energy?
8) In nuclear physics light ions can be stopped with a 1mmm Silicon detector, after they passed through a thin ΔE counter. Explain why the result of the product of the two counters is proportional to the mass. $\Delta E \times E_{cin} \propto m$