Exercises for the Calorimeter Reconstruction and Machine Learning Workshop 2023

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1 Day 2

1. The nuclear interaction length of a material is given by

$$\lambda_{\text{int}} = \frac{A}{N_A \rho \sigma_{\text{tot}}} \approx 35\text{g/cm}^2 A^{1/3} \tag{1}$$

   while as a reminder the radiation length is defined as

$$X_0 = \text{const.} \frac{A}{N_A \sigma_{\text{pair}}} \propto A/Z^2 \; quad. \tag{2}$$

   Plot both nuclear interaction length and radiation length for as a function of A and Z. Put markers for materials in our material list for simulation.

2. Adapt your EM calorimeter to also capture Hadronic showers.

   a) What happens in terms of performance, cost etc.?

   b) How do energy sum and DNN regression relate?

3. Build an optimal hadronic calorimeter (no transversal granularity) for showers between 1 and 100 GeV and stay below 50k CHF.