Problem set 8 – Quark Gluon Plasma Physics – SS 2023

Discussion in the lecture: Thursday June 30

8.1 Simple parton energy loss model

In the lecture a simplified parton energy loss model was discussed which assumed a constant fractional energy loss $\varepsilon_{\text{loss}} = |\Delta p_T|/p_T = \text{const}$. In this problem we consider the case of a constant absolute energy loss Δ, i.e., the transverse momentum after the energy loss is given by $p'_T = p_T - \Delta$.

a) Write down the formula for the charged-hadron $R_{\text{AA}}(p_T)$ for a transverse momentum spectrum described by

$$\frac{1}{p_T}\frac{\mathrm{d}n}{\mathrm{d}p_T} \propto \frac{1}{p_T^n}$$

assuming a constant absolute energy loss.

b) Determine the value Δ which describes the $R_{\text{AA}}(p_T)$ measured in central (0–5%) Pb–Pb collisions at $\sqrt{s_{\text{NN}}} = 5.02\,\text{TeV}$ (arXiv:1611.01664) for $p_T > 25\,\text{GeV}/c$ best by extending the jupyter notebook charged_hadron_Raa_to_be_completed.ipynb. This notebook reads a data file obtained from hepdata.net.

Hint: You'll find many `curve_fit` examples. For instance, take a look at this example from the web page of the Advanced Lab Course for physics students at Heidelberg University.