

Take Home Exam - 2

Submission Date – November 01, 2022
Course – PH505

Total Marks = 10

This is an extension of the previous take home exam.

Consider the multiplicity distribution of π^0 s produced in the $p + p$ collision in an event is a Gaussian distribution with $\mu = 5$ and $\sigma = 1$. These produced π^0 s decay to 2γ ($\pi^0 \rightarrow \gamma\gamma$). The transverse momentum of these π^0 s follows a probability distribution given by $P(p_T) = \exp(-0.2 \times p_T)$ between 0.2 GeV/c and 5 GeV/c. The pseudo-rapidity (η) of these π^0 s follows a Gaussian probability distribution with $\mu = 0, \sigma = 2$. The pseudorapidity (η) is defined as $\eta = -\ln \tan \frac{\theta}{2}$, where θ is the polar angle of the particle. Generate 10^6 number of events and carry out the followings. (Take $m_{\pi^0} = 140 \text{ MeV}$)

- Construct the invariant mass of 2γ in the same event. Plot the distribution.
- Construct the invariant mass of 2γ taking one γ from one event and the other γ from another event. This is called background distribution. Plot the distribution.
- Subtract (b) from (a) after properly normalizing the distribution and obtain the reconstructed π^0 . Plot the distribution by fitting a gaussian function. Print the width of the fit.

Keep all the figures (a, b and c) in one page and send me the pdf file of these figures along with the code.

Send your code to basanta@iitb.ac.in.
