FYS4555 – Fall 2018

Compulsory Project I

12.9.2018, to be delivered 21.9.2018

Farid Ould-Saada, Even S. Håland

Study of Bhabha scattering

1. Write down the lowest order Feynman diagrams of the Bhabha process $e^+e^- \rightarrow e^+e^-$ as well as the corresponding matrix elements $\mathcal{M}_i$.
2. Using QED Feynman rules, the completeness relations and the trace formalism, calculate the various contributions to the spin-average matrix-element squared $|\mathcal{M}|^2$.
3. Calculate the differential cross section in the centre of mass and plot it at $\sqrt{s} = 14\ GeV$ as a function of $\cos\theta$, where θ is the scattering angle.
    1. Also show the various contributions and compare to the process $e^+e^- \rightarrow \mu^+\mu^-$(use the results obtained in the lecture).
4. Calculate and plot the total Bhabha cross section cross section as a function of $\sqrt{s}$. *Care must be taken here.*
    1. Estimate the number of events expected at $\sqrt{s} = 14\ GeV$ assuming an integrated luminosity of $10\ pb^{-1}$ and an efficiency x acceptance of 50%.
    2. Compare to the process $e^+e^- \rightarrow \mu^+\mu^-$.
5. Compare your calculations to the experimental results you may find on the net.