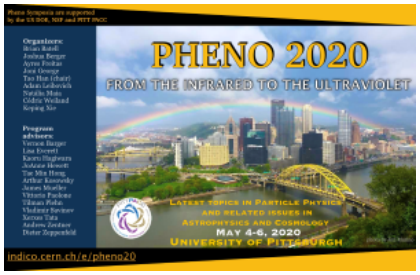

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The Electroweak PDFs (II): the necessity and applications

Monday, May 4, 2020 5:30 PM (15 minutes)

The Weizsaicker-Williams approximation, i.e., ''equivalent photon approximation", is a powerful tool, both in understanding the electromagnetic radiation and in studying the photon interaction processes. Just like the quark and gluon partons in quantum chromodynamics, photon could be treated as a parton constituent in the initial state beam particles and described using a photon parton distribution function (PDF). However, questions arise when people consider physics processes beyond the electroweak (EW) scale characterized by Z boson mass, where the "photon" is not well defined anymore. Does the conventional photon PDF remain valid at scales above m_Z? Do we need to consider adding in the Z and the γZ mixing PDFs? How much do the EW PDFs affect the theoretical predictions?
Therefore, we take a realistic process, $e^-\mu^+ \to e^- W^+ \bar{\nu}_\mu$, to explore the relative contribution at leading order from the photon, Z boson, and the interference, which helps answer the necessity of the EW PDFs. It is found that, the EW PDFs affects are strongly polarization dependent, which agrees with the chiral feature of the EW theory. In the initial e_L^- beam case, we obtain a large cancellation between the Z and the γZ interference. But for the e_R^- case, we get a constructive contribution from the γZ interference. The EW PDF contribution from the Z and γZ interference become comparable with the one from photon PDF at energies starting around $\sqrt{s} = 1$ TeV. Particularly, for e_R^- beam, the EW PDFs contribute 20% of the total cross section at 500 GeV, which can be tested at colliders in the near future, such as ILC and FCCee.

Summary

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