Proton-proton bremsstrahlung at the threshold region of the pion production

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So far many studies in proton-proton bremsstrahlung reaction have been done in order mainly to investigate the off-shell effect in the nucleon-nucleon interaction [1]. Theoretical calculations [2] have shown a significant contribution of the Δ pole in this reaction near the threshold of pion production as well as the nucleon pole (Fig.1 : left and middle).
Recently, Yuasa et al. performed an experiment at RCNP using 400 MeV proton beam[3], where they found unexpectedly large reaction rate at the pion threshold region when symmetric configuration was taken in the final state three body channel. The observed cusp like structure in the cross section indicates a contribution from the pion loop.
We postulate that this structure is driven by the process of the rescattering of an S-wave pion as shown in Fig.1 (right). This is a new reaction mechanism for the proton-proton bremsstrahlung and of great interest, where the pion plays for the threshold effect in the reaction.
Once the pion is allowed to appear in the reaction, it seems that there are many diagrams that contribute to the process. However, many of the processes which contain the πNN P-wave coupling are suppressed at the threshold region due to a small momentum of the pion. The remaining dominant contribution is then expected to be brought by the S-wave contribution as shown in Fig. 1. We compute the pion loop diagram explicitly and investigate an interference effects with other conventional processes (nucleon and delta pole diagrams).

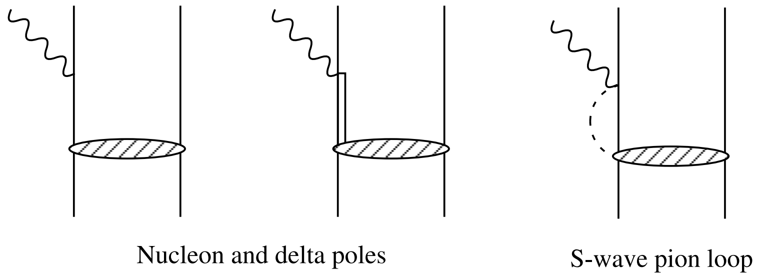

Figure 1: Diagrams for ppγ reaction

References

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