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Impact of the Delta (1232) resonance in neutral pion photoproduction in chiral perturbation theory.

Monday, June 29, 2015 5:50 PM (20 minutes)

In this talk we will discuss the reaction p + γ ⟶ p + π0 and how it has been described using Chiral Perturbation Theory (χPT).

Since the early 1990s χPT has been applied to pion photoproduction. The first study was that of Bernard et al. [1,2], detailing a O(p3) relativistic approach to describe the data from Mainz [3] and Saclay [4] from threshold, Eγ ≈ 145 MeV, to Eγ ≈ 160 MeV. In 1996 and 2001 the same authors revisited this phenomenon in O(p4) heavy baryon χPT [5,6]. They improved on previous results by fitting to data from threshold to Eγ ≈ 165 MeV. There has been a resurgence of interest in this topic following the publication of the results from the A2 and CB-TAPS collaborations at the Mainz Microtron (MAMI) [7]. This data has reached unprecedented levels of accuracy from the threshold region through to the first excited hadronic state, the Δ(1232). This data was analyzed by Fernandez-Ramirez et al. [8] using rel. χPT and HBχPT. They concluded that for energies above Eγ ≈ 170 MeV both the theories fail. All of the above studies acknowledge that the Δ(1232) is important but do not include it in their work. It was incorporated into a O(p3) EOMS covariant theory late last year by Blin et al. [9]. Their analysis showed how including the resonance improves the fit. Another aspect highlighted by Fernandez-Ramirez et al. [10] is that calculations often limit the angular momentum to P-waves, when it is not fully understood if the interference produced from D-wave states (or higher) are negligible. In our discussion, we will detail both the relativistic and the heavy baryon approach.

Furthermore, we will show the effects of including the Δ(1232), and how this improves theoretical descriptions of this phenomenon. Finally, we will discuss the consequences of truncating the angular-momentum to P-waves, compared to including D-waves and higher.

References

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