Magnetic moments of the $\Lambda(1405)$ and $\Lambda(1670)$ resonances

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The introduction of techniques of the unitrized chiral perturbation theory ($U\chi\mathcal{PT}$) has allowed one to show that the octet of the lowest energy $J^P = 1/2^-$ baryonic resonances can be generated dynamically from meson-baryon scatterings with the lowest order chiral Lagrangian. These findings allow one to classify those states as quasibound meson-baryon states, or equivalently, multiple scattering resonances in coupled channels.
In this talk, using $U\chi\mathcal{PT}$, we show our study of the magnetic moments of the $\Lambda(1405)$ and $\Lambda(1670)$ resonances, as well as the transition magnetic moment from the $\Lambda(1670)$ to the $\Lambda(1405)$, which allows us to determine the partial decay width for the decay $\Lambda(1670) \to \Lambda(1405)\gamma$. To extract the magnetic moments of these resonances, we compute amplitudes for the process $MB \to M'B'\gamma$ with $U\chi\mathcal{PT}$, where we take a summation over the Feynman diagrams which generate the resonance both on the left and on the right of the photon coupling. The amplitudes obtained in this way are compared to a resonance description of the Breit-Wigner form.
We also perform comparison of the results obtained here with those of ordinary quark models, showing that there are appreciable differences between them. This offers an evidence that the nature of these states as dynamically generated from multiple scattering of coupled channels of mesons and baryons differs from an ordinary quark model description. One of the interesting results obtained in this work is the abnormally small decay width for the $\Lambda(1670) \to \Lambda(1405)\gamma$ transition, which differs in two order of magnitude from the quark model predictions. Short of a difficult measurement of the transition, given the small numbers predicted, even the determination of upper bound would provide interesting information about the nature of there resonances.

Model	$\Lambda(1405)$	$\Lambda(1650)$	transition
$U\chi\mathcal{PT}$	$+0.24 \sim 0.45$	-0.29 ± 0.01	0.023 ± 0.009
QM	-0.13	$+0.01$	0.14

Table 1: Magnetic moments obtained by the chiral unitary approach ($U\chi\mathcal{PT}$) and the quark model (QM) in units of the nuclear magneton. The sign of the transition magnetic moment is not determined.

References

[1] D. Jido, A. Hosaka, J.C. Nacher, E. Oset and A. Ramos, hep-ph/0203248