The $\Lambda_b \to J/\psi\ K\ \Xi$ decay and the NLO chiral terms of the meson-baryon interaction

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The meson-baryon interaction in the strangeness $S = -1$ sector has been one of the favorite grounds to test nonperturbative chiral dynamics. The existence of the $\Lambda(1405)$ resonance below the $\bar{K}N$ threshold makes the use of nonperturbative unitary schemes mandatory to study the $\bar{K}N$ interaction with its coupled channels. The combination of chiral dynamics and unitarity in coupled channels has proved very efficient in describing this interaction, even using the chiral Lagrangians to lowest order. Nowadays the aim for precision and the extension of the approach to higher energies has motivated the introduction of higher order terms of the chiral Lagrangians in the kernel, or potential, of the meson-baryon interaction, and new fits to extended data have been performed to determine the parameters of the higher order chiral potential [1-6]. In [6] the authors pay particular attention to the $K^-p \to K\Xi$ reaction, since the $K\Xi$ channels appear to be particularly sensitive to the NLO terms. In this work the authors have also shown that the high spin hyperon resonances $\Sigma(2030)$ and $\Sigma(2250)$, i.e. $I = 1$ resonances, may have an important effect for $K\Xi$ production reactions. This is why data filtering $I = 0$ at high energies would be most welcome as a complement of the $K^-p \to K\Xi$ scattering data.

One such opportunity arises from the weak decay of Λ_b into J/ψ and meson-baryon components. Indeed, a recent study of the $\Lambda_b \to J/\psi K^-p(\pi\Sigma)$ decay has been performed in [7], and the relevant finding for the present work is that the reaction filters the final meson-baryon components in $I = 0$. The reaction mechanism for production of J/ψ and $K\Xi$ is the same as for K^-p or $\pi\Sigma$, except that a different channel is chosen in the final state interaction of the very few meson-baryon states which are allowed by the selection rules to be produced in a primary step.

In the present paper we study the weak decay Λ_b into J/ψ and three quarks that hadronize to produce meson-baryon components, which turn out to be $\bar{K}N$ and $\eta\Lambda$. The final state interaction of these states in coupled channels gives rise to the production of $K\Xi$ in the final state. Thus, not having $K\Xi$ produced in the first step, this pair comes from rescattering of meson-baryon components and its production turns out to be very sensitive to details of the meson-baryon interaction, and in particular to the higher order terms. Hence the analysis of the $\Lambda_b \to J/\psi\ K\ \Xi$ reaction opens a new possibility to improve our knowledge about the NLO parameters of the chiral meson-baryon interaction.

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