A partial wave analysis for p + p → p + K^+ + Λ in the GeV energy scale*

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The understanding of strangeness production is a key-aspect of the description of the strong interaction between hadrons. The production channel p+p→ p + K^+ + Λ is of major interest, since it rather dominant in the strangeness production in elementary and heavy ion collisions in the GeV energy range. The production of this final state can proceed via several intermediate channels, like for example nucleon resonances. While the existence of such resonance is well known, their properties and influence to the production of strangeness is not quantitatively understood upt ot now. Furthermore, structures like the Σ-N Cusp can occur in the $p + K^+ + \Lambda$, which is interpreted as a direct coupling between the Σ-N channel to Λ-p channel[1]. Also exotic matter like kaonic nuclear clusters can be produced in this reaction resulting in the same final state. This state was predicted by several theory groups but experimental results are very controversial up to now[2, 3, 4].

The description of all the production channels, that can contribute to the p K^+ Λ final state, requires a special analysis framework. For the analysis the Bonn-Gatchina Partial Wave Analysis (PWA) framework is used [5]. This kind of analysis enabled us to extract the strength of different production channels taking into account the different kinematical and quantum mechanical constraints. In this framework the transition amplitude from an initial wave to a final state is parameterized as a function of the energy and phase. The wave functions of different transitions with the same quantum numbers can mix, which leads to interference. Since the amplitudes and phase parameters of these transitions are not known, they have to be fitted by the PWA.

This method has been used to describe the experimental data measured at the HADES [6, 7] and FOPI [8]. In figure 1 the p-Λ invariant mass is plotted. The black cross show the experiential results. The different colored lines correspond to the 5 best solutions, which have been obtained by a systematical analysis using the BG-PWA framework.

In the analysis it was shown that interferences play an important effect in the description of the experimental data. This complicates the search for exotic matter, since the signature can be washed out. On the other hand it was shown, that the extraction of the different N* contribution by performing the PWA of a data sample at one beam energy only is not feasible, since ambiguities show up. Based on these results, an analysis program is ongoing in which further available data sample obtained also by the DISTO and the COSY-TOF collaboration, will be analyzed in a combined approach. In the following table the available exclusive statistics for different beam energies is listed. The goal of

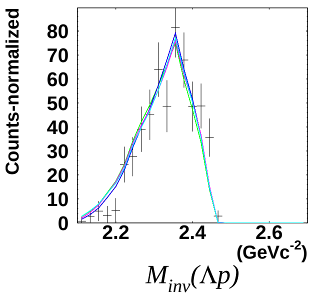

Figure 1: Λp invariant mass of FOPI experimental data (black dots) and PWA solutions (colored lines)

Beam Energy	Experiment	Statistics (k Events)
1.92	COSY-TOF [11]	150
2.15	DISTO [9]	121
2.16	COSY-TOF [10]	43
2.25	COSY-TOF [12]	36
2.40	COSY-TOF [12]	1.6
2.5	DISTO [9]	304
2.85	DISTO [9]	424
3.1	FOPI [8]	0.9
3.5	HADES [6, 7]	21

the combined analysis is to provide an energy dependend description of the production mechanism. This will allow to pin down the contribution of different production channels in a more precise way.

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