Hunting for K^{*+} in pp and pNb reactions*

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In a recent study performed by the HADES collaboration for $p+p$ and $p+Nb$ collisions at 3.5 GeV, the production of neutral kaons was investigated [1]. The high statistics available for this analysis suggests that the exited states of the kaons can be investigated as well. One excited state that is decaying into a neutral kaon is the $K^{*+}(892)$ (Fig. 1). Information about the production of this particle at the energy of 3.5 GeV is of great interest, since no $K^{*+}(892)$ measurements at such low energy are available [2, 3].

The study of the $K^{*+}(892)$ resonance can be divided into two main steps. In the first step the total and differential cross sections for $K^{*+}(892)$ production in $p+p$ reactions are reconstructed. The second step is to use this result as a reference for a further investigation of $K^{*+}(892)$ production in $p+Nb$ reactions. The latter is interesting, because one can study the contribution by $p+n$ reactions to the total yield, scattering processes inside the nucleus, secondary production processes (e.g. $\pi+N \to K^*+\Lambda$) and eventual in-medium modifications of the $K^{*+}(892)$. The most efficient way to reconstruct $K^{*+}(892)$ using HADES data is by the decay scheme shown in Fig. 1.

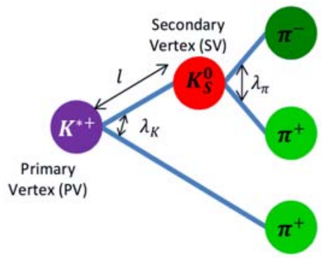

Figure 1: The short-lived K^{*+} decays at the primary vertex into a K_S^0 and a π^+. The K_S^0 decays into a pair of charged pions after a short time.

By selecting triplets of charged pions in each event and applying geometrical cuts to constrain the decay topology one can reconstruct the invariant mass spectrum of $K_S^0\pi^+$-pairs, showing the signal of $K^{*+}(892)$ (Fig. 2).

For $p+p$ reactions we find more than 1000 reconstructed $K^{*+}(892)$. This statistics is sufficient to perform a differential analysis. In order to correct the data for acceptance and efficiency a model capable of reproducing the experimental data was needed. For this reason, as well as to test the efficiency of the implemented reconstruction procedure, simulations of the $K^{*+}(892)$ production in $p+p$ collisions were performed. The two production channels,

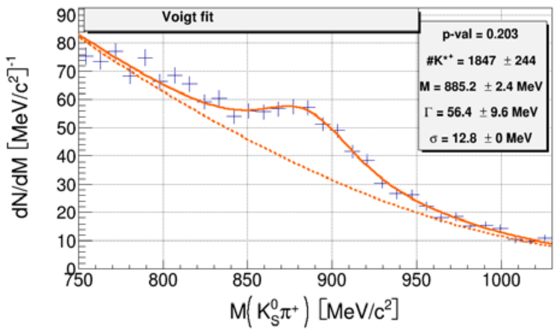

Figure 2: The invariant mass spectrum of the selected $K^{*+}(892)$ candidates. The measured values are in a fair agreement with the properties listed in PDG, which are $M = 891.66$ MeV/c^2 and $\Gamma = 50.8$ MeV/c^2.

that are expected to be dominant, $p+p \to p+K^{*+}+\Lambda^0$ and $p+p \to p+K^{*+}+\Sigma^0$, were simulated and the data is to be modeled by determining the relative contribution of each channel, that allows to reproduce the experimental data. In the simulations a uniform phase space population was assumed. There are, however, few effects that complicate the analysis. One is the detector resolution, which was estimated from simulations to be around 12 MeV/c^2. This effect can be accounted for by fitting the signal using a Voigt function, which is a convolution of a Breit-Wigner function, which represents the resonance, and a Gaussian function, which models the resolution. A second issue is the phase-space limitation for the production of $K^{*+}(892)$. The threshold energies for the two main production channels (see above) are 2.95 and 3.02 GeV, respectively. This means that the available center of mass energy of 3.18 GeV is just a bit above those values. Hence, the phase space limitations will be substantial, especially for particles with high transverse momentum. Thus, the fitting function must be further modified in order to account for the shape of the signal.

After the analysis of $p+p$ data is completed, it will be extended to $p+Nb$ data in order to study the nuclear effects in the production of $K^{*+}(892)$.

References

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* Work supported by BMBF and the Excellence Cluster "Universe".
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doi:10.15120/GR-2014-1-NQM-HADES-06