## ROC-model calculations on $K^+d$ correlations from proton-carbon collisions

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First experimental results [1] on $K^+d$ correlations from proton-carbon collisions seem to provide direct evidence for $K^+$-meson production through two-step reaction mechanism and an indication for a cluster mechanism. It was proposed that both processes contribute significantly in $pC$ collisions at 1.2 GeV, while they are strongly suppressed at 2.3 GeV.
Here we analyze these data [1] within the Rossendorf-Collision (ROC) model [2, 3]. In this model the contributions from the interaction of the projectile with a varying number of target nucleons $a$, $1 \leq a \leq A$ are summed-up incoherently and the cross sections are calculated on the basis of a probabilistic interpretation of the Glauber theory. The comparison of the calculations with the data in Fig. 1 and Fig. 2 shows that the experimentally observed bump in the deuteron-momentum spectrum at a beam energy of $T_p = 1.2$ GeV as well as the broad distribution at 2.3 GeV are partially reproduced in the framework of the ROC-model.

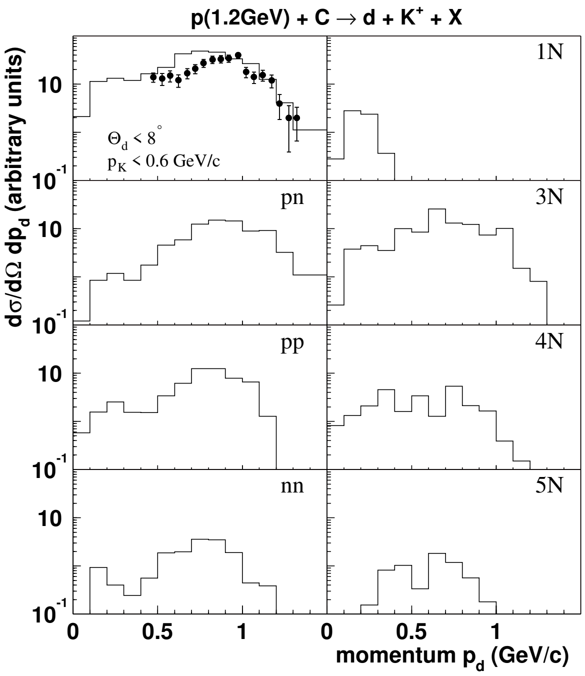


Fig. 1: Deuteron momentum spectra measured in coincidence with $K^+$-mesons (dots) [1] compared with ROC-model calculations (histograms) at 1.2 GeV. The various subprocesses are indicated by the number and types of participating target nucleons.

The ROC-model decomposes the contributions from processes with different numbers and types of participating target nucleons $a$, but ROC calculates the cross section of the final states without detailed assumptions on intermediate steps. Therefore, the interaction of the incident proton with the $a$=$[pn]$ cluster is, in principle, identical to conventional two-step processes [4] with formation of intermediate pions $pN_1 \to \pi d$, $pN_2 \to K^+\Lambda$, or to the cluster mechanism $p[pn] \to dK^+\Lambda$ proposed in Ref. [1]. Due to charge conservation contribution from $[pp]$ and $[nn]$ processes are only possible if an additional pion is produced, either directly or via the creation of a $\Sigma$ hyperon instead of $\Lambda$.
According to the ROC-model all these channels can yield significant contributions. Fig. 1 illustrates that the strengths from the $[pp]$ and $[nn]$ clusters at 1.2 GeV are comparable to that of the [pn] cluster. Even more important, the contributions from the interaction with clusters consisting of more than two nucleons are of considerable magnitude, too. This leads to a large variety of open channels and the result is a complicated superposition of contributions from all these channels. The deuterons with low momenta arise from the fragmentation of the nuclear residue.
At 2.3 GeV (Fig. 2) the decomposition into the various cluster contributions yields a similar picture with clusters consisting of three and four nucleons contributing considerably to the cross section. Of special interest are the spectra from the interaction with a single nucleon. Again the low-momentum deuterons from the fragmentation are visible. In addition there is a high-momentum component from the reactions $p+[n] \to d+K^+ +K^-(+\pi^0)$ and $p+[p] \to d+K^+ +K^- +\pi^-$.

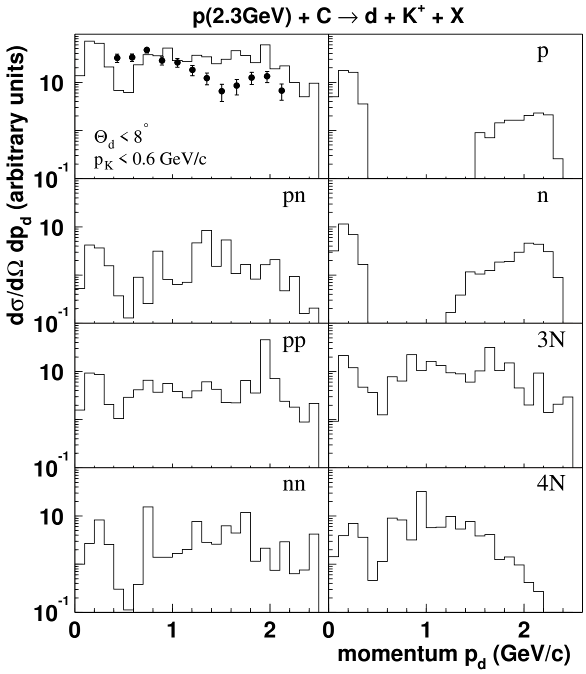


Fig. 2: Same as Fig. 1 for 2.3 GeV.

Further steps towards the better understanding of the reaction mechanism should be exclusive measurements, a systematic investigation of $K^+$ coincidences with other fragments like $^3$H, $^3$He and $^4$He and especially the investigation of the lightest target nuclei.

**References:**


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