Deuteron breakup $p + d \to \{pp\}_s + n$ at GeV energies with forward emission of the $\{pp\}_s$ diproton

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Study of the deuteron breakup $pd \to \{pp\}_s n$ with forward emission of a fast proton pair $\{pp\}_s$ with small excitation energy $E_{pp} < 3$ MeV has been performed in the T_p=0.5–1.97 GeV beam energy range using the ANKE spectrometer. In kinematically complete experiment with higher than in [1] statistics the E_{pp} spectra, the θ_k angular distribution of the proton momentum in the pair c.m.s., and the distribution of the neutron emission angle in the range $\theta_n = 168 - 180°$ were measured. The E_{pp} spectra essentially differ from the phase space distributions but, as expected, are well described (Fig. 1) within the Migdal-Watson approach of the $^1S_0$ final state interaction of the protons in a pair (except for 1.97 GeV where both descriptions fail). The proton angle θ_k is distributed isotropically, also consistent with the $^1S_0$ state of the pair. The θ_n distribution is non-isotropic and T_p energy dependent (Fig. 2); this might be a reflection of the fact that contributions of different mechanisms crucially change with energy as predicted by the ONE+SS+Δ model [2]. The differential cross section $d\sigma/d\Omega$ at $\theta_n = 180°$ follows an exponential drop with T_p energy in the range 0.5–1.4 GeV but significantly deviates from this dependence at 1.97 GeV (Fig. 3). Such a change of the regime is similar to that observed for the $pd \to dp$ backward elastic scattering [3] where flattening of the energy dependence is observed at 2.0–2.5 GeV.

The one-pion exchange (OPE) mechanism together with the one-nucleon exchange (ONE) contribution were used recently [4] for description of the energy dependence of the differential cross section averaged over the 8° angular interval around 180° obtained in our earlier measurements [1]. The model qualitatively describes also the entire set of the data.

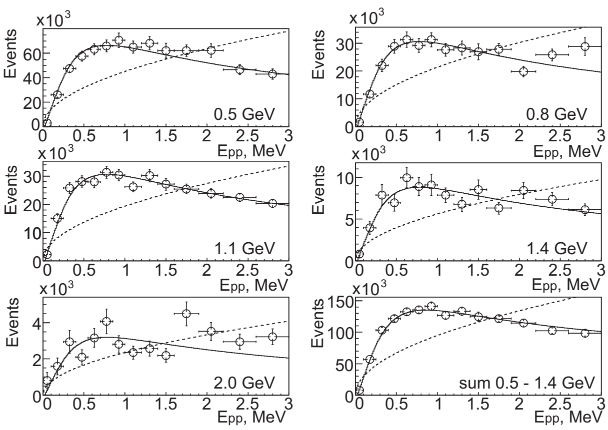

Fig. 1: Spectra of the kinetic energy E_{pp} in c.m.s. of the proton pair. Solid line corresponds to the Migdal-Watson approach, dotted line is the phase space distribution.

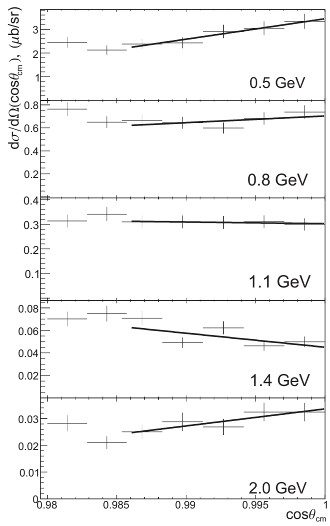

Fig. 2: Dependence of the differential cross section on the neutron emission angle in c.m.s. of the reaction.

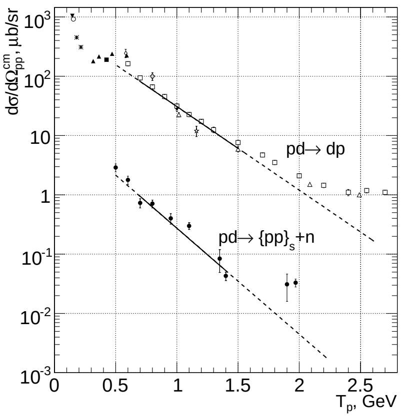

Fig. 3: Energy dependence of the differential cross sections of the $pd \to \{pp\}_s n$ and $pd \to dp$ processes at θ_n=180°. Full circles: present experiment; the $pd \to dp$ data: from [3] and refs. therein.

References:

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