Momentum correlation of particles recorded in the ANKE forward detector

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The absolute momentum values (p_1 and p_2) of two particles in any three-particle final-state process are strictly correlated if they are emitted into fixed directions (θ_1,ϕ_1 and θ_2,ϕ_2). The correlations are to some extent conserved if the precise directions are changed by some restricted solid angles. The ANKE forward detector (FD) accepts the secondaries with a polar emission angle from zero up to about 16°. However, the angular range is substantially reduced for particles of definite momentum (see Fig.1, which presents the ejectile momentum p versus the projection of the polar angle θ_{xz} on the median plane), and, moreover, it is limited to 5° for particles with full 2π azimuthal angle acceptance. Therefore, one may expect the existence of a significant kinematical correlation for particles recorded in this detector even without any additional kinematical cuts. Fig.2 shows the correlated momentum distributions for particle pairs produced in a hydrogen cluster target and both particles recorded in the FD. The momenta of the two ejectiles were calculated from the information on hit wires in the forward MWPCs. The correlations well correspond to the one expected from simulation (Fig.3) and are caused by the dominant processes with two positively charged particles: $pp \to pp\pi^0, pp \to pn\pi^+, pp \to d\pi^+$. The distributions are very useful for calibration purposes. They give a good overview of the experimental conditions like intensity of the main recorded processes, their momentum ranges and possible overlaps, background, etc. The distributions with the deuterium target (Fig.4 and Fig.5) show that the same processes as obtained with the hydrogen target are clearly observable with the deuterium target in a quasifree mode. As expected, some additional processes show up with deuterium.

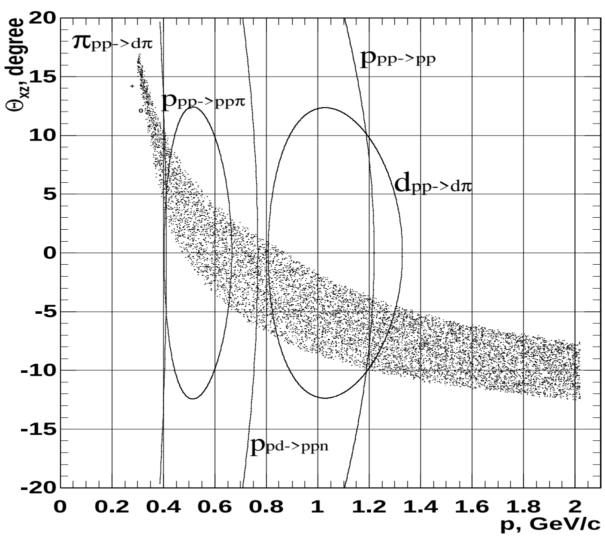

Fig. 1: FD angular-momentum acceptance

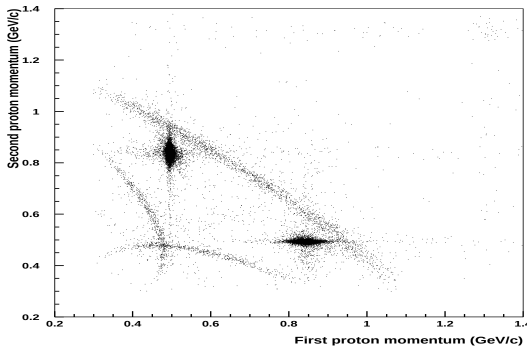

Fig. 2: Momentum of the two particles detected in the FD (experimental data, H_2 target, T_p=0.7 GeV).

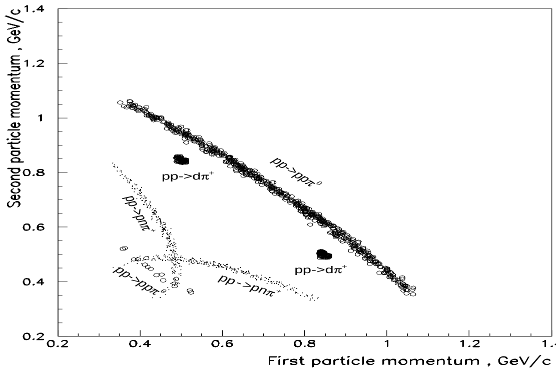

Fig. 3: Simulation for experimental conditions of Fig.2

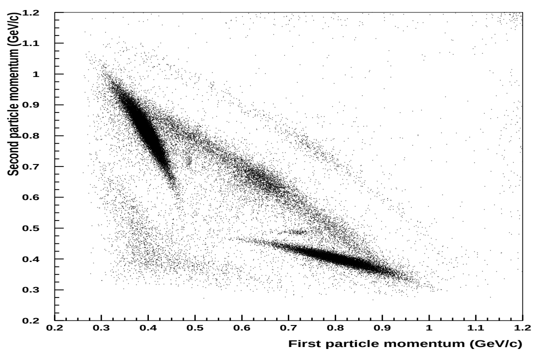

Fig. 4: Same as Fig.2 for D_2 target and T_p=0.6 GeV.

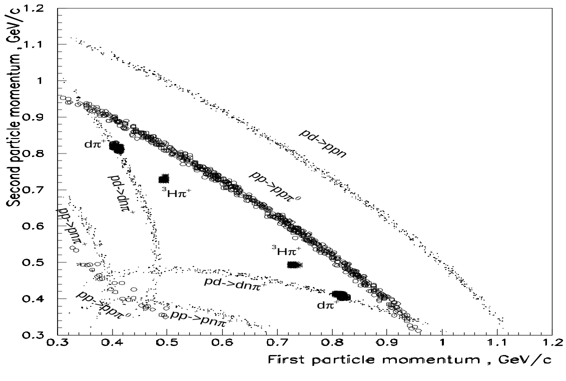

Fig. 5: Simulation for experimental conditions of Fig.4

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