Angular and momentum distributions of the $pp \to pp\eta$ reaction products.

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The S-wave interaction of η–mesons with nucleons influences substantially the energy dependence of the $pp \to pp\eta$ total cross section as observed by H. Calén et al.[1]. In angular and momentum distributions of the $pp \to pp\eta$ reaction products these final state interactions should be more sensitive. In order to search for such effects, we analysed experimental data collected in the near–threshold $pp \to pp\eta$ measurements performed at the COSY–11 facility. These measurements were done for nominal beam momenta varied continuously in the range from Q = - 9.6 MeV/c below to Q = 20.4 MeV/c above the threshold momentum equal to 1981.6 MeV/c. The nominal beam momentum, calculated from the synchrotron frequency and the beam orbit length, was corrected by -2 MeV/c based on the difference between the measured missing mass of the two outgoing protons and the known mass of the η–meson.

Figures 1 and 2 show examples of CM angular distributions of the η momentum vector and the proton–proton relative momentum vector, respectively, determined for the beam momenta range from 1993 to 1996 MeV/c, which is equivalent to an excess energy range of Q = 4 MeV to Q = 5 MeV. These distributions were obtained by correcting the experimental counts for the detection acceptance calculated from Monte Carlo simulations with phase space distribution of the reaction products weighted by the (p–p)-FSI. The angular distributions are flat indicating dominant S-waves in the exit channel.

Figure 3 shows the distribution of the event yield as a function of the relative momentum of the two outgoing protons again determined for beam momenta in the range from 1993 to 1996 MeV/c. The solid line indicates the result of a Monte Carlo calculation with phase space distribution weighted by the (p–p)-FSI whereas the dashed line represents calculations with a uniform phase space distribution. The solid line is normalized to the data points at small relative momenta, where (p–p)-FSI is particularly strong. With this normalization, the data points at higher relative momenta are underestimated. This can be caused by the $(\eta - N)$-FSI which has not been taken into account. Theoretical calculations describing the three body ppη final state with inclusion of (p–p)-FSI and (p–η)-FSI would be very useful for testing this hypothesis.

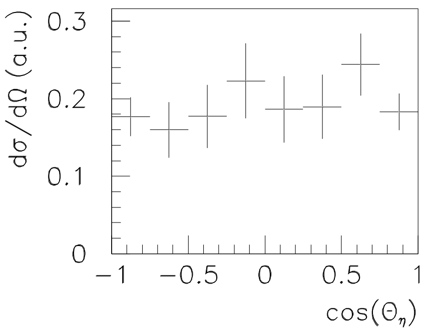

Figure 1: Angular distribution of the η momentum vector in the CM system.

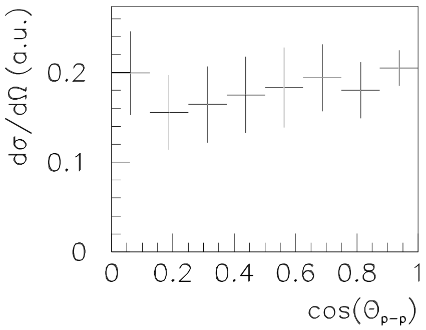

Figure 2: Angular distribution of the relative momentum vector of two protons the in CM system.

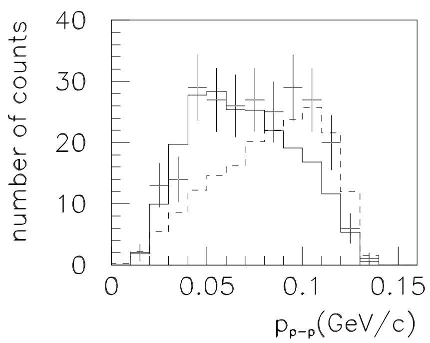

Figure 3: Distribution of the relative proton - proton momentum. Histograms are described in text.

References:

[1] H. Calén et al., Phys. Lett. **B366**(1996)39