Eta production

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Results of the study of the ηpp dynamics presented in the talk are avaiable via the e-Print Archive server [1]. Here we abridged the text to few remarks – from the introduction of this article – concerning investigations of the interaction between the η meson and the proton.

Due to the short live time of the flavour-neutral mesons (eg. η or η′), the study of their interaction with nucleons or with other mesons is at present not feasible in direct scattering experiments. One of the methods permitting such investigations is the production of a meson in the nucleon-nucleon interaction close to the kinematical threshold or in kinematics regions where the outgoing particles possess small relative velocities. In the last decade major experimental [2–4] and theoretical [5, 6] efforts were concentrated on the study of the creation of η and η′ mesons via the hadronic interactions [7]. Measurements have been performed in the vicinity of the kinematical threshold where only a few partial waves in both initial and final state are expected to contribute to the production process.

The determined energy dependences of the total cross section for η′ [2, 3] and η [3, 4] mesons in proton-proton collisions reveals that the proton-proton FSI enhances the total cross section by more than an order of magnitude for low excess energies. Interestingly, in the case of the η meson the increase of the total cross section for very low and very high energies is much larger than expected from the $^1S_0$ final state interaction between protons. The excess at higher energies can be assigned to the significant onset of higher partial waves, and the influence of the attractive interaction between the η meson and the proton could be a plausible explanation for the enhancement at threshold.

The interaction between particles depends on their relative momenta. Therefore it should show up as modification of the phase-space abundance in the kinematical regions where the outgoing particles possess small relative velocities. Only two invariant masses of the three subsystems are independent and therefore the entire accessible information about the final state interaction of the three-particle system can be presented in the form of the Dalitz plot. To some extent this information is still available from the projections of the phase space population onto the invariant mass distributions. These have been recently determined at Q = 15 MeV by the COSY-TOF collaboration [8] and at Q = 15.5 MeV by the COSY-11 group [1]. The structure of the observed spectra may indicate a non-negligible contribution from the P-waves in the outgoing proton-proton subsystem [6]. The amount of the P-wave admixture derived from the proton-proton invariant mass distribution leads to a good description of the excitation function at higher excess energies while at the same time it spoils significanly the agreement with the data at low values of Q [6]. In contrast to the P-wave contribution the three-body treatment [9] of the $pp\eta$ system leads to an even larger enhancement of the cross section near threshold than that based on the Ansatz of the factorization of the proton-proton and proton-η interactions. For the complete understanding of the low energy $pp\eta$ dynamics, a rigorous three-body approach to the $pp\eta$ system is required. A herald of such calculations have been already reported [9, 10].

[1] P. Moskal et al., e-Print Archive: nucl-ex/0307005.
[2] F. Balestra et al., Phys. Lett. **B 491**, 29 (2000);
R. Wurzinger et al., Phys. Lett. **B 374**, 283 (1996);
P. Moskal et al., Phys. Lett. **B 474**, 416 (2000);
P. Moskal et al., Phys. Rev. Lett. **80**, 3202 (1998).
[3] F. Hibou et al., Phys. Lett. **B 438**, 41 (1998).
[4] E. Chiavassa et al., Phys. Lett. **B 322**, 270 (1994);
H. Calén et al., Phys. Rev. Lett. **79**, 2642 (1997).
A. M. Bergdolt et al., Phys. Rev. **D 48**, R2969 (1993).
H. Calén et al., Phys. Lett. **B 366**, 39 (1996).
J. Smyrski et al., Phys. Lett. **B 474**, 182 (2000).
[5] M. Batinić et al., Phys. Scripta **56**, 321 (1997);
A. Moalem et al., Nucl. Phys. **A 600**, 445 (1996);
J.F. Germond, C. Wilkin, Nucl. Phys. **A 518**, 308 (1990);
J.M. Laget et al., Phys. Lett. **B 257**, 254 (1991);
T. Vetter et al., Phys. Lett. **B 263**, 153 (1991);
B.L. Alvaredo, E. Oset, Phys. Lett. **B 324**, 125 (1994);
M.T. Peña et al., Nucl. Phys. **A 683**, 322 (2001);
F. Kleefeld et al., Acta Phys. Pol. **B 29**, 3059 (1998).
V. Baru et al., Phys. Rev. **C 67**, 024002 (2003).
V. Bernard et al., Eur. Phys. J. **A 4**, 259 (1999).
K. Nakayama et al., Phys. Rev. **C 61**, 024001 (1999);
E. Gedalin et al., Nucl. Phys. **A 650**, 471 (1999);
V. Baru et al., Eur. Phys. J. **A 6**, 445 (1999);
S. Bass, Phys. Lett. **B 463**, 286 (1999);
A. Sibirtsev, W. Cassing, Eur. Phys. J. **A 2**, 333 (1998).
[6] K. Nakayama et al., e-Print Archive: nucl-th/0302061.
[7] P. Moskal et al., Prog. Part. Nucl. Phys. **49**, 1 (2002).
G. Fäldt et al., Physica Scripta **T 99**, 146 (2002).
[8] M. Abdel-Bary et al., Eur. Phys. J. **A 16**, 127 (2003).
[9] A. Fix, H. Arenhövel, in preparation (2003).
[10] A. Deloff, e-Print Archive: nucl-th/0309059.