η meson production in proton-proton collisions at 40 and 72 MeV excess energy

Henrik Petrén[(a)] for the CELSIUS/WASA collaboration

[(a)] Dept. of Physics and Astronomy, Uppsala University

The production of η mesons in proton-proton collisions has been studied with the WASA detector using internal pellet targets in the CELSIUS storage ring in Uppsala. Data were taken at two beam energies, 1360 MeV and 1445 MeV, corresponding to CM excess energies of 40 and 72 MeV, respectively. The η was detected by its 2γ decay in a near-4π electromagnetic calorimeter, whereas the protons were measured by a combination of straw chambers and plastic scintillator planes in the forward direction. The analysis yielded $69{\cdot}10^3$ events at 1360 MeV and $93{\cdot}10^3$ events at 1445 MeV, with a background contribution of less than 5%. A parametrization of the matrix element including almost all final states up to two units of total angular momentum describes the data at both energies, allowing us to investigate the influence of different partial waves.

While the invariant mass spectra are similar to the spectra obtained by TOF [1] and COSY-11 [2,3], the $\cos\theta^*_\eta$-distribution is found to be anisotropic with its maximum at 90° at both energies. From the parametrization of the matrix element it is inferred that this is due to interference between the Ss and Sd final states. Although no conclusion can be drawn regarding the Ps transitions, a significant contribution from the Pp final state is needed to describe data. These partial waves contribute to the enhancements seen at small proton-η and large proton-proton relative momenta. The enhancements have previously also been explained by an energy dependence of the primary production amplitude [4,5] and an η-proton final state interaction. The last alternative is less likely, as measurements by COSY-11 show that the invariant mass distributions in η' production are similar to the η case [6], and the η'-proton inte raction is known to be much weaker than the η-proton one [7]. If existing models are confronted with anisotropic angular distributions, a consistent picture could perhaps be found even in the absence of measurements of spin correlation coefficients.

[1] Abdel-Bary, M., *et al.*, Eur. Phys. J. **A 16**, 127 (2003).

[2] Moskal, P., *et al.*, Phys. Rev. **C 69**, 025203 (2004).

[3] Moskal, P., *et al.*, Eur. Phys. J. **A 43**, 131 (2010).

[4] Deloff, A., Phys. Rev. **C 69**, 035206 (2004).

[5] Ceci, S., *et al.*, Acta Phys. Pol. **B** Suppl. **2**, 157 (2009).

[6] Klaja, P., *et al.*, Phys. Lett. **B 684**, 11 (2010).

[7] Moskal, P., *et al.*, Phys. Lett. **B 482**, 356 (2000).

E-mail: henrik.petren@fysast.uu.se