Production of ω-Mesons at COSY-11

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Within meson exchange models the production of ω mesons in the $pp \to pp\omega$ reaction is essentially driven by both mesonic and nucleonic exchange currents [1]. To separate the contributions from the different exchange currents total cross section data are not sufficient but differential observables like angular distributions are needed.

At the COSY-11 system the reaction $pp \to pp\omega$ has been measured at excess energies of 25, 50 and 107 MeV in order to extract angular distributions of the ω emission angle as a function of the excess energy.

The COSY-11 installation is optimized for threshold studies where a full 4 π solid angle acceptance is achieved in the cm system. With increased excess energy the detection efficiency is decreasing. But due to the large exit window at the COSY-11 dipole even for high excess energies the full azimuthal angular distribution is covered if the reaction plane is parallel to the COSY dipole plane. Therefore the full angular distribution for the ω emission is measurable. To extract the angular distribution the missing mass distribution has to be generated for separate bins in $\cos\Theta^*_\omega$, the ω emission angle in the cm system with respect to the beam direction. For each $\cos\Theta^*_\omega$ bin the number of ω events has to be determined and compared to corresponding Monte Carlo data samples. The Monte Carlo data are generated assuming a pure s-wave phase space distribution including the known pp final state interaction. Deviations from these assumed s-wave behaviour which are certainly expected at such high excess energies would modify the $\cos\Theta^*_\omega$ distribution by the efficiency variations as a function of the other relevant kinematic variables. Therefore double differential distributions have to be studied.

An instructive variable is given by the orientation of the ejectile plane relative to the beam axis. The yield of the ω production can vary with the angle of the ejectile plane which would result in a modification of the $\cos\Theta^*_\omega$ distribution extracted at COSY-11.

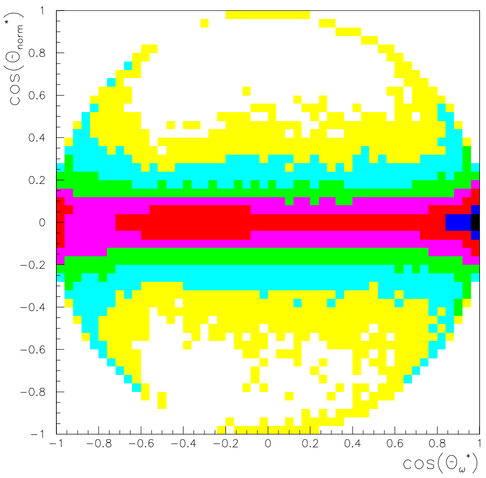

Fig. 1: Two dimensional distribution in the cm system for the ejectile plane perpendicular versus the ω emission angle for the data at $\varepsilon = 107$ MeV.

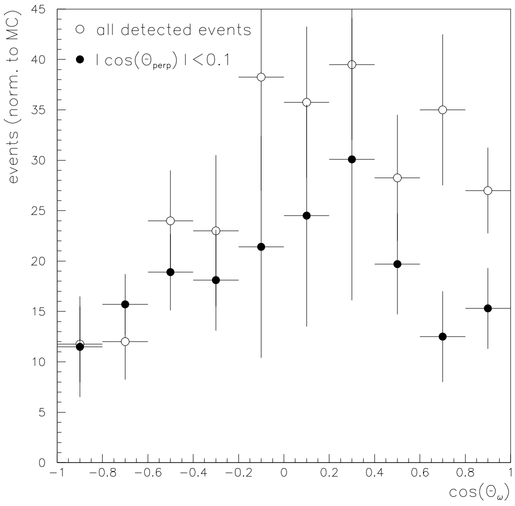

Fig. 2: Angular distribution of the produced ω mesons at $\varepsilon =$ 107 MeV including the full data sample (open symbols) and with a cut on the ejectile plane orientation $|\cos\Theta^*_{perp}| < 0.1$ (full symbols).

In Fig. 1 the distribution of events in the field of the cosine of the ejectile plane perpendicular $\cos\Theta^*_{perp}$ versus the $\cos\Theta^*_\omega$ is shown for the data at $\varepsilon = 107$ MeV. Mainly the region around $\cos\Theta^*_{perp} = 0$ is populated with events, i.e. when the ejectile plane is parallel to the COSY dipole plane.

To detect possible modifications of the $\cos\Theta^*_\omega$ distribution due to a dependency of the ω production from the orientation of the ejectile plane the angular distribution is determined for different cuts on the ejectile plane perpendicular $\cos\Theta^*_\omega$. Fig. 2 shows the distributions with a cut on $|\cos\Theta^*_{perp}| < 0.1$ (filled symbols) and for the full data sample (open symbols). The distributions show differences indicating a non uniform ω production with regard to the ejectile plane orientation. Therefore double differential event selection for the extraction of angular distributions is required. Only the data points with a restriction on the ejctile plane orientation show the physically expected symmetry around 0 but the extracted angular distribution is not consistent with recent data from the TOF collaboration [2] and DISTO data [3].

To reduce the errors on the data the analysis is continued. The background substraction in the missing mass distribution will be improved by Monte Carlo data and different binnings in the double differential distributions will be studied.

References:

[1] K. Nakayama et al., Phys. Rev. C**57**, 1580 (1998).
[2] S. Abd El-Samad et al., Phys. Lett. B**522**, 16 (2001).
[3] F. Balestra et al., Phys. Rev. Lett. **81**, 4572 (1998), Phys. Rev. C **63**, 024004 (2001).