Abstract

In the framework of this thesis a first measurement of the $pn \to d\omega$ total cross section has been performed at mean excess energies of $Q \approx 26$ and 60 MeV. The motivation, apparatus, analysis, results and their tentative interpretation are discussed in the following.

The comparison of the cross sections for meson production in proton-proton and proton-neutron collisions close to threshold, constrain theoretical models describing the production mechanisms. For η production the observed cross section ratio $R = \sigma_{\rm tot}(pn \to pn\eta)/\sigma_{\rm tot}(pp \to pp\eta) \approx 6.5$ is generally attributed to isovector dominance in model calculations based on meson exchange. It is therefore interesting to investigate whether a similar isospin dependence is found also for the ω, the next heavier isoscalar meson. Relatively few experiments were performed for the $pp \to pp\omega$ reaction, but in proton-neutron collisions no data whatsoever are available.

The $pn \to d\omega$ reaction was studied in the $pd \to p_{\rm sp}d\omega$ reaction at four proton beam momenta between 2.6 and 2.9 GeV/c at the ANKE spectrometer of COSY-Jülich. A deuterium cluster-jet target was used as an effective neutron target, detecting the low momentum recoil protons ($p_{\rm sp}$), which have momenta of about 80 MeV/c, in a silicon telescope placed close to the target. These recoil protons can be treated as "spectators" that influence the reaction only through their modification of the kinematics. By variation of angle and momentum of the spectator protons, a certain range in excess energy Q is selected experimentally. This range is used to extract results in pn collisions for the corresponding Q values. The deuterons emitted at angles below 8° with a momenta around 2 GeV/c were detected in the forward system of the ANKE spectrometer. Inclined Čerenkov counters in combination with two layers of scintillation counters enabled us to identify these deuterons despite a two orders of magnitude higher proton background. Their momenta were reconstructed using the information from two multi-wire proportional chambers. The $pn \to d\omega$ reaction was then identified *via* the missing mass technique. In order to normalise the data, first the efficiencies of all detectors were evaluated. Secondly the absolute luminosity was determined by the pd elastic scattering reaction, employing the possibility to identify slow deuterons simultaneously in the silicon telescope.

Measurements in $pp \to pp\omega$ at SATURNE show there to be a strong contribution from multi-pion production below the ω peak in the missing mass spectrum. This can only be reliably estimated by comparing data above and below the ω threshold. Used are the experimental data at 2.6, 2.7, 2.8 and 2.9 GeV/c beam momentum, which correspond to mean Q values in $pn \to d\omega$ of -40, -5, 26 and 60 MeV respectively. At the highest energy, there is clear evidence for an ω peak, whereas at 2.8 GeV/c the residual ω signal depends much

more sensitively upon the background description. The cross sections extracted for $pn \to d\omega$ at $Q \approx 26\,\mathrm{MeV}$ and $60\,\mathrm{MeV}$ are significantly smaller than theoretical predictions. This suggests that the reaction mechanism for ω production differs from the one for the η, possibly implying a relatively larger contribution from isoscalar meson exchange. Measurements with higher precision in both Q and in cross section are scheduled already for August 2003. The results are expected to shed even further light on the basic production mechanisms.