# RECENT MEASUREMENTS OF THE $\eta$ PRODUCTION IN PD COLLISIONS AT CELSIUS

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In October and November of 1994 twenty seven 8-hour CELSIUS shifts were used to study pd $\longrightarrow$ $\eta$+X reactions. The experiment was a part of the long term research program to study the production of mesons in light ion collisions at CELSIUS. The main goal of the experiment was to measure the total cross-section and the $\eta$ production angle distribution for $^3$He$\eta$ reaction channel and to estimate the total cross-sections for pd$\eta$ and ppn$\eta$ channels. All these reactions are poorly known both experimentally and theoretically and a large effort is needed to understand the involved mechanisms. A second goal of the experiment was to explore the $\eta$ tagging possibilities for the future rare decay studies of this meson within the WASA program.

The experiment was performed using the PROMICE-WASA experimental setup shown schematically in fig. 1.

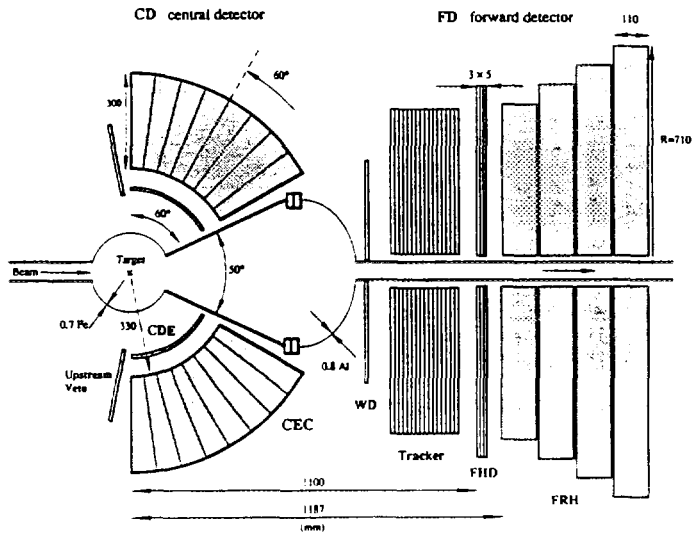


Fig. 1. Schematic layout of the PROMICE-WASA experimental set-up

There are several important improvements of the set-up made recently, which can be summarized as follows:

1 two sets of straw chambers were placed between Juelich Hodoscope (JH) and the scattering chamber to provide position resolution of 4 mm at present and ≈ 300 $\mu$m in future,

2 a set of 4 counters made of 3 mm thick plastic scintillator was placed around the beam pipe close to the spherical part of the scattering chamber (WD in fig. 1) to improve the background conditions [1],

3 luminosity measurement was improved by installing a multistrip silicon detector for recording protons or deuterons recoiling to large angles in pp or pd elastic collisions,

4 a new tigger based on energy deposits in WD was developed to select $^3$He$\eta$ channel.

The measurements were done at 4 beam energies: 930, 965, 1037 and 1100 MeV. A simple phase space Monte Carlo simulation shows that at these energies the acceptance of the Forward Detector - JH and the Range Detector (RH) - for charged particles accompanying $\eta$ is much larger than the acceptance of the CsI arrays for 2 $\gamma$'s from the $\eta$ decay. Therefore an attempt was made to use FD alone. Unfortunately this turned out to be possible only for $^3$He$\eta$ channel. An example of missing mass distribution obtained for $^3$He selected with WD trigger is shown in fig.2. For the pd$\eta$ channel the backgroung from other reactions was too high to see any signature of the $\eta$ peak. However when the presence of 2 $\gamma$'s in the CsI arrays was required a clear peak corresponding to $\eta$ mass was found in the pd missing mass as well. This is shown in fig.3 which represents missing mass spectrum obtained for pd at 965 MeV beam energy.

The silicon multistrip detector was working quite satisfactory and together with the straw chamber provided an extremely clean sample of the pd elastic events for each of the beam energies. Two dimensional spectrum representing $\theta_p$ (forward scattered proton as measured by the straw chamber) versus the energy deposit of the recoiling deuteron in the Si detector is shown in fig. 4.

From the data analysis done so far follows that roughly 9000, 13000, 14000 and 6000 $\eta$ were detected at 930, 965, 1037 and 1100 MeV respectively in $^3$He$\eta$ channel. For the pd$\eta$ channel these numbers are at least 10 times lower due to smaller acceptance of the CsI arrays.

**References**

[1] D. Reistad et al. Some conditions for experiments with thin internal targets, International Conference on Physics with GeV-Beams, Juelich, Germany, August 22-25, 1994.

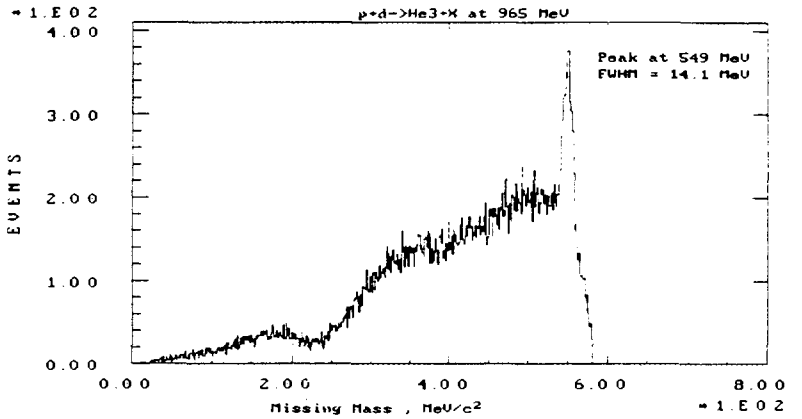


Fig.2. Missing mass distribution for pd$\rightarrow$$^{3}$He+X at 965 MeV beam energy

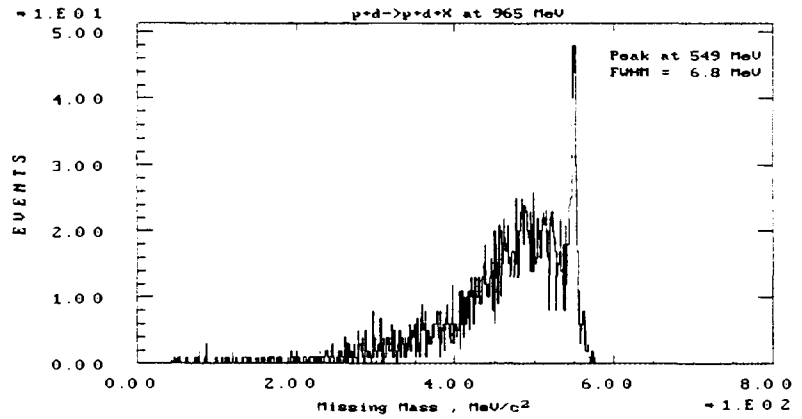


Fig.3. Missing mass distribution for pd$\rightarrow$pd+X at 965 MeV beam energy

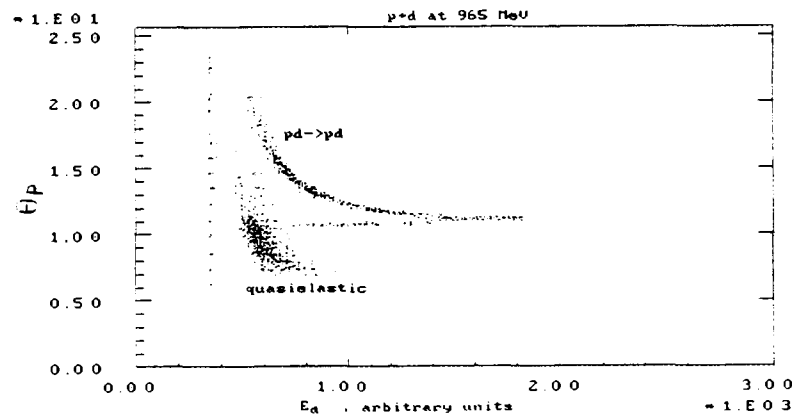


Fig.4. Elastic and quasielastic scattering of protons on a deuteron target