First Measurements of the $p + p \to p + p + \eta\prime$ Reaction near Threshold

COSY–11 Collaboration

The η and $\eta\prime$ mesons are composed of the $u\overline{u}$, $d\overline{d}$ and $s\overline{s}$ quarks. They differ only in the content of the $s\overline{s}$ quark pair. A few MeV above the threshold the cross section for the $p + p \to p + p + \eta$ reaction, is in the order of $1\mu b$ see [1]. Till now there are no data concerning the production of the $\eta\prime$ meson in proton-proton collision. There exists only estimation [2] according to which the cross section for the $p + p \to p + p + \eta\prime$ reaction is about two or three orders of magnitude smaller than the one for η production.

In october this year we performed two measurements with beam energy of 4 MeV/c above and 3 MeV/c below the reaction threshold. In both cases the experiment last about 40 hours. The estimated luminosity was about 5 $10^{29} cm^{-2} s^{-1}$.

Our detection system [3] allow us to measure the velocity and momentum of each positively charged particle. Having momentum and velocity we can calculate the registered particle mass. Thus we can choose all events with two protons in the exit channel. As $\eta\prime$ is a neutral particle and is not registered by the COSY - 11 system we identify it by means of the missing mass method. In the preliminary analysis we obtained missing mass spectra for above and below threshold measurement which are shown in figure 1 and figure 2 respectively. These spectra are still not normalized to the elastic scattering. However taking into account that the time of the measurements were equal in both cases and assuming that the changes in flux were not larger than a factor of 2, we can conclude that during this first trial at least fifty events were observed which are due to the production of $\eta\prime$ meson.

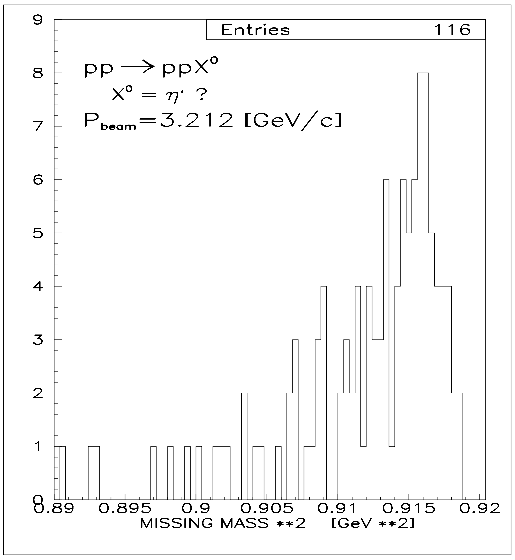

Figure 1: Missing mass of the unobserved particle in the $p + p \to p + p + X^{\circ}$ reaction at a beam momentum of 3.212 GeV/c, 4 MeV/c above threshold.

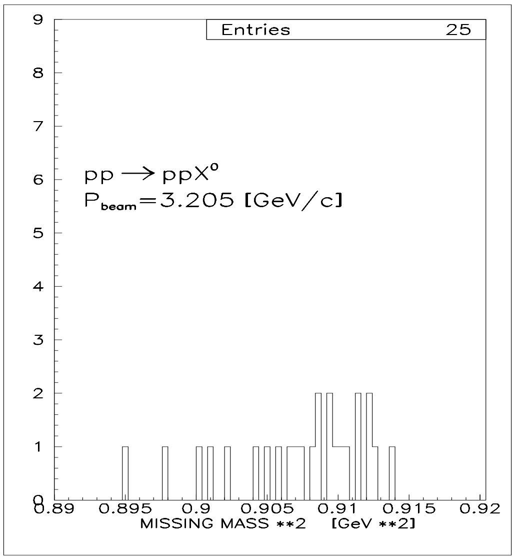

Figure 2: Missing mass of the unobserved particle in the $p + p \to p + p + X^{\circ}$ reaction at a beam momentum of 3.205 GeV/c, 3 MeV/c below threshold.

References

[1] Ulf Schuberth *The Reaction $pp \to pp\eta$ Close to Threshold* Ph.D. thesis, Uppsala 1995

[2] Y. Le Bornec *The interactions of heavy mesons with nuclei* IPNO-DRE 90.07

[3] A. Budzanowski et al. *COSY - 11 Detector Arrangement* Report KFA-IKP(I)-1991