

## Online analysis of the $pp \rightarrow pp\eta'$ reaction at COSY-11

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One of the main goals of the COSY-11 collaboration is to study the  $\eta$  and  $\eta'$  meson interactions with nucleons. The first part of these investigations, namely the study of the proton- $\eta$  interaction, has been recently performed. Phenomenological analysis of the determined differential distributions for the production cross sections revealed an enhancement of the population density in the kinematical regions corresponding to the low proton- $\eta$  relative momentum [1, 2]. Encouraged by this finding we realized the second part of these investigations, the study of the interaction of the meson  $\eta'$  with protons [3]. Firstly, over the last few years, we have determined the energy dependence of the total cross section for the  $pp \rightarrow pp\eta'$  reaction [4]. Contrary to the  $\eta$  case, a signal from the proton- $\eta'$  final state interaction is not seen in the excitation function for the  $pp \rightarrow pp\eta'$  reaction. Therefore in September 2003 we have performed a high statistics measurement of the  $pp \rightarrow pp\eta'$  reaction at an excess energy of  $Q = 15.5$  MeV in order to generate the distribution of events over the phase space. We expect that the determination of the distributions of the invariant masses for two-particle subsystems of the  $pp\eta'$  final state will give the first ever experimental evidence for this still completely unknown interaction.

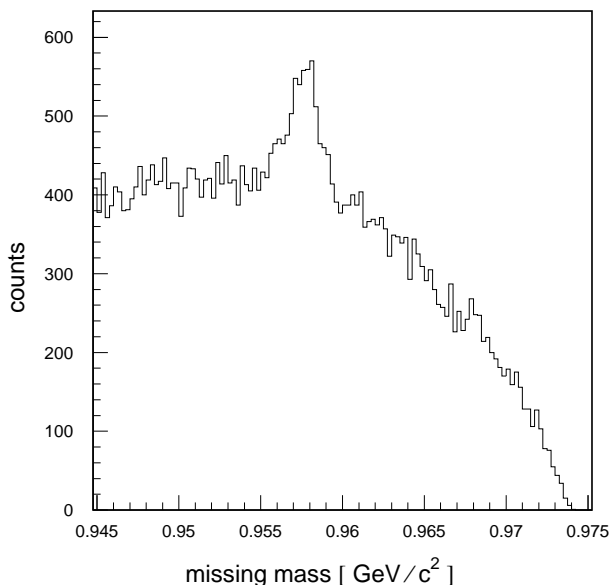


Fig. 1: *On-line missing mass distribution of the  $pp \rightarrow ppX$  reaction, measured in October 2003.*

Although the close-to-threshold total cross section for the  $pp \rightarrow pp\eta'$  reaction is by a factor of 30 smaller than the one for the  $pp \rightarrow pp\eta$  reaction, three weeks of measurements for  $pp \rightarrow pp\eta'$ , granted by the Programme Advisory Committee, was enough to obtain a statistics

comparable to the one of a one week measurement of the  $pp \rightarrow pp\eta$  reaction. This is due to the fact that i) the luminosity was by factor of three improved and ii) the COSY-11 detection system acceptance for the  $pp \rightarrow pp\eta'$  reaction is by a factor of 2.3 larger than that for the reaction  $pp \rightarrow pp\eta$  at the same excess energy. The latter factor originates from the fact, that the center of mass of the  $pp\eta'$  system is moving much faster than the one of  $pp\eta$  system. Consequently the cone of the reaction products in the laboratory is smaller and hence a larger fraction of events can be registered.

Using a proton beam [5] and a hydrogen target [6] the  $pp \rightarrow ppX$  reaction has been studied at a beam momentum of 3.257 GeV/c, which in the case of  $pp \rightarrow pp\eta'$  reaction is equivalent to the excess energy of  $Q = 15.5$  MeV. Events corresponding to the  $pp \rightarrow pp\eta'$  reaction have been measured using the COSY-11 facility [7] by simultaneous registration of the outgoing charged ejectiles, which are detected by means of drift chambers and scintillator hodoscopes. The momentum vectors of protons are reconstructed by tracking back the trajectories to the target point. The  $\eta'$  meson is identified via the missing-mass technique. The missing-mass spectrum – of the unregistered system X – determined on-line from 10% of the data written to tapes is shown in the figure 1. One recognizes a clear signal at a mass equal to the mass of the  $\eta'$  meson. We estimate that the overall number of registered  $pp \rightarrow pp\eta'$  events amounts to about 13000. The data analysis aiming in the determination of the Dalitz plot distribution is in progress.

### References:

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