Study of the total width of the η' meson - status of the data analysis

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The analysis of the $pp \to pp\eta'$ data from the COSY–11 measurement is essentially completed. During 2008 detailed studies of the position of the drift chambers, consituting the crucial factor in determining momenta of the outgoing protons, were performed. Under the assumption that the reconstructed trajectory of a particle through both drift chambers (DCs) should be a straight line the relative position of the DCs was corrected. The left plot in Fig. 1 shows the $\chi^2/nfree$ dependence (from a fit of a straight line to the reconstructed distance of the particle to the wires) on the relative position of DC2 with respect to DC1. As a next step the absolute position of the DCs was corrected using the shape of the kinematical ellipse of the elastically scattered protons (see [1] for details). Finally the position of DC2 was corrected by +0.42, -0.27 and +0.05 cm in X, Y and Z directions respectively and DC1 in X direction by +0.28 cm.

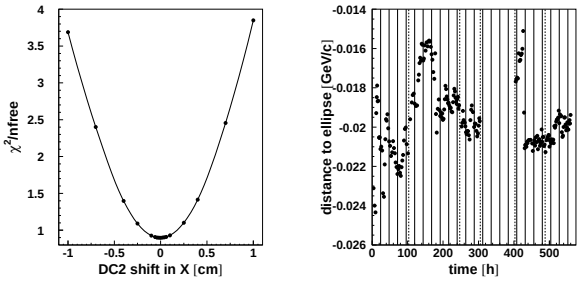

Fig. 1: **Left:** $\chi^2/nfree$ reulting from the fit of a straight line to the signals from both drift chambers as a function of the position of the second chamber with respect to the first one.
Right: Deviations of the position of the kinematical ellipse for elastically scattered protons from the expected position. Straight lines denote 24 h intervals and dashed lines separate different beam momenta (3218, 3211, 3214, 3213 and 3224 MeV/c respectively).

Having calibrated signals from all detectors one can focus on the check of stability of the reconstructed momenta of the outgoing protons, which depends on the stability of the beam momentum and position of the target (i.e. stability of the density of the target stream). These were monitored based on the momentum distribution of the elastically scattered protons. The fluctuations of the position of the kinematical ellipse of the elastically scattered protons are presented in the right plot in Fig. 1. In order to correct the mean deviation by adjusting the beam momentum one would need to apply changes ten times larger than the uncertainty of the beam momentum settings. Similarly, any variations of the target position in the X direction perpendicular to the proton beam would be in contradiction to the information from a diagnosis unit installed to determine the exact position of the target stream [2]. Therefore, the observed deviations can be plausibly explained only by variations of the density of the target stream along the Z direction (longitudinal to the proton beam). In

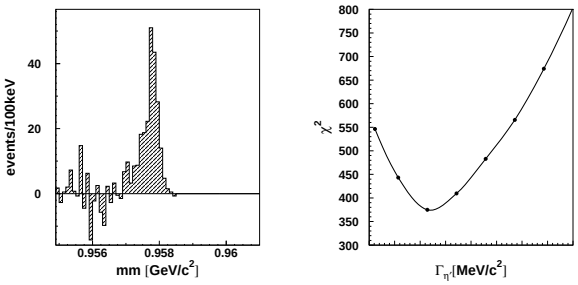

Fig. 2: **Left:** Example of a missing mass spectrum for the $pp \to ppX$ reaction for the energy closest to the threshold of the η' meson production ($Q = 0.9MeV$). Since the FWHM of the presented signal is $\approx 0.3MeV/c^2$ the achieved experimental missing mass resolution is comparable with the total width of the η' meson (≈ 0.2 MeV/c^2 [3]).
Right: χ^2 dependence for the fit of simulated distributions to experimental missing mass spectra for different total widths of the η' meson ($\Gamma_{\eta'}$) assumed in simulations. The only free parameters were the normalisation factors. The obtained statistical error ($\chi^2_{min} \pm 1$) amounts to about $\pm 0.01MeV/c^2$ (preliminary).

Z direction the target has a length of $\approx$ 1 cm, and in order to explain the discussed variations a shift of the center of the density distribution by $\approx$ 1 mm would be sufficient.
The corrections discussed above will be applied in the near future. The present preliminary results shown in Fig. 2 were obtained without taking into account the density variations inside the target. The left plot presents one out of five missing mass spectra obtained from data at a beam momentum of 3211 MeV/c. For each beam momentum a set of Monte Carlo histograms with different total width of the η' meson was prepared. Fitting simultaneously the spectra for all beam momenta by varying only the normalisation factors one can determine the total width of the η' meson from the form of the χ^2 plot (Fig. 2 right). Nevertheless, due to the still missing correction of fluctuation of the target position the evaluation of the total width of the η' meson is still in progress.

References:

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[3] C. Amsler *et al.* (Particle Data Group), Phys. Lett. **B667**, 1 (2008)

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