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TWO-PROTON CORRELATION FUNCTION FOR THE $pp \to pp + \eta$ AND $pp \to pp + pions$ REACTIONS

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For the very first time, the correlation femtoscopy method is applied to a kinematically complete measurement of meson production in the collisions of hadrons. The shape of the two-proton correlation function derived for the $pp \to pp\eta$ reaction differs from that for the $pp \to pp(pions)$ and both do not show a peak structure opposite to results determined for inclusive measurements of heavy ion collisions.

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In this contribution we briefly describe results presented in details in reference [1].

Momentum correlations of particles at small relative velocities are widely used to study the spatio-temporal characteristics of the production processes in relativistic heavy ion collisions[2]. This technique, called *correlation femtoscopy*[3], originates from photon intensity interferometry initiated by Hanbury Brown and Twiss[4]. Implemented to nuclear physics[3,5,6] it permits to determine the duration of the emission process and the size of the source from which the particles are emitted[3]. In the case of the $pp \to pp\eta$ reaction the knowledge of this size might be essential to answer the intriguing question whether the three-body $pp\eta$ system is capable of supporting an unstable Borromean bound state postulated by Wycech[7].

In contrast to heavy ion collisions[8], in the case of single meson production, the kinematics of all ejectiles may be entirely determined and hence a kinematically complete measurement of meson production in the collisions of hadrons gives access to complementary information which could shed light on the interpretation of the two-proton correlations observed in heavy ion reactions. It is also important to underline that the correlation of protons was never exploited till now in near threshold meson productions, and as an observable different from the distributions of cross sections, it may deepen our understanding of the dynamics of meson production.

Here we report on a η meson and multi-pion production experiment in which the mesons were created in collisions of protons at a beam momentum of 2.0259 GeV/c[9]. Momentum vectors of outgoing protons from the $pp \to ppX$ reaction were measured by means of the COSY-11 detector[10].

The shape of the obtained proton-proton correlation function reflects not only the space-time characteristics of the interaction volume but it may also be strongly modified by the conservation of energy and momentum and by the final state interaction among the ejectiles. In order to extract from the experimental data the shape of the correlation function free from these effects we constructed a double ratio dividing the experimental functions by the corresponding simulated correlation function for a point-like source[1]. The determined double ratios are presented in Figure 1. A significant discrepancy between the two-proton correlation functions

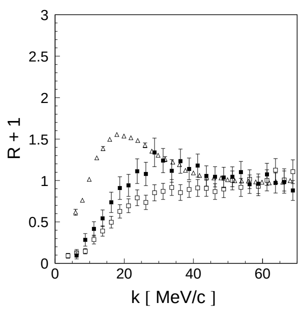

Fig. 1. The two-proton acceptance corrected correlation functions normalized to the corresponding simulated correlation function for a point-like source. Results for the $pp \to pp\eta$ (full squares) and $pp \to pp$+*pions* (open squares) are compared to the two-proton correlation function determined from heavy ion collisions (triangles). The double ratio is a well established measure of correlations used e.g. by the ALEPH, OPAL and DELPHI collaborations[11,12,13]. Variable k denotes the proton momentum in the proton-proton ceneter of mass frame.

determined from inclusive heavy ion reactions[14] and from exclusive proton-proton measurements[1] is clearly visible. The data from the kinematically exclusive measurement do not reveal a peak structure at 20 MeV/c.

At present it is not possible to draw a solid quantitative conclusion about the size of the system since e.g. in the case of the $pp \to pp\eta$ reaction it would require to solve a three-body problem where pp and $p\eta$[15] interactions contribute significantly to the proton-proton correlation. However, based on semi-quantitative predictions[16] one can estimate that the system must be unexpectedly large with a radius in the order of 4 fm. This makes the result interesting in context of the predicted quasi-bound ηNN state[17] and in view of the hypothesis[7] that the proton-proton pair may be emitted from a large Borromean like object whose radius is about 4 fm.

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