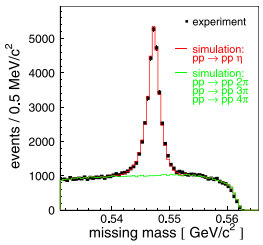
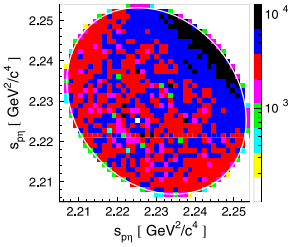
Proton-proton correlation function for the pp → ppη reaction measured with COSY-11

Paweł Klaja[1,2] & Paweł Moskal[1,2] for the COSY-11 collaboration
[1]IKP, Forschungszentrum Jülich, 52425 Jülich, Germany
[2]Institute of Physics, Jagellonian University, 30-059 Kraków, Poland

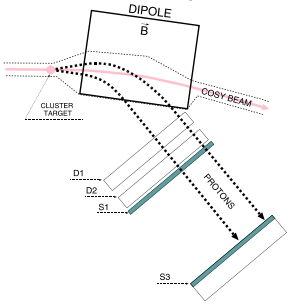
MENU2007 Conference, Jülich, September 2007

the pp → ppη reaction measured at the beam momentum of p_B=2.0259 GeV/c [1]





COSY-11 detection setup



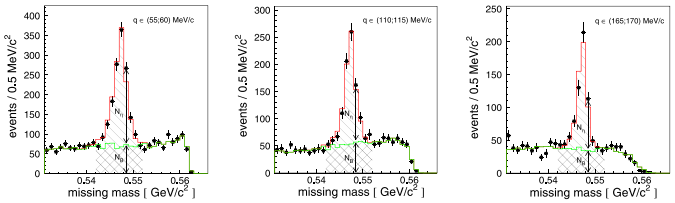
correlation femtoscopy [2]

technique [3, 4, 5] permits to determine space-time features of the reaction volume and is based on the correlation function:

$$R(q) + 1 = C \cdot \frac{Y_{12}(q)}{Y^{*}_{12}(q)}$$

where $Y_{12}(q)$ denotes the coincidence yield and $Y^{*}_{12}(q)$ stands for the uncorrelated reference sample derived using event mixing technique

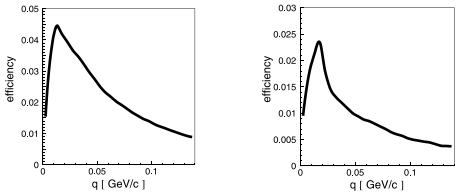
multi-pion production background subtruction [6]



the probability that i^{th} pp → ppX event with a missing mass m_i, and relative momentum q_i corresponds to pp → ppη reaction reads:

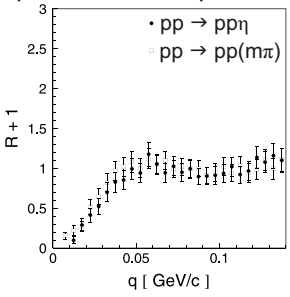
$$\omega_i = \frac{N_\eta}{N_\eta + N_B}(m_i, q_i)$$

overall efficiency and acceptance of the COSY-11 apparatus



pp → ppη pp → pp(mπ)

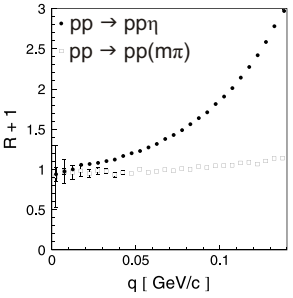
experimental two-proton correlation function



double ratio:

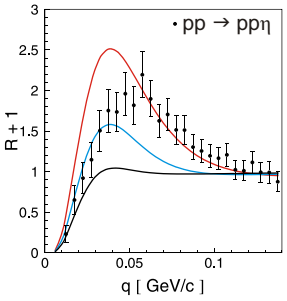
$$R(q) + 1 = C_{exp/MC} \cdot \left[\frac{Y_{exp}(q)}{Y^{*}_{exp}(q)} \Big/ \frac{Y_{MC}(q)}{Y^{*}_{MC}(q)} \right]$$

two-proton correlation function simulated

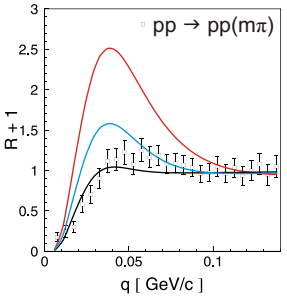


experimental results of COSY-11 [7] compared with theoretical calculations by A. Deloff [8, 9]:

$r_0^{pp\eta} \approx 2.5$ fm



r_0 = 2.0 fm
r_0 = 3.0 fm
r_0 = 5.0 fm



$r_0^{pp(m\pi)} \approx 4.0$ fm

references:

[1] P. Moskal et al.: Phys. Rev. C 69 (2004) 025203
[2] R. Lednicky: Nukleonika 49 (Sup 2) (2004) S3
[3] R. Hanbury-Brown, R. G. Twiss: Phil. Mag. 45 (1954) 663
[4] S. E. Koonin: Phys. Lett. B 70 (1977) 43
[5] R. Lednicky and L. Lyuboshits: Sov. J. Nucl. Phys. 35 (1982) 770
[6] P. Klaja and P. Moskal et al.: Acta. Phys. Slovaca 56 (2006) 251
[7] P. Klaja, P. Moskal, A. Deloff: AIP (2007), in print
[8] A. Deloff: private communication (2007)
[9] A. Deloff: AIP (2007), in print