Near Threshold Production of η' Mesons in the Proton-Proton Scattering

A. Khoukaz* and C. Quentmeier* for the COSY-11 collaboration

Data on the η' meson production in the reaction channel $pp \to pp\,X$, one of the main research topics [1–3] of the internal beam facility COSY-11 at COSY-Jülich, have been taken at excess energies of Q = 26.5, 32.5 and 46.6 MeV [4]. The event selection was performed by accepting events with two identified protons. The four-momentum determination of positively charged ejectiles yields a full event reconstruction for the reaction type $pp \to ppX$ and the X-particle system can be identified using the missing mass method. Therefore, kinematical distributions of the reaction ejectiles can be studied.

In Fig.1 the resulting angular distributions are shown. The quoted error bars include statistical and systematical errors. Within the errors the presented distributions at excess energies of Q = 32.5 MeV and Q = 46.6 MeV are compatible with an isotropic emission. This is consistent with the result from the DISTO collaboration at an excess energy of Q = 144 MeV [6].

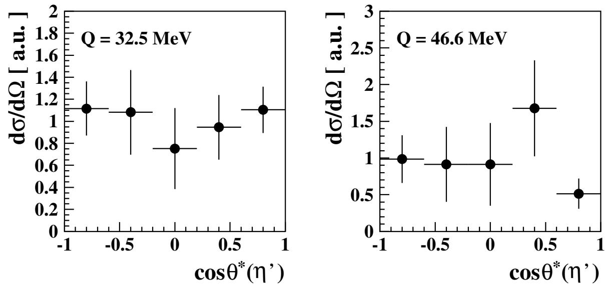

Figure 1: Angular distributions of the emitted η' mesons in the center of mass system for the reaction $pp \to pp\eta'$ at Q = 32.5 MeV and Q = 46.6 MeV.

In Fig.2 the extracted total cross sections (filled circles) are compared with other existing data [1, 2, 5, 6]. The solid line indicates a fit to the data resulting from pure s-wave three body phase space calculations modified by the proton-proton final state interaction (FSI) and Coulomb effects [7] which describes the whole set of existent data even up to excess energies of Q = 144 MeV. In addition, the dashed line shows a corresponding calculation but neglects both final state interactions and Coulomb effects. This curve was arbitrarily fixed to the present data point at Q = 26.5 MeV. From the comparison of these two curves with the data we conclude that the excitation function can be described without further contributions from higher partial waves and in particular without strong effects of an η'-proton interaction. The formerly discussed possibility of a repulsive η'-proton interaction [8, 9] seem to be of minor importance. This observation is in agreement with the result [3] that the η'-proton scattering length is small and similar to the one for the π^0-proton system.

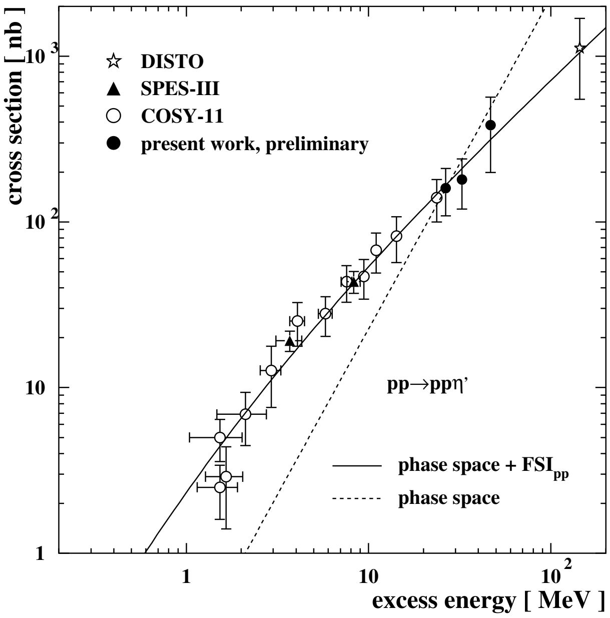

Figure 2: Total cross sections for the reaction $pp \to pp\eta'$ as function of the excess energy Q. Filled circles correspond to the data presented in this paper and open circles, triangles and stars correspond to data from [1,2, 5,6], respectively. The curves are explained in the text.

* Institut für Kernphysik, Westfälische Wilhelms-Universität, Münster, Germany

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