FINAL STATE INTERACTION IN NEAR-THRESHOLD MESON PRODUCTION* **

A. Sibirtsev

Institut für Theoretische Physik, Universität Giessen
D-35392 Giessen, Germany

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It is discussed what kind of information other than the FSI parameters can be extracted from near-threshold meson production.

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It was predicted by Watson and Migdal [1] that close to threshold the energy dependence of the cross section is dominated by the Final State Interaction (FSI). Within the Watson–Migdal approximation the transition amplitude is factorized in terms of the production and FSI amplitudes. Further study were performed by Gottfried and Jackson [2] with introduction the absorptive correction to the Born amplitude due to the initial and FSI.

As was first proposed by Gell–Mann and Watson [3] the near-threshold energy dependence of the $pp \to pp\pi^0$ cross section is well reproduced by the Phase–Space (PS) basis and the FSI. Within the nonrelativistic limit the PS for n-particles is proportional to $\varepsilon^{(3n-5)/2}$, where ε stands for the excess energy and equals to the difference between the invariant collision energy and the total mass of the produced particles. At the range $0 \leq \varepsilon \leq 100$ MeV the cross section for 3-particle production might increase 4 orders of magnitude due to the PS only. Let us to analyze not the cross section itself but the average reaction amplitude given as

$$|M| = \left(\frac{F\sigma}{R_3}\right)^{1/2}, \tag{1}$$

where F is the flux factor and R_3 is the three-body PS. Fig. 1(a) shows the $|M|$ evaluated from the $pp \to pp\pi^0$ data [4, 5]. If the prediction [3] is

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true, the data should indicate the FSI between the final protons. Taking the production amplitude as a constant [6], the $|M|$ is factorized in terms of this constant and the pp scattering amplitude T_{pp}. Solid line in Fig. 1 shows the T_{pp} from the Nijmegen-93 model [7] averaged over the available PS. The discrepancy at low ε is due to the repulsive Coulomb interaction not incorporated in the present calculations.

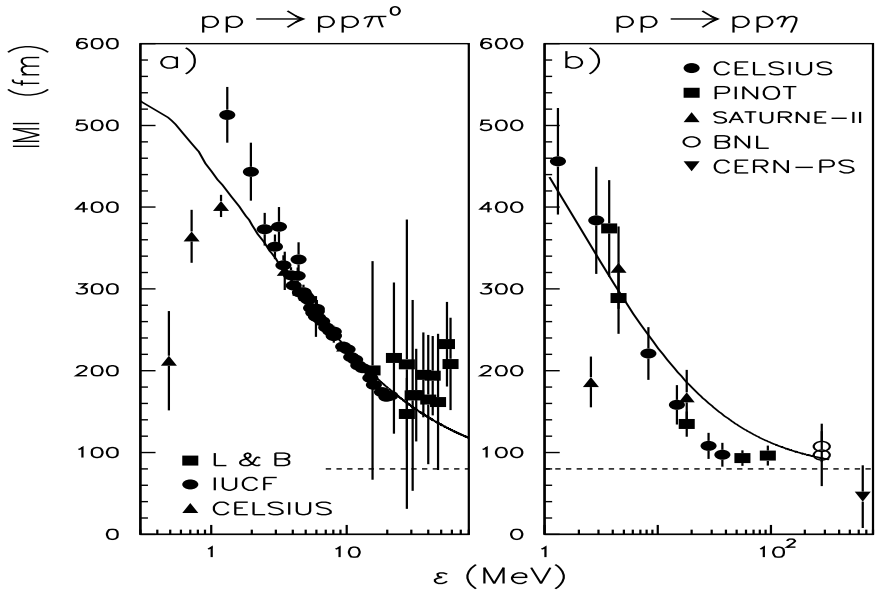

Fig. 1. The amplitudes for the (a) — $pp \to pp\pi^0$ and (b) — $pp \to pp\eta$ reactions. The symbols show the results extracted from the experimental data [4, 5, 8]. The solid line shows the averaged pp scattering amplitude.

Similar situation holds for $pp \to pp\eta$ reaction. Fig. 1(b) shows the reaction amplitude extracted from the data [4, 8] together with the average T_{pp} [6]. Both $pp \to pp\pi^0$ and $pp \to pp\eta$ reactions indicate the same strength of the FSI at the same range of the excess energy. Moreover, Fig. 1 obviously illustrates the validity of the Watson–Migdal approximation.

The aim of the near-threshold meson production experiments is not to measure the pp scattering amplitude, which can be determined more precisely through the partial waves analysis. The crucial measure for meson production is the production amplitude, which is shown in Fig. 1 with the dashed line. One possible and almost model independent[1] way to evaluate the production mechanism from the data is to make the FSI corrections based on the known scattering amplitude similar to the procedure we per-

[1] In sense of the Watson–Migdal approximation.

formed for $pp \to pp\pi^0$ and $pp \to pp\eta$ reactions. Obviously it is necessary to measure the reaction at wide range of $0 \leq \varepsilon \leq 100$ MeV in order to escape ambiguity of the analysis.

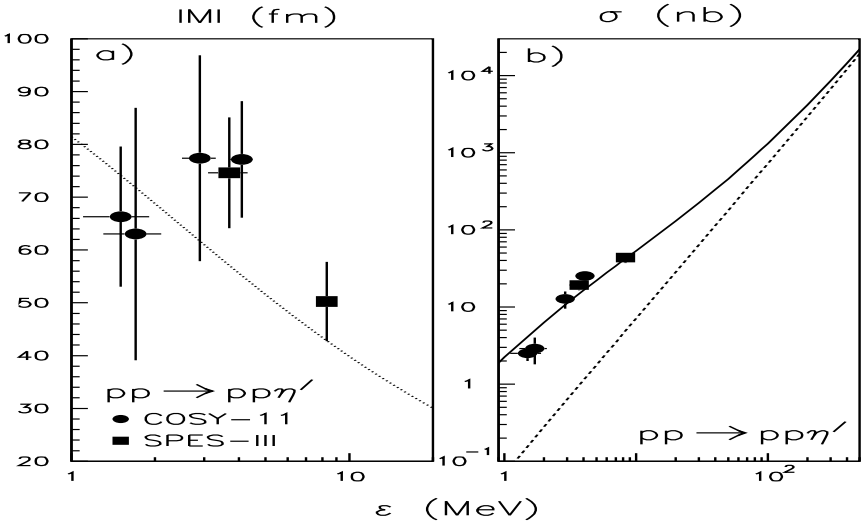

Fig. 2. The amplitude (a) and cross section (b) for the $pp \to pp\eta'$ reaction. The experimental data are from Ref. [9]. The dotted line in (a) shows the T_{pp} averaged over the PS, the solid line in (b) shows the one-pion exchange calculations with FSI, while the dashed line in (b) — without FSI.

As an example one can look recent data [9] on $pp \to pp\eta'$ reaction. The average reaction amplitude is shown in Fig. 2(a). Neglecting the FSI one can fit the data with the constant $|M| \simeq 70$ fm and motivate that the cross section is reproduced by the PS alone. However, from near-threshold π^0 and η-production we learned the FSI dominance, which is indicated with the dotted line in Fig. 2(a).

Fig. 2(b) shows one-pion exchange [6] calculations with (solid line) and without (dashed line) FSI between the final protons. The model with FSI quite reasonably reproduce the data, however we need more data at the range $\varepsilon \simeq 100$ MeV for crucial verification.

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