Charge dependence in $NN \to d\pi$ reactions?

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We review to what extent charge independence breaking in the isospin related reactions of the type $NN \to d\pi$ can or could be seen in existing data. Lacking accurate data of differential cross sections at the same relative final momenta in the reactions $pp \to d\pi^+$ and $np \to d\pi^0$, we resort to global fits of angular dependencies and total cross sections [1]. In particular we try to investigate relative quantities which are not susceptible to the notorious neutron beam normalization uncertainties.

A simple and effective parameterization is obtained for the total $pp \to d\pi^+$ cross section (with the Coulomb and external mass difference effects removed [2]) fitting the data well up to the final c.m. momentum $\eta = q/m_\pi \approx 3$. Comparison of the angular dependence (the ratio A_2/A_0 with A_i the coefficients of the Legendre polynomials $P_i(\cos\theta)$) remains inconclusive due to the low quality of most np data. However, a possible discrepancy is seen between the energy dependencies of the $np \to d\pi^0$ and $pp \to d\pi^+$ total cross sections, which may require invoking explicitly isospin symmetry breaking interactions.

To improve the prospects of confirming charge dependence improved neutron experiments are needed at the energies corresponding to existing $d\pi^+$ data momenta. If e.g. the angular dependencies are given as parameterizations instead of raw data, the form $\sigma(\theta) = A_0[1 + aP_2(\cos\theta) + ...]$ is preferred to the frequently used form $\sigma(\theta) = A_0 + A_2P_2(\cos\theta) + ...$, where any normalization uncertainty is conveyed also to the angular dependence, which should, however, be independent of the normalization.

[1] H. Machner and J.A. Niskanen, nucl-ex/0511027.
[2] J. A. Niskanen, M. Vestama, Phys. Lett., **B 374** (1997) 253.

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