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## Zero-energy $\pi^-$ -D scattering: precise determination of the $\pi$ N scattering lengths and of the charged $\pi$ NN coupling constant

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It is very important to know precisely the  $\pi$ N scattering lengths  $a^+$  and  $a^-$  and the  $\pi$ NN coupling constant with well controlled uncertainties in order to test chiral symmetry predictions. Using the precise values of the  $\pi^-$ p and  $\pi^-$ d scattering lengths deduced recently from pionic atom experiments<sup>1</sup>, the most accurate source for a determination of the isoscalar combination  $a^+$  is the theoretical description of the threshold  $\pi^-$ -deuteron scattering. We critically and quantitatively assess the sources of systematic uncertainties in such a study.

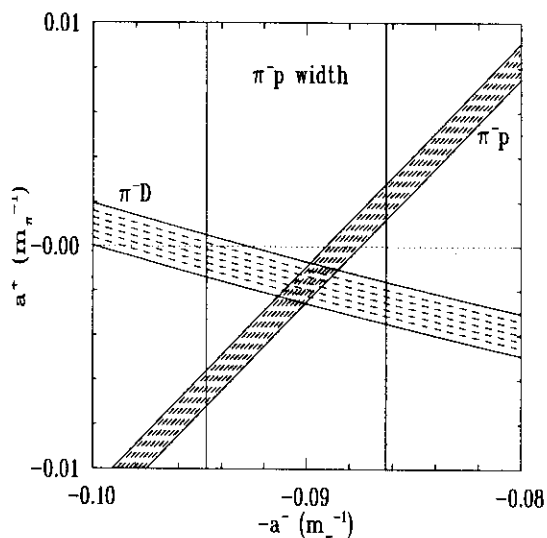


Fig. 1. Our graphical determination of the  $\pi$ N scattering lengths in excellent agreement with the central values of the experimental PSI group<sup>2</sup>

Based on this, we obtain the preliminary, though nearly final, values  $(a_{\pi^-p} + a_{\pi^-n})/2 = (-17 \pm 3(\text{statistic}) \pm 9(\text{systematic}))10^{-4}m_\pi^{-1}$  and  $(a_{\pi^-p} - a_{\pi^-n})/2 = (900 \pm 12)10^{-4}m_\pi^{-1}$ . These are in excellent agreement with hydrogen data, but with much smaller errors as can be seen in Fig. 1.

The isovector GMO sum rule for zero-energy forward  $\pi$ N scattering is then critically studied to obtain with these new precise values the charged  $\pi$ NN coupling constant,  $g_c^2 = (14.23 \pm 0.09)(17)$ . The impact of this value on the recent debate concerning the determination of the coupling constant will also be discussed<sup>3</sup>.

### References

1. D. Chatellard, *et al.*, Nucl. Phys. **A625**, 310 (1997); P. Hauser, *P. al.*, Phys. Rev. C **58** R1869 (1998).
2. H.-Ch. Schröder *et al.*, ETHZ-IPP PR-99-07, Phys. Lett. **B** in press.
3. J. Rahm *et al.*, Phys. Rev. **C57**, 1077 (1998); Comment by M. C. M. Rentmeester *et al.*, Phys. Rev. Lett. **81**, 5253 (1998); Reply by T. E. O. Ericson *et al.* Phys. Rev. Lett. **81**, 5254 (1998).

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