

Recent Few-Nucleon Experiments and Discrepancies to be solved

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After existence of $\pi\pi$ -exchange three-nucleon force ($\pi\pi$ 3NF) was confirmed in 1998, many 3N experiments have been made to investigate $\pi\pi$ 3NF in more detail and to search for other 3NF's. Experimental data for cross section and polarization observables of pd and nd elastic scattering, pd breakup, and pd capture have been accumulated in intermediate energy region at RCNP, KVI, RIKEN and other facilities. These experiments are reviewed.

In all the three reaction channels, discrepancies between experiments and exact 3N calculations have been found, and discrepancies become larger with beam energy. After $\pi\pi$ 3NF and relativity are included in calculations, large discrepancies still remain. 3NF's other than $\pi\pi$ 3NF are candidates for origins of the discrepancies at intermediate energy.

On the other hand, there are two famous discrepancies called A_y puzzle and Space Star anomaly in low-energy region of around 10 MeV, and many accurate and systematic experiments have been performed. Recent experiments are reviewed. The two discrepancies have been found first in 1980's. At this low energy, effects of $\pi\pi$ 3NF are small and they may be not the origins of these discrepancies. 2NF are well determined at low energy and there is little space to modify 2NF. Then, discrepancies at low energy have not been solved till now, for about 25 years.

Recent systematic experiments have revealed some features of the discrepancies at low energy. The features may be helpful to guess the origin(s) of the discrepancies. Possibilities of some origins will be discussed. Theoretical challenges to solve these discrepancies are desired.

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