Electro-weak structure of few-body nuclei

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In the present contribution, we report about the recent progresses made in our understanding of the nuclear few-body systems and their interactions with electro-weak probes. In particular, we will focus on three- and four-body nuclear systems. After a general overview of the non-relativistic approach used in these studies, of its successes and failures in predicting trinucleon elastic form factors [1] and *pd* radiative capture observables [2], we will focus on the proton weak capture on ^{3}He, also known as *hep* reaction [3,4]. There has been in the past few years a revival of interest in this process: in fact, the first Super-Kamiokande collaboration results for the energy spectrum of electrons recoiling from scattering with solar neutrinos [5] suggested an enhancement in the *hep* S-factor by a factor of about 30, relative to the value adopted by the Standard Solar Model of Bahcall *et al.*, of 1998 (SSM98) [6]. Although diminuished with the increasing of days of data acquisition, an enhancement of about 17 was still required, by the end of 1999, to fit the data [7]. A new study of last year [3,4], has repeated the calculation of the *hep* S-factor, finding an enhancement of a factor of about 4.5 compared with the SSM98 value. The main differences between this new study and the one from which the SSM98 adopts its value [8], are: (i) we used more accurate initial and final state wave functions, obtained with the correlated hyperspherical harmonics method [9], using the Argonne v_{18} two-nucleon [10] and Urbana IX [11] three-nucleon interactions; (ii) performing a partial wave expansion of the initial state, we included not only the S-, but also all the P-waves. We will carefully discuss the importance of these two points in performing a reliable calculation. Finally, future plans and developments will be outlined.

References

1. L.E. Marcucci *et al.*, Phys. Rev. **C58**, 3069 (1998).
2. M. Viviani *et al.*, Phys. Rev. **C61**, 064001 (2000).
3. L.E. Marcucci *et al.*, Phys. Rev. **C63**, 015081 (2000).
4. L.E. Marcucci *et al.*, Phys. Rev. Lett. **84**, 5959 (200).
5. Y. Fukuda *et al.*, Phys. Rev. Lett. **81**, 1158 (1998); Phys. Rev. Lett. **82**, 2430 (1999).
6. J.N. Bahcall *et al.*, Phys. Lett. **B433**, 1 (1998).
7. Y. Suzuki, contribution to Lepton-Photon Symposiium 99 (1999), http://www-sk.icrr.u-tokyo.ac.jp/doc/sk/pub/index.html.
8. R. Schiavilla *et al.*, Phys. Rev. **C45**, 2628 (1992).
9. M. Viviani *et al.*, Few-Body Syst. **18**, 25 (1995); Phys. Rev. Lett. **81**, 1580 (1998).
10. R. Wiringa *et al.*, Phys. Rev. **C51**, 38 (1995).
11. B.S. Pudliner *et al.*, Phys. Rev. **C74**, 4396 (1995).