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Coupled-cluster computation of electroweak observables[1]

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Recently, coupled-cluster computations were extended to electro-weak observables in light and medium-mass nuclei. In particular, we have reformulated the Lorentz Integral transform method within the coupled-cluster formalism [1] to allow the investigation of break-up observables with the continuum properly taken into account. This new method, dubbed LIT-CC, has permitted ab-initio studies of photodisintegration cross sections in stable nuclei (16O, 40Ca) and Coulomb break-up cross sections in unstable nuclei (22O). Next, we aim at studying Gamow-Teller strengths distribution using this method. I will report on a recent calculation of the total Gamow-Teller strength in the beta decay of 14C, 22O and 24O [2]. We found that two-body currents lead to a quenching of the Ikeda sum rule and it is interesting to see how the strength is distributed. This will be studied using the LIT-CC method. Finally, our long term goal is to tackle neutrino-nucleus interactions using this coupled-cluster theory. Neutrino cross sections and nuclear effects lead to systematic uncertainty in the extraction of oscillation parameters in neutrino experiments. Because detectors include complex nuclei, knowledge of their interactions with neutrinos is required with quantified uncertainties to be used in simulations. The LIT-CC method is well suited to investigate the charge-changing quasi elastic peak in neutrino scattering. While our goal is to tackle the weak response in 16O, I will show some preliminary results on 4He, in particular regarding the Coulomb sum rule.

[1] S. Bacca, N. Barnea, G. Hagen, G. Orlandini and T. Papenbrock, Phys. Rev. Lett. 111, 122502 (2013).
[2] A. Ekstroem, G.R. Jansen, K.A. Wendt, G. Hagen, T. Papenbrock, S. Bacca, B. Carlsson, D. Gazit, Phys. Rev. Lett. 113, 262504 (2014).

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