International Nuclear Physics Conference INPC2013: 2-7 June 2013, Firenze, Italy

Electromagnetic reactions and few-nucleon dynamics

S. Bacca[1]

[1] *TRIUMF, 4004 Wesbrook Mall, Vancouver, BC, V6T 2A3, Canada*

Contact email: *bacca@triumf.ca*

The interaction among nucleons is governed by quantum chromodynamics (QCD). In the low energy regime relevant to nuclear physics, QCD is not perturbative and thus difficult to solve. A series of potentials have been devised in the literature to describe nuclear forces in terms of effective degrees of freedom: protons and neutrons. For the determination of realistic nuclear Hamiltonians and to discriminate among different potentials, a variety of observables have to be investigated. The study of electromagnetic reactions is fundamental to understand the nuclear dynamics, because a clear comparison between theory and experiment is facilitated by the perturbative nature of the electromagnetic probe. By concentrating our analysis on light-nuclei, where ab-initio approaches are applicable, we can study the sensitivity of electromagnetic reactions to different Hamiltonians, the only ingredients of theoretical calculations.

The difficulty in calculating electromagnetic cross sections is that excited states in the continuum are involved, where the nucleus is broken up in several pieces. Their complicated calculation can be avoided by using the Lorentz Integral Transform (LIT) method [1], where the problem is reduced to a bound state Schrödinger-like equation. Recent results obtained from the application of this method to the calculation of electromagnetic reactions will be showcased. An example is the monopole transition form factor $F_{\mathcal{M}}(q)$ in ^{4}He [2], shown in Figure 1. We observe that $F_{\mathcal{M}}$ exhibits a strong potential model dependence, and can serve as a kind of prism to distinguish among different potentials and shed more light on few-nucleon dynamics. We will also discuss how we extend these calculations to medium mass nuclei, to describe the giant dipole resonance of ^{16}O from first principles [3]. By merging the LIT with coupled cluster theory [4] we open up the exciting possibility to investigate inelastic reactions for medium-mass stable and possibly unstable nuclei with ab-initio methods.

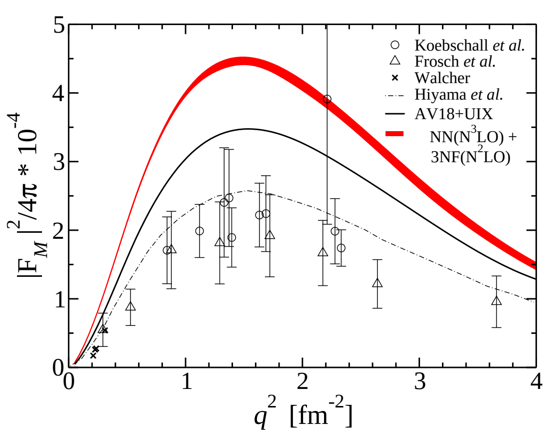

Figure 1: *Monopole transition form factor to the first 0^+ excited state of ^{4}He: calculations with different three-body Hamiltonians in comparison to experimental data.*

[1] V. D. Efros , W. Leidemann, G. Orlandini, and N. Barnea, J. Phys. G, **34**, R459 (2007);
[2] S. Bacca, N. Barnea, W. Leidemann, and G. Orlandini, Phys. Rev. Lett. **119**, 042503 (2013);
[3] S. Bacca, N. Barnea, G. Hagen, G. Orlandini, and T. Papenbrock, in preparation;
[4] G. Hagen, T. Papenbrock, D. J. Dean, and M. Hjorth-Jensen, Phys. Rev. C **82**, 034330 (2010).