THREE-NUCLEON REACTIONS WITH IMPROVED CHIRAL FORCES

Dr. Roman Skibinski[1], Prof. Jacek Golak[1], Dr. Kacper Topolnicki[1], Prof. Henryk Witala[1], Prof. Evgeny Epelbaum[2]

[1]Jagiellonian University
[2]Ruhr-Universitat

The improved chiral nucleon-nucleon (NN) interaction with the semi-local regularization was derived recently (E.Epelbaum et al., Eur.Phys.J.A51(2015)26, Phys.Rev.Lett.115(2015)122301) up to the fifth order of the chiral expansion. It leads in the two-nucleon sector to very precise description of phase shifts and observables up to 300 MeV and only tiny dependence on the regularization parameter. This is a much better picture than observed for the older (Nucl.Phys.A747 (2005),362) version of the chiral NN force. For the three-nucleon (3N) systems the older version of the interaction also leads to a big cutt-off dependence (Witala et al, J.Phys.G41(2014)094011, Skibinski et al, Phys.Rev.C84(2011)054005), especially at N3LO. In the present contribution the application of state-of-the-art NN potential (E.Epelbaum et al., EPJA51(2015)26, PRL115(2015)122301), obtained within the formalism of Faddeev equations (J.Golak et al, Phys. Rept.415(2005)89), to 3N systems will be presented. In some cases the 3N force up to N2LO but with a consistent semi-local regularization will be also taken, for the first time, into account. In particular predictions on the cross sections and spin observables for the elastic nucleon-deuteron scattering and the deuteron breakup induced by nucleon will be discussed. Finally, the chosen applications of the improved chiral interaction to the electroweak processes such as deuteron photodisintegration, proton-deuteron radiative capture and muon capture on 3He leading to the 3H, d+n or n+n+p and a muonic neutrino in the final state, will be given. In all cases the convergence of predictions, their dependence on regularization parameter and the estimation of truncation errors will be presented.