HK 42: Few-body physics

Time: Tuesday 16:30–18:15 Location: H-ZO 100

Group Report HK 42.1 Tu 16:30 H-ZO 100

Current conservation and analytic determination of the magnetic moment of the Delta-resonances. — Amand Faessler[1] and •Alexander Machavariani[2] — [1]Institute für Theoretische Physik der Univesität Tübingen, Tübingen D-72076, Germany — [2]High Energy Physics Institute of Tbilisi State University, University str. 9, Tbilisi 380086, Georgia

The pion-nucleon bremsstrahlung $\pi + N = :\gamma' + \pi' + N'$ is studied within a new form of the Ward-Takahashi identities for the on shell amplitudes. Based on this current conservation it is shown, that the double Δ exchange diagram with the $\Delta - \gamma'\Delta'$ vertex cancel exactly against the appropriate longitudinal part of the external particle radiation diagrams. Consequently, a model independent relation between the magnetic dipole moments of the Δ resonances and the full magnetic moment of the proton μ_p and neutron μ_n is obtained. In particular, $\mu_{\Delta^+} = \frac{M_\Delta}{m_p}\mu_p$, $\mu_{\Delta^o} = \frac{M_\Delta}{m_o}\mu_n$ and $\mu_{\Delta^{++}} = \frac{3}{2}\mu_{\Delta^+}$, $\mu_{\Delta^-} = \frac{3}{2}\mu_{\Delta^o}$. This result is generalized within the field theoretical formulation with the quark degrees of freedom, where pions and nucleons are treated as the bound systems of quarks. It is shown that relations generated by current conservation for the on shell πN bremsstrahlung amplitude with composite nucleons and pions have the same form as in the usual quantum field theory without quark degrees of freedom. Consequently, the model independent relations for the magnetic dipole moments of the Δ resonances remain be the same in the quantum field theory with the quark degrees of freedom.

HK 42.2 Tu 17:00 H-ZO 100

Halo nuclei in effective theory at next-to-leading order — •David L. Canham[1,2] and H.-W. Hammer[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik (Theorie), Universität Bonn — [2]Bethe Center for Theoretical Physics, Universität Bonn

An effective theory with separable s-wave interactions is used to explore the universal properties of Efimov states and three-body systems composed of two neutrons and a core. This effective potential is well suited to describe the short-range interactions of halo nuclei. To leading order, only one coupling constant is needed in the two-body effective potential, tuned to reproduce the scattering length. The effective range enters at next-to-leading order (NLO). We explore the NLO corrections to three-body states assuming a large scattering length as compared to the range of the interaction. One finds that the renormalization places certain constraints on the value of the effective range, known as the *Wigner Bound*.

HK 42.3 Tu 17:15 H-ZO 100

Three-boson bound states in finite volume with EFT — •Simon Kreuzer[1,2] and H.-W. Hammer[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik (Theorie), Universität Bonn — [2]Bethe Center for Theoretical Physics, Universität Bonn

The universal properties of a three-boson system with large scattering length are well understood within the framework of Effective Field Theory. They include a geometric spectrum of shallow three-body bound states called *Efimov states* and log-periodic dependence of scattering observables on the scattering length. We investigate the modification of this spectrum in a finite cubic box using a partial wave expansion. The dependence of the binding energies on the box size is calculated and the renormalization of the Effective Field Theory in finite volume is verified explicitly.

HK 42.4 Tu 17:30 H-ZO 100

The role of general symmetries in the three-alpha decay of ^{12}C resonances — •Oliver Kirsebom for the MAGISOL-Collaboration — Institut for Fysik og Astronomi, Aarhus Universitet, 8000 Århus C, Denmark

We use the Dalitz plot to study the decay of ^{12}C resonances into three alpha particles. The requirement of a symmetric three-alpha final state together with conservation of spin, parity and isospin forces the density to vanish in certain regions of the Dalitz plot thereby inducing general structures that do not in any way depend on the details of the interaction Hamiltonian except, of course, its ability to conserve spin, parity and isospin. The implications of this understanding is twofold. First, the observed density of the Dalitz plot can be used to determine or at least impose constraints on the spin and parity of the decaying ^{12}C resonance. Second, once the inevitable structures due to symmetries have been identified the remaining structures in the Dalitz plot can be understood as resulting from the dynamical interactions at play, thus allowing for an understanding of the decay mechanism. In this contribution I present experimental Dalitz plots extracted from complete kinematics studies of the ^{10}B(^{3}He, $p\alpha\alpha\alpha$) and the ^{11}B(^{3}He, $d\alpha\alpha\alpha$) reactions. I show how our measurements allow us to determine the spin and parity of ^{12}C states whose quantum numbers were hitherto unknown. Finally, I compare the measured Dalitz distributions to theoretical calculations and discuss the implications for our understanding of the decay mechanism, in particular the validity of the model of a sequential decay through the broad 2^+ resonance in ^{8}Be.

HK 42.5 Tu 17:45 H-ZO 100

Progress in the Quantum Monte Carlo approach to small- and medium-sized nuclei — Paolo Armani[1], Stefano Gandolfi[2], Pietro Faccioli[1], and •Francesco Pederiva[1] — [1]Dipartmento di Fisica and I.N.F.N., Universita' di Trento, via Sommarive, 14 I-38100 Trento, Italy — [2]S.I.S.S.A., International School for Advanced Studies, via Beirut, 2 I-34014 Trieste, Italy

Green's Function Monte Carlo methods have been successfully applied in the past to describe nuclei with masses up to A=12. In the last few years, the introduction of the Auxiliary Field Diffusion Monte Carlo method (AFDMC) of S. Fantoni and K. Schmidt allowed to compute properties of systems with larger masses due to a more efficient treatment of the spin- and isospin-dependent part of the nucleon-nucleon interaction.

We present recent calculations of the properties of nuclei up to ^{16}O with a potential including the tensor component. However, the treatment of spin-orbit and three body terms within AFDMC remains difficult. In this context we will then present the recent developments in the quest of a Diffusion Monte Carlo scheme based on Effective Field Theory Hamiltonians, in which the pionic degrees of freedom are treated explicitly, under the assumption of the conservation of the nucleon number and with the introduction of an explicit kinetic term for nucleons already at the leading order.

HK 42.6 Tu 18:00 H-ZO 100

implementation of low-momentum effective interaction in spin-isospin dependent 3D approach — Shahriar Bayegan and •Mehdi Harzchi — Department of Physics, University of Tehran, P.O.Box 14395-547, Tehran, Iran

The formulation of the low-momentum effective interaction in the model space Lee-Suzuki method is implemented in a spin-isospin dependent three-dimensional approach, based on helicity representation. In this approach the low-momentum effective interaction has been formulated as a function of the magnitude of momentum vectors and the angle between them. As an application the Bonn-B potential has been used into the model space Lee-Suzuki method and it has been shown that the low-momentum effective interaction reproduces the same two-body observables obtained by the bare potential.

[1] S. Bayegan, M. Harzchi, M.R Hadizadeh, Nucl. Phys. A814 (2008) 21.

[2] S.K. Bogner, T.T. S Kuo, A. Schwenk, D.R. Entem and R. Machleit, Phys. Let. B576 (2003) 265.

[3] K. Suzuki, Prog. Theor. Phys. 68 (1982) 246.