Particle and Nuclear Physics

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The research focuses on experimental and theoretical study of elementary particles and atomic nuclei with the goal to contribute to the detailed tests of the standard model (SM) of fundamental interactions, to search for physical phenomena beyond the SM, and improve the present knowledge of the nuclear structure and nucleon interactions.
Theoretical and Experimental Particle Physics
Research in theoretical particle physics concentrates mainly on an adequate description of the Higgs sector of the electroweak theory, possible phenomena beyond the SM such as baryon and lepton number violation, the study of low energy meson interactions, calculations of the effective field amplitudes, a deeper study of some specific mathematical methods of quantum field theory.
Research in experimental particle physics is performed within the framework of the world leading accelerator experiments with an emphasis on the exploitation of the full potential of the Czech Republic's membership in CERN . These experiments are: ATLAS at CERN (study of the properties of the Higgs boson and the top quark; B physics; heavy ion interactions; diffraction physics), NA62 at CERN (investigation of the CP violation and of rare decays of K mesons), Belle and Belle II at KEK (study of CP violation and rare decays of B-mesons). Important parts of the research are neutrino physics (Daya Bay , NOvA , DUNE and SuperNEMO experiments) and astroparticle physics (experiments AUGER and CTA)." Research activities are oriented also on the development, production and testing of components of detector complexes.

Theoretical and Experimental Nuclear Physics

Research in the physics of atomic nuclei and related strongly interacting many?body systems is aimed at the following areas:
(i) Experimental study of nuclear properties at high excitation energies. Subjects of investigation are various statistical features of excited nuclear states and their decays. We participate in the measurement of cross sections of the neutron?induced reactions in experiment n_TOF at CERN.
(ii) Microscopic theory of collective nuclear dynamics. The research include calculations based on realistic two?nucleon potentials as well as related phenomenological functional approaches.
(iii) Theory of quantum phase transitions and chaos in algebraic models of nuclei and other bound many-body systems. We focus on the dynamical signatures of quantum chaos and on quantum critical properties of the ground and excited states.

Selected outputs

- ATLAS Coll. (G. Aad et al.): Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC, Phys. Lett. B 716, 1-29 (2012).
- Daya Bay Collaboration (F.P. An (Beijing, Inst. High Energy Phys.) et al.): Observation of electron-antineutrino disappearance at Daya Bay, Phys.Rev.Lett. 108 (2012) 171803
- C. Cheung, K. Kampf, J. Novotny, C. H. Shen and J. Trnka: A Periodic Table of Effective Field Theories, JHEP 1702 (2017)
- L. Damone et al. (n_TOF collaboration): Be-7 (n,p)Li-7 Reaction and the Cosmological Lithium Problem: Measurement of the Cross Section in a Wide Energy Range at n_TOF at CERN, Physical Review Letters 121, 042701 (2018).
- V.?O. Nesterenko, A. Repko, J. Kvasil, and P.-G. Reinhard: Individual Low-Energy Toroidal Dipole State in Mg-24, Physical Review Letters 120, 182501 (2018).
- M. Kloc, P. Stránský, P. Cejnar: Quantum Quench Dynamics in Dicke Superradiance Models, Physical Review A 98, 013836 (2018).