Symposium on “Advances in Effective Field Theories”

Nov. 7-9, JSC Hörsaal, Forschungszentrum Jülich

in celebration of the **Lise Meitner Prize** awarded to

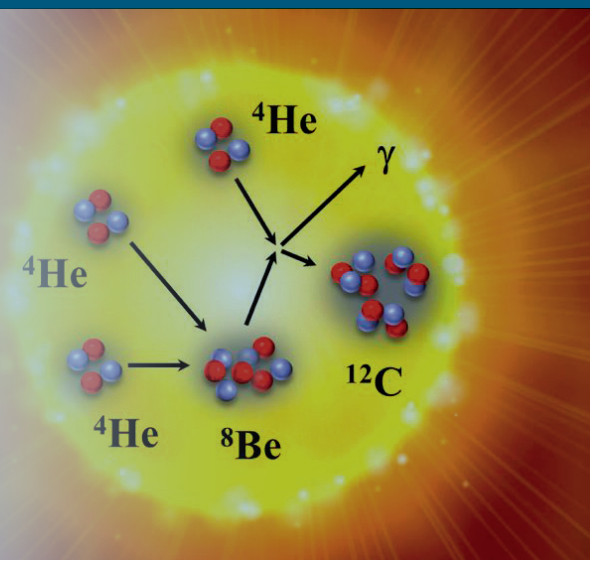
Prof. Ulf-G. Meißner

„for his developments and applications of effective field theories in hadron and nuclear physics, that allowed for systematic and precise investigations of the structure and dynamics of nucleons and nuclei based on Quantum Chromodynamics.“

Mitglied der Helmholtz-Gemeinschaft

Invited speakers:

Silas Beane
Johan Bijnens
Gilberto Colangelo
Zohreh Davoudi
Evgeny Epelbaum
Feng-Kun Guo
Hans-Werner Hammer
Martin Hoferichter
Norbert Kaiser
Dean Lee
Thomas Mannel
Jie Meng
José A. Oller
Martin Savage
Stefan Scherer
Achim Schwenk
Antonio Vairo
Jordy de Vries
Wolfram Weise (Keynote)
Qiang Zhao
Bing-Song Zou



Award ceremony occurs on November 8th | Dinner reception
for invited speakers and honorary guests follows shortly afterwards

Program available at
http://www.fz-juelich.de/SharedDocs/Downloads/IKP/EN/AEFT_Program.html?nn=364550

Contact
Send inquiries to *t.luu@fz-juelich.de*

EPS

JÜLICH
FORSCHUNGSZENTRUM

Mon 7th	Tue 8th	Wed 9th
8:00-9:20 Registration/ Visitor Badge	9:00-9:45 Kaiser (35+10 min.)	9:00-9:45 Davoudi (35+10 min.)
9:20-9:30 Opening statements		
9:30-10:15 Mannel (35+10 min.)	9:45-10:30 Vairo (35+10 min.)	9:45-10:30 Lee (35+10 min)
Coffee Break 10:15-10:45	Coffee Break 10:30-11:00	Coffee Break 10:30-10:50
10:45-11:30 Meng (35+10 min.)	11:00-11:45 Zhao (35+10 min.)	10:50-11:35 Zou (35+10 min.)
11:30-12:15 Hoferichter (35+10 min.)	11:45-12:30 Savage (35+10 min.)	11:35-12:20 Guo (35+10 min.)
		12:20-12:30 **Closing statements**
Lunch @ Casino 12:15-13:30	Lunch @ Casino 12:30-14:00	Lunch @ Casino and departure 12:30
13:30-14:15 Schwenk (35+10 min.)	14:00-14:45 Beane (35+10 min.)	
14:15-15:00 Bijnens (35+10 min.)	14:45-15:30 Colangelo (35+10 min.)	
15:00-15:45 Scherer (35+10 min.)	Coffee Break 15:30 -16:00	
Coffee Break 15:45-16:15	16:00-16:45 de Vries (35+10 min.)	
16:15-17:00 Epelbaum (35+10 min.)	16:45-17:45 Weise: Keynote (45+15 min.)	
17:00-17:45 Oller (35+10 min.)	17:45-18:00 Medal/ Diploma presentation	
17:45-18:00 Greeting Words Prof. Schmidt (VS)	19:00-21:00 Dinner reception (bus to and from)	
18:-18:45 Hammer (35+10 min.)		

Mon 9:30-10:15

Heavy Particle Effective Theories

Thomas Mannel
Universität Siegen

I will give an overview over the various heavy particle effective theories, which have a common set-up. These are the Heavy Quark Effective Theory, the Heavy Quark Expansion, the Soft Collinear Effective Theory and last not least the Heavy Baryon Chiral Perturbation Theory.

Mon 10:45-11:30

Covariant density functional theory for nuclear structure

Jie Meng
Peking University

Mon 11:30-12:15

Chiral effective field theory for dark matter direct detection

Martin Hoferichter
University of Washington

In order to extract constraints on New Physics from direct-detection experiments, both the single-nucleon matrix elements as well as the nuclear structure aspects need to be under control. The response of a nucleus interacting with a WIMP, with relevant momentum transfers of the order of the pion mass, can be conveniently addressed within chiral EFT, in particular including the effects of two-body currents. In the talk I will review chiral-EFT calculations for the relevant nuclear structure factors, and discuss the corresponding analysis strategies for direct-detection experiments.

Mon 13:30-14:45

The strong interaction at neutron-rich extremes

Achim Schwenk
Technische Universität Darmstadt

The strong interaction described by quantum chromodynamics is responsible for binding neutrons and protons into nuclei and for the many facets of nuclei and dense matter in astrophysics. Combined with the electroweak interaction, it determines the properties of all nuclei in the nuclear chart in a similar way as quantum electrodynamics shapes the periodic table of elements. While the latter is well understood, it is still unclear how the nuclear chart emerges from the underlying forces.

During the last decades, nuclear structure theory has made great progress on many fronts and evolved into a field with a systematic theoretical foundation, with nuclear forces based on the underlying interactions and advanced methods to solve the nuclear many-body problem with controlled uncertainties. Effective field theories have played a guiding role in this process, as they reduce the complexity of the underlying theory to the relevant degrees of freedom in a systematic way. We will discuss the advances and challenges in understanding and predicting nuclei and neutron stars based on effective field theories of the strong interaction, focusing on the special role of extreme neutron-rich systems.

Monday, 7th

Mon 14:15-15:00

Loops and volumes in ChPT

Johan Bijnens
Lund University

I will discuss some of the progress in the purely mesonic sector both as regards to higher loop calculations and extensions to finite volume and other lattice artefacts.

Mon 15:00-15:45

The chiral MAID interface: Pion photo- and electroproduction close to threshold

Stefan Scherer
Johannes Gutenberg University Mainz

We discuss the extended on-mass-shell scheme for manifestly Lorentz-invariant baryon chiral perturbation theory. We present a calculation of pion photo- and electroproduction up to and including order q^4. The low-energy constants have been fixed by fitting experimental data in all available reaction channels. The results can be accessed via a web interface, the so-called chiral MAID (http://www.kph.uni-mainz.de/MAID/chiralmaid). We explain how the program works and how it can be used for further analysis.

Mon 16:15-17:00

Precision nuclear physics with chiral interactions

Evgeny Epelbaum
Ruhr-Universität Bochum

Mon 17:00-17:45

S-matrix solution of Lippmann-Schwinger equation for regular and singular potentials

José Oller
University of Murcia

We have derived a new method based on S-matrix theory to solve the Lippmann-Schwinger equation in partial waves that can applied to both ordinary and singular potentials. A new integral equation derived from the Lippmann-Schwinger equation is found that allows one to calculate exactly the discontinuity of the T-matrix along the left-hand cut. For an ordinary potential the method reproduces the standard results, while for singular potentials this new method provides renormalized solutions that satisfy all the required analytical properties for a partial-wave amplitude. Illustrations of the method to regular and singular potentials in nucleon-nucleon scattering will be discussed.

Mon 18:00-18:45

Open Effective Field Theories and Universality

Hans-Werner Hammer
Technische Universität Darmstadt

The effects of the inelastic reactions can be taken into account in low-energy effective field theories by adding local anti-Hermitian terms to the effective Hamiltonian density. Here we show that an additional modification is required in equations governing the density matrix when multi-particle states are considered. We define an effective density matrix by tracing out final states with large kinetic energies and show that it satisfies a Lindblad equation that is uniquely determined by the effective Hamiltonian density. The consequences for universality in ultracold atoms and other systems close to the unitary limit will be discussed.

Tue 9:00-9:45

Our Passion for Chiral Dynamics: Low-Energy Pion-Photon Reactions

Norbert Kaiser
Technische Universität München

Tue 9:45-10:30

Heavy Majorana neutrinos production and decay in the hot early universe

Antonio Vairo
Technische Universität München

Tue 11:00-11:45

The unusual mass region around 4.2 GeV in e+e- annihilations

Qiang Zhao
Institute of HEP, CAS

I'll review the unusual phenomena occuring in the mass region around 4.2 GeV in e+e- annihilations and try to outline the key issues for understanding the nature of the mysterious vector charmonium Y(4260).

Tue 11:45-12:30

Electroweak Properties of Light Nuclei from Lattice QCD

Martin Savage
University of Washington

I will present recent results on the electroweak properties of light nuclei from lattice QCD.

Tue 14:00-14:45

Toward baryon-baryon phase shifts from first principles

Silas Beane
University of Washington

I will review recent progress in calculating baryon-baryon interactions using lattice QCD simulations.

Tue 14:45-15:30

Extracting the quark mass ratio Q from η to 3π

Gilberto Colangelo
Universität Bern

The $\eta\to 3\pi$ amplitude is sensitive to the quark mass difference m_u-m_d and offers a unique way to determine the quark mass ratio $Q^2\equiv (m_s^2-m_{ud}^2)/(m_d^2-m_u^2)$ from experiment. I will describe a recent dispersive calculation of this amplitude and the subsequent fit of the KLOE data on the charged mode, varying the subtraction constants in the range allowed by chiral perturbation theory. The parameter-free predictions obtained for the neutral Dalitz plot and the neutral-to-charged branching ratio are in excellent agreement with experiment. The new value of the quark mass ratio we obtain is $Q = 22.0 \pm 0.7$.

Tuesday, 8th

Tue 16:00-16:45

Fundamental symmetries and effective field theory

Jordy de Vries
NIKHEF

I discuss some recent developments in various topics related to (violations of) fundamental symmetries involving nucleons and nuclei. The focus is on applications of chiral perturbation theory and its extension to nuclear systems.

Tue 16:45-17:45

"The Effectiveness of Effective Field Theories"

Keynote Speech

Wolfram Weise
Technische Universität München

Wed 9:00-9:45

Neutrinoless double beta decay: The role of effective field theory and lattice QCD

Zohreh Davoudi
Massachusetts Institute of Technology

Neutrinoless double beta decay, being a lepton-number violating process, has been the focus of numerous experimental and theoretical investigations in recent years, and the hope is that the planned US ton-scale experiment will push the current limits towards a discovery. If observed, it unambiguously proves that neutrinos are Majorana particles. Nonetheless, the underlying new physics responsible for this process can only be constrained if the theoretical predictions of the rate could be refined. This talk demonstrates the roadmap in connecting the underlying theory to the corresponding nuclear matrix elements, focusing mainly on the nonperturbative nucleonic matrix elements in the simplest extension of Standard Model in which the light left-handed neutrino is mediating the process. The role of lattice QCD and effective field theory in this program, in particular, the prospect of a direct matching of the nn to pp amplitude to lattice QCD within the light-neutrino exchange scenario, will be discussed.

Wed 9:45-10:30

Nuclear binding near a quantum phase transition

Dean Lee

How protons and neutrons bind to form nuclei is the central question of nuclear theory. While the answer may seem as simple as the fact that nuclear forces are attractive, the full story is more complex and interesting. I present numerical evidence from ab initio lattice simulations showing that nature is near a quantum phase transition, a zero-temperature transition driven by quantum fluctuations. Using lattice effective field theory, Monte Carlo simulations are performed for systems with up to twenty nucleons. For even and equal numbers of protons and neutrons, a first-order transition is found at zero temperature from a Bose-condensed gas of alpha particles to a nuclear liquid. Whether one has an alpha-particle gas or nuclear liquid is determined by the strength of the alpha-alpha interactions, and the alpha-alpha interactions depend on the strength and locality of the nucleon-nucleon interactions.

Wed 10:50-11:35

Hidden Charm Penta-quarks

Bing-Song Zou
Institute of Theoretical Physics, CAS

Recently, two hidden charm penta-quarks might have been observed by the LHCb experiment. Predictions prior to the experiment and post interpretations are briefly reviewed and commented. Prospects for further experiments are discussed.

Wed 11:35-12:20

Interactions between charmed and light mesons from chiral dynamics

Feng-Kun Guo
Institute of Theoretical Physics, CAS

I will discuss the S-wave interactions between charmed and light mesons and the related excited charmed mesons such as the puzzling D_{s0}^*(2317) and D_0^*(2400). The theoretical framework is the chiral perturbation theory for charmed mesons and its unitarization. I will show that the D_{s0}^*(2317) is consistent with having a dominant DK molecular structure, and the D_0^*(2400) quoted by the Particle Data Group probably corresponds to two different states. An affirmative evidence for the latter statement is provided by that the very recent lattice data for the coupled-channel (D\pi, D\eta, D_s\bar K) energy levels agree very well with our postdictions, which has two poles with I=1/2, without adjusting any parameter. The two-pole structure of the D_0^*(2400) may be checked by high-statistic data in the future.