GFB Newsletter

Fall 2017

APS Topical Group on Few-Body Systems & Multiparticle Dynamics

OUR MISSION

To advocate, promote, and advance research on few-body systems in atomic, molecular, nuclear, particle, and mathematical physics.

INTRODUCTION

This newsletter summarizes the past year activities of the APS Topical Group on Few-Body Systems and Multiparticle Dynamics (GFB). Most of the information contained in this newsletter has been posted on the GFB website that is managed by the APS (https://www.aps.org/units/gfb/).

The GFB regular activities include seeking and managing nominations of GFB members for APS fellowships, the suggestion and sponsorship of invited sessions for the APS APRIL and DAMOP meetings, and managing and granting student travel awards to these scientific meetings and/or to others.

This year we are very proud to report that in the fall of 2016 the GFB in conjunction with its counterpart, the European Research Committee for Few-Body Problems (ERCFBP), announced the creation of the Faddeev Medal to honor Ludwig Faddeev's lifelong contributions to physics and specifically few-body physics. An international panel of experts has selected Vitaly Efimov and Rudolf Grimm as the winners of the inaugural 2018 award. You can read more about this further below.

As of June 2017, the GFB membership has grown to 376 members. One of our goals is to keep up with the growth seen over the last few years and to continue to serve and engage with the few-body physics community.

We hope you enjoy the reading.

APS FELLOWS

The granting of APS fellowship to qualified members of the GFB is a priority. The GFB Fellowship Committee oversees this process including soliciting candidates and putting forward nominations.

In 2016 two APS Fellowships were awarded from the GFB nominations. The winners were Professors William Detmold (Massachusetts Institute of Technology) and Kalman Varga (Vanderbilt University).

William Detmold's Citation

"For pioneering work in calculating few-body hadronic systems from first principles using lattice quantum chromodynamics, including the spectrum of the light nuclei and hypernuclei, Bose-condensed multimeson systems, and the first inelastic nuclear reaction."

Kalman Varga's Citation

"For the development of a class of variational methods for accurate treatment of quantum few-body systems of various natures."

In 2017 one APS Fellowship was awarded from the GFB nominations. The winner was Professor Roxanne Patricia Springer (Duke University).

Roxanne Patricia Springer's Citation

"For significant contributions to understanding the low-energy properties of hadrons, nuclei, and especially for pioneering contributions to the use of low-energy effective field theory techniques in the quest to identify and understand the fundamental symmetries of nature."

APS APRIL MEETING

This year the APS April Meeting took place in Washington DC at an unusual time: January 28-31, 2017. There was one contributed session on "Few-Body Systems" sponsored by GFB. That session was chaired by Saori Pastore (LANL).

In addition, the GFB Program Committee worked with other units such as the Division of Nuclear Physics (DNP) and the Division of Particles and Fields (DPF) to organize invited sessions that emphasize few-body physics. The following three invited sessions were co-sponsored by GFB:

Session C16 (with DPF): Light Nuclei Beyond the Standard Model (chaired by Ken Nollett, San Diego State University)

Emanuele Mereghetti (LANL) on "Electric Dipole Moments of Light Nuclei"

Bartosz Fornal (UCSD) on "Is there a sign of new physics in beryllium transitions?"

Matthias Schindler (Univ of South Carolina) on "Parity violation in few-nucleon systems"

Session R15 (with DNP): The Future of the Nucleon-Nucleon Interaction (chaired by Matthias Schindler, University of South Carolina)

Ruprecht Machleidt (Univ of Idaho) on "Historical perspective and future prospects for nuclear interactions"

Rodrigo Navarro Perez (LLNL) on "(Im)precise nuclear forces: from experiment to model"

Maria Piarulli (ANL) on "Local chiral potentials within Delta-intermediate states and the structure of light nuclei"

Session U16 (with DNP and DPF): Neutrino Detection Challenges for Nuclear Physics (chaired by Saori Pastore, LANL)

Anna Hayes (LANL) on "Neutrino scattering from ^{12}C"

Minerba Betancourt (FermiLab) on "The MINERvA experiment"

Alessandro Lovato (ANL) on "Neutrino-nucleus interaction: an ab-initio perspective"

TRAVEL AWARDS

Every year the GFB carries out a travel award program directed to graduate students and early-career postdocs working on the physics of few-body systems. The nomination process is announced on the GFB website and by an e-mail to all GFB members. The information for the 2018 travel awards can be found here: http://jila.colorado.edu/~jpdincao/Site/GFB2018.html

We congratulate the four winners of the 2017 GFB Student Travel Awards. Three students presented talks at the April 2017 Meeting in Washington DC from January 28–31. They were:

- **Robert Baker**, student of Jerry Draayer at Louisiana State University. Robert spoke on "*Ab initio results for intermediate-mass, open-shell nuclei* " (see https://meetings.aps.org/Meeting/APR17/Session/C13.7)

- **Samuel Emmons**, student of Lucas Platter at the University of Tennessee. Samuel spoke on "*Three-body recombination in heteronuclear systems at finite temperature with a large positive scattering length*" (see https://meetings.aps.org/Meeting/APR17/Session/J2.2)

- **Arman Margaryan**, student of Roxanne Springer at Duke University. Arman spoke on "*Elastic Compton Scattering from* ^{3}*He*" (see https://meetings.aps.org/Meeting/APR17/Session/Y12.2)

One student was awarded a travel grant for presenting a talk at the DAMOP 2017 Meeting in Sacramento, CA, June 5-9, 2017:

- **Alaina Green**, student of Subhadeep Gupta at the University of Washington. Alaine presented the talk "*Photoassociation spectroscopy of heteronuclear LiYb*" (see https://meetings.aps.org/Meeting/APR17/Session/Y12.2)

THE FADDEEV MEDAL

The GFB in conjunction with its counterpart, the European Research Committee for Few-Body Problems (ERCFBP), announced the creation of the Faddeev Medal to honor Ludwig Faddeev's lifelong contributions to mathematical physics and specifically few-body physics. One of his most significant and well-known achievement was the formulation in 1961 of the Faddeev equations to solve the three-body-problem quantum mechanically. The implications on atomic, nuclear and particle physics were of gigantic proportions driving decades of intense theoretical and experimental activity to understand the dynamics of the lightest elements.

The announcement of this prestigious award was given on August 11, 2016, during the 23th European Conference on Few-Body Problems in Physics, held in Aarhus (Denmark), in the presence of the great Faddeev. He passed away, at the age of 82, on February 26, 2017.

An international panel of experts, chaired by G. Orlandini (Trento), has selected the winners of the 2018 award. They are:

Vitaly Efimov: "*For the theoretical discovery of a series of weakly-bound three-body quantum states known as Efimov states."*

Rudolf Grimm: *"In recognition of his ground-breaking experiments confirming the Efimov effect."*

The prize consists of US$1250 for each of the winners, a medal, and an invitation to the 22nd International Conference on Few-body Problems in Physics in Caen, France, next July, to participate in a special session there, devoted to the presentation of the medals. (For more details on FB22, please see https://fb22-caen.sciencesconf.org)

In the early 1970s Vitaly Efimov was studying the binding of the three-nucleon system and realized that the two-nucleon system has a near-threshold bound state. Efimov showed that, if a two-body interaction generates a bound state at threshold then the corresponding three-body system has an infinite number of three-body bound states, all of which are copies of one another, related via magnification by a specific factor which he calculated. Efimov also computed the impact that finite two-body binding energy would have on his prediction. This remarkable result was followed by an intensive search for systems that manifested this behavior, but no nuclear systems could be firmly established as candidates for the "Efimov effect".

This is one of the most counterintuitive quantum phenomena present in a system of just a few particles, but it is also a very general result. The universality of the phenomenon predicted by Efimov led to a search for its signatures in various branches of physics, and the hope that it could provide a more profound insight into strongly-correlated systems.

For approximately three decades, the Efimov effect remained largely a purely theoretical curiosity; nature seemed to not co-operate by producing the conditions necessary for its occurrence. This changed in 2006 when a team led by Rudolf Grimm, from the University of Innsbruck, Austria, used the unique properties of ultracold quantum gases to control interatomic interactions in a gas of Cesium atoms. They produced the first Efimov resonance in a sample of Cesium atoms at temperatures of 10's of nano-Kelvin. This observation brought to life the Efimov effect, and initiated a new, highly active, research field dedicated to probing its intimate properties. Today, the Efimov effect has been verified by several other groups triggering an evergrowing number of opportunities to explore new physics associated with it in different fields, including atomic, nuclear, hadronic, chemical, and condensed matter physics.

GFB and the ERCFBP are delighted to have two such distinguished recipients of the inaugural Faddeev medal. We also want to express our gratitude to Springer and to FB22, for financial support that made this award possible.

The next Faddeev medal will be awarded at the 23rd International Few-body Conference in 2021. It is anticipated that nominations will open in Summer 2019.