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NB. EMail addressed to ghpexec@anl.gov will reach all members of the Executive.

Join GHP by following a link on the lower-right of our web page; namely, from:
<http://www.aps.org/units/ghp/>.

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1 Elections

Elections will open soon for three posts in the GHP Executive (Vice-Chair, Secretary/Treasurer, and Member-at-Large) in 2018. Paul Reimer (Past Chair), Ramona Vogt (Secretary/Treasurer), and Xiaochao Zheng (Member-at-Large) will have completed their terms. (According to the GHP Bylaws, a Secretary/Treasurer can serve two consecutive terms. Ramona will have completed one term in 2018.)

Our rules state that: *the Committee shall nominate at least two candidates for the offices of Vice-Chair and for the open position of Member-at-Large; the slate of candidates will be balanced as much as possible to ensure wide representation amongst the various fields of physics included in the GHP’s membership; the Nominating Committee shall be chaired by the immediate Past Chair and shall include four members in addition to its Chair, one of whom shall be appointed by the APS.*

Nominating Committee

Paul Reimer (*Chair*)
reimer@anl.gov

Karl Slifer karl.slifer@unhedu	Julie Roche rochej@ohio.edu	Vicky Greene senta.v.greene@vanderbilt.edu	Wally Melnitchouk wmelnitc@jlab.org
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Attracting and serving a diverse and inclusive membership worldwide is a primary goal for APS. In calling for nominations, we wish to remind you how important it is to give full consideration to qualified women, members of underrepresented minority groups, and scientists from outside the United States. There is strength in diversity and so the Executive would like to see nominations from across the entire spectrum of GHP’s membership.

2 Fellowship

The GHP Fellowship Committee, chaired by GHP Vice-Chair Garth Huber, that handled the nominations was:.

Fellowship Committee		
Garth Huber (<i>Chair</i>) huberg@uregina.ca		
Carl Gagliardi cgggroup@comp.tamu.edu	Susan Gardner svg@pa.uky.edu	Eric Swanson swansone@pitt.edu

We remind the GHP that each year the APS allocates a number of Fellowship Nominations to a Topical Group. That number is based primarily on membership. Since we are in the neighborhood of 500 members, we are allocated TWO Regular nominations.

In 2018, two GHP members became APS Fellows through GHP. They are:

- Oscar A. Rondo-Aramayo (University of Virginia) *For pioneering contributions to the study of quark-gluon correlations in nucleons using inelastic scattering of polarized electrons off transverse polarized proton and deuteron targets to measure the nucleon transverse spin asymmetry A_2 and the associated structure function g_T and its moments.*
- Moskov Amarian (Old Dominion University) *For pioneering work on Deeply Virtual Compton Scattering and Gluon Polarization with the HERMES experiment at DESY, and a creative and broad program in hadronic physics at HERMES and Jefferson Lab.*



Figure 1: (Left) Oscar Rando-Aramayo. (Right) Moskov Amarian.

The instructions for nomination may be found at <http://www.aps.org/programs/honors/fellowships/nominations.cfm>
The entire process is now online.

The Executive urges members of GHP to nominate colleagues who have made advances in knowledge through original research and publication or made significant and innovative contributions in the application of physics to science and technology. They may also have made significant contributions to the teaching of physics or service and participation in the activities of the Society. We also note that maintaining a diversity in our Fellows can broaden the impact of the GHP.

3 Dissertation Award

The GHP Dissertation Award was established in February 2012, thanks to significant contributions from Brookhaven Science Associates (the management contractor for the

Brookhaven National Laboratory), Jefferson Science Associates, LLC (the management contractor for Jefferson Lab), Universities Research Association (the management contractor for Fermi National Accelerator Lab) and personal contributions from some of our members.

The current Award is a \$ 1000 stipend and a travel allowance of up to \$ 1500 to attend the GHP Meeting to receive the Award. The winner is invited to deliver a plenary presentation at the Biennial GHP Meeting, in Denver, CO, 10-12 April 2019. Tanja Horn is Chair of the Dissertation Award Committee. The members are:

Dissertation Award Committee

Tanja Horn (*Chair*)

hornt@jlab.org

Anne Sickles sickles@illinois.edu	Jo Dudek jdudek@wm.edu
Karl Slifer karl.slifer@unh.edu	Michael Birse mike.birse@manchester.ac.uk

The submissions are judged according to the following criteria: quality of the written dissertation (40%), contribution of the student to the research (30%), impact of the work (15%), and broader involvement of the student in the community (15%).

Nominations can be made until

27 November 2018

for the 2019 Dissertation Award. Nominations should be entered on the APS website <https://www.aps.org/programs/honors/nomination.cfm>.

For important information regarding the status and future of the Dissertation Award, please see the next section.

3.1 Status of the Dissertation Award

In order to maintain the GHP Dissertation Award at its current level, the endowment needs to be increased by $\sim 33\%$, as per the recommendations of the 2016 Haxton Prizes and Awards Task Force which are in the process of being implemented, as discussed below.

The Haxton Task Force report was the first since the 2002 Sarachik Task Force made the recommendation (in the old APS Bylaws) to review all Society prizes and awards every five years to ensure that they are all properly funded and that the subject area of the award remains relevant. They were also to ensure that the selection committee members for each prize and award was sufficiently broad to represent all areas covered by the prize. This language is currently in the mandate of the Committee on Prizes and Awards, see <https://www.aps.org/about/governance/committees/copa/index.cfm>. Nonetheless, the Haxton Task Force conducted the first APS-wide review of prizes and awards since 2002 (which even predates the formation of the GHP). The Task Force reviewed the 52 prizes and 13 dissertation awards and made 14 recommendations. We will only mention a few relevant to the GHP Dissertation Award.

The first recommendation is the transition to online nominations only. This has already been implemented, as can be noted in the instructions above and in this year's call for nominations. (Previously, the nominations were requested to be sent directly to the Chair of the

Dissertation Award Committee. The new online system assures that no nominations are inadvertently lost and only complete nominations are reviewed.)

Recommendation five was that the council discuss the appropriateness of Dissertation Award criteria that restrict the location where the thesis work is done or require Society or Unit memberships of the student or adviser. The Task Force felt that restrictions on the location where the work was carried out is at variance with general APS efforts to engage the international community, especially since international researchers play an important role in supporting the APS journals (roughly 60% of *e.g.* Physical Review C manuscripts are submitted from outside the US) as well as APS itself. They also questioned the relevance of student and/or adviser membership in the sponsoring unit to the overarching goal of recognition of outstanding student research.

The GHP Dissertation Award currently places restrictions on location or membership: the current requirements are either that the work be done at a US university or the student have a US research residency for international students or APS membership. While we have yet to learn whether the APS Council has addressed this particular recommendation, the GHP Executive Committee has decided to eliminate this restriction and will have any modified requirements in place for the 2021 award.

Recommendation ten dealt with the amount of the award and the multiplier needed for endowment. The Task Force recommended that the minimum award stipend be placed at \$1,500. The current GHP Dissertation Award stipend is \$1,000. We will be able to present the 2019 award at the current level but are being asked to increase the stipend to the recommended amount for 2021. The Task Force also recommended a larger multiplier for the award – a factor of 30 over the amount of the stipend rather than the 25 factor in place when the award was initially endowed.

To ensure the award will continue to be presented on a biennial basis, we need to increase the award fund to \$22,500. We are faced with a shortfall of somewhat more than \$7,000 to endow a biennial award at the required amount.

However, the GHP Executive feels that these new requirements also present an opportunity to endow the award at a sufficient level to present it annually, resulting in plenary talks by two winners at each biennial GHP meeting, allowing the GHP to recognize more outstanding dissertation research in hadronic physics. This would require raising an additional \$22,500, or a total of about \$30,000.

We have had many outstanding candidates for the award so far and have only been able to award three of them. It would be gratifying to expand our capability to award more graduate student work. Our previous winners are still in physics. Jin Huang (2013) did his thesis work at MIT on E06-010 at JLab, was a postdoc at Los Alamos National Laboratory, and is now an Associate Physicist at BNL; Daniel Pitonyak (2015) was a postdoc at BNL and Penn State Berks before becoming an Assistant Professor at Lebanon Valley College; and Phiala Shanahan (2017) held a joint position at the College of William & Mary and JLab before becoming an Associate Professor of Physics at MIT in 2018.

The JLab 12 GeV program, the continuation of the STAR experiment and the new sPHENIX experiment at BNL; international hadronic physics experiments at the CERN LHC, GSI in Germany, KEK in Japan and elsewhere; in addition to the advent of the EIC represent the richness of our field and make the case for an expanded, annual award.

Therefore:

Help us to endow the GHP Dissertation Award!

As stated above, the GHP Dissertation Award is presented biennially, “to recognize outstanding young scientists who have performed original research in the area of hadronic physics.” It currently consists of a \$1,000 stipend, a certificate, up to \$1,500 in travel reimbursement, and a registration waiver to attend and give an invited talk at the biennial meeting of the Topical Group on Hadronic Physics—where the Award is presented. To meet the minimum requirement for dissertation award stipends—set forth by the 2016 APS Prizes & Awards Committee Task Force Report—we will need to raise the stipend to \$1,500. In addition, we would like to make this an annual, rather than a biennial award.

We are therefore in the process of raising funds to reach our campaign goal of \$30,000. Please help us raise the funds to allow the GHP to give this award annually, in perpetuity. To help us meet this goal, please consider making a gift to the award fund, either online by selecting “Dissertation Award in Hadronic Physics” at the APS donation page, <https://www.aps.org/memb-sec/donation/DonationFunds.cfm>, or by a check payable to American Physical Society, which can be mailed to:

APS Development Office
One Physics Ellipse
College Park, MD 20740

Please note, “GHP Dissertation Award” in the memo field. For more information on making a gift, please reach out to Mariam Y. Mehter, APS Campaign and Donor Relations Manager at (301) 209-3639 or mehter@aps.org.

We are grateful for your interest and support!

4 GHP Program at the APS April Meeting, 2019

Denver, CO

<http://www.aps.org/meetings/april/>

GHP participates in the annual APS April Meeting, which is also the primary meeting of the unit in even years. Roughly 100 of our members attend the APS April meeting each year.

GHP is allocated two invited sessions at the April meetings. We often organize joint sessions with other units, in order to raise our profile by increasing the number of sessions sponsored by the GHP. (The maximum currently possible is four.)

The program committee for the 2019 APS April meeting is

GHP Program Committee

David Richards (*Chair*)

dgr@jlab.org

Tanja Horn hornt@jlab.org	Garth Huber huberg@regina.edu
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The GHP-sponsored sessions, as well as other sessions of interest to our members will be listed in the March 2019 edition of the newsletter.

5 GHP 2019: 8th Workshop of the GHP

The Eighth Workshop of the APS Topical Group on Hadron Physics will be held the three days immediately before the April APS meeting.

10-12 April 2019

The meeting will be held at the Sheraton Denver Hotel, the same location as the GHP meetings in 2009 and 2013. The meeting website can be found at <https://www.jlab.org/indico/event/282> while email inquiries can be made to ghpworkshops@gmail.com.

The Program Committee is chaired by David Richards and Garth Huber, the GHP Chair-Elect and Vice Chair respectively. The remainder of the Program Committee includes members of the GHP executive and other GHP members. The full Program Committee is:

- David Richards (co-chair) dgr@jlab.org
- Garth Huber (co-chair) huberg@uregina.edu
- Abhay Deshpande abhay.deshpande@stonybrook.edu
- Tanja Horn hornt@jlab.org
- Swagato Mukherjee swagato@bnl.gov
- Spencer Klein srklein@lbl.gov
- Paul Reimer reimer@anl.gov
- Susan Schadmand s.schadmand@juelich.de
- Anne Sickles sickles@illinois.edu
- Ramona Vogt rlvogt@lbl.gov

The topics covered include:

- Light- and heavy-quark mesons & baryons
- Exotic hadrons
- Transverse and longitudinal structure of hadrons
- Hadron tomography and hadronization
- Neutrino-hadron interactions
- QCD effects in nuclei
- Physics of the quark-gluon plasma
- Physics of gluon saturation
- EFT approaches in hadron physics
- Lattice QCD and other non-perturbative approaches
- Future facilities

Confirmed plenary speakers include the GHP Fellows from the last two years: Kawtar Hafidi, Oscar Rando-Aramayo and Moskov Amarian.

Abstract submission is open. The abstract submission deadline is **7 January 2019** while early registration deadline is **1 March 2019**.

6 APS Addresses Decline in International Student Applications to U.S. Physics Ph.D. Programs

Survey reveals that some physics departments had a 40 percent drop in non-U.S. applicants

(Communicated by Tawanda W. Johnson, APS Press Secretary tjohnson@aps.org. Reprinted from September 2018 APS News.)

In the wake of a decline in applications from international students to physics Ph.D. programs in the United States, APS leadership recently met with congressional staff on Capitol Hill as part of a larger effort to reverse the trend.

“Physics students want to come to the United States from all over the world because they know their educational and career opportunities here will be extraordinary, said APS President Roger Falcone. “Our countrys research, technology, and economy have been enormously strengthened by a positive attitude toward such immigration of students. We should continue to be a welcoming place, and to embrace open and global mobility for people.

Added Francis Slakey, chief government affairs officer in the APS Office of Government Affairs (APS OGA), “The U.S. is at high risk of no longer attracting the best and brightest minds in physics.

During the 2018 APS March Meeting, a small number of Society members informed APS OGA that their physics departments had experienced a substantial decrease in the number of applications from non-U.S.-based students to their respective Ph.D. physics programs between 2017 and 2018.

To help inform the Societys response, APS OGA worked with department chairs of U.S. physics Ph.D. programs that reported graduating 10 or more students per year to gather data concerning the number of international student applicants. A total of 74 department chairs were contacted, and 49 responded to the inquiry.

The departments that responded to the survey represent 40 percent of all international physics graduate students enrolled in the U.S. Additionally, 41 percent of all physics graduate students enrolled in the U.S. were at one of the 49 respondent departments.

According to the data collected in the report, there was an overall decrease of almost 12 percent in the number of international applicants to the physics Ph.D. programs that responded to the survey.

Although some institutions did not see a decline in their international applications, there were a handful of programs that experienced declines of more than 40 percent.

Among the questions asked in the study were: “How has the general decline in applications impacted your 2018 cohort?, “Has the overall class size changed?, and “Did you accept more domestic students?

The replies, all of them reported anonymously to protect the integrity of the Ph.D. physics programs, included the following: “Weve admitted more domestic students, so as to fill our program. On the other hand, many of the better applicants in the past were international students, so our sense is that the overall quality of the applicants we admitted this year was somewhat lower than in the past.

Respondents were also asked, “Could you comment on what countries had the largest declines

in terms of applicants, from 2017 to 2018?” For schools reporting their Chinese applicant numbers, the average decline was 16.4 percent.

Some department chairs speculated about the possible reasons for the decrease. “There is speculation among the faculty, but it is not necessarily evidence based: That Chinese institutions have ‘arrived in terms of quality, meaning many Chinese students prefer to stay home rather than go to the U.S. for graduate study, replied one department chair.

Another department chair stated, “Anecdotal evidence and rumors suggest that China has been investing heavily in training young scientists, particularly in the area of condensed matter physics, and so many talented students may be choosing to stay in China for their post-graduate studies rather than go abroad.

To address these concerns, APS OGA is implementing a strategy that entails making the F-1 visa the standard method international students use to enter the U.S. to study at colleges and universities “dual intent. Under current law, international students have to prove that they will return to their countries after they have been educated in the United States. That can be an extremely high burden of proof for students who may have to demonstrate that they have a spouse, a child, an ill relative or property to care for back home.

With an F-1 “dual-intent visa, students would no longer be required to provide proof that they are only in the United States temporarily and have the ability to declare that they plan to live and work in the United States permanently, giving them a smoother pathway for a science, technology, engineering, and mathematics (STEM) career in America.

Historically, the United States has been able to attract the best and brightest students to its universities and research facilities. And those students have had a positive effect on the U.S. economy. During the 2016-17 academic year, for example, international students and their families at U.S. universities and colleges contributed an estimated \$36.9 billion to the U.S. economy. Moreover, American innovation is bolstered by international talent. Of the 87 startup companies valued at least at \$1 billion in 2016, more than half were founded by immigrants, with 21 companies founders first coming to the U.S. as international students.

But in recent years, the United States overseas counterparts have ramped up their research programs, giving America more competition. That dynamic, coupled with a drop in international enrollment in STEM fields at U.S. universities, is driving the APS strategy. APS OGA is also working with a number of other scientific societies to flesh out the plan.

Additionally, APS OGA recently organized meetings on Capitol Hill with 16 physics department chairs who advocated for the importance of attracting international students to physics Ph.D. programs and making the F-1 visa “dual intent.

“There are several reasons that attracting international students to the field of physics is important. First of all, it is good for physics: the more different world experiences we bring in, the more different ways we can think about solutions to a problem, said Brett D. DePaola, William and Joan Porter Professor & Head of the Department of Physics at Kansas State University.

DePaola added, “Second, Ive found that over the years on average, international students are better prepared for graduate level classroom work than their American counterparts. But our domestic students, on average, are better prepared for laboratory work. Both skill sets are important in developing strong physicists. Ive found that by working together, our domestic and international students teach each other, eliminating the knowledge and experience gaps for both groups. Thus, international students are definite assets to the United States graduate

education programs in physics.

7 Meeting Summaries

NB. We would be pleased to receive summaries from GHP membership of meetings that they have organized or attended. Please send the summaries to the GHP Secretary-Treasurer.

7.1 POETIC 8: 8th International Conference on Physics Opportunities at an ElecTron-Ion Collider

(Communicated by Andreas Schaefer andreas.schaefer@physik.uni-regensburg.de)

POETIC 8 was held in Regensburg, Germany, March 19-23, 2018. The home page of the conference, with links to the talks, may be found at <https://indico.cern.ch/event/663878/>.

The POETIC conference series differs in scope and profile from the many other EIC-related conferences and workshops. Large events like the annual EIC User Group meetings cover aspects of all fields its more than 700 members work on and many small workshops address specific R&D topics of accelerator and detector design. The POETIC meetings focus on new developments and long-term efforts in EIC theory. The program, which covers both the lower energy EIC in the US and the high energy LHeC at CERN, consists traditionally of plenary talks only. As the challenge for theory to meet the experimental accuracy expected for the EIC is very high, a substantial fraction of the talks addressed recent developments in higher-order/higher-twist perturbative QCD and high precision Lattice QCD calculations. Within both approaches, we have witnessed in recent years tremendous progress in controlling systematic uncertainties, in particular, for the rather delicate objects which dominate much of the theory discussion: GPDs, TMDs, Wigner functions, Distribution Amplitudes, and Double Parton Distributions. Such achievements are very non-trivial, however, the progress reported by the 78 participants has demonstrated that the aim of matching the experimental precision by the time the EIC is operational is not unrealistic. Vital to this endeavor is the ever closer collaboration of experiment, analytic QCD and numerical QCD. With the strong endorsement of EIC by the National Academy of Sciences (published in July) the matching of experimental and theoretical precision was transformed from a long term aim into a concrete short term task. The talks given at POETIC 8 outlined in many respects the path to be taken, while for other aspects of EIC physics further clarification is needed. In any case, the sheer amount of work to be done requires a strong coordinated effort. POETIC 9 will have to demonstrate that the hadron physics community does meet this challenge. Judging by the highly advanced theoretical analyses and the many innovative ideas presented at POETIC 8, one can be very optimistic that it will succeed to do so.

In addition, POETIC 8, as is the case for all POETIC meetings, served as a testing ground for new ideas which enrich the field also beyond the immediate EIC physics case. Some of these concern the proposed Large Hadron electron Collider (LHeC) which would combine very high luminosity with much higher energy than the EIC. Obviously, the spectrum of physics problems which could be addressed by an LHeC is significantly broader than for the EIC, inviting many-fold theory studies.

POETIC 8 was supplemented by a satellite workshop on dedicated and improved Monte Carlo Event Generators for the EIC as well two extensive introductory lectures by Feng Yuan

(theory) and Ernst Sichtermann (experiment), both from Berkeley, where POETIC 9 will take place.

In summary, POETIC 8 demonstrated how rapidly the reach of first principles QCD calculations as well as experimental techniques in hadron physics are expanding and motivated its participants to focus even more on contributing to this development.

7.2 ECT* Workshop on Exposing Novel Quark and Gluon Effects in Nuclei

(Communicated by Ian Cloët icloet@anl.gov)

The workshop “Exposing Novel Quark and Gluon Effects in Nuclei” was held at the ECT* in April 2018 (<http://www.ectstar.eu/node/4211>), and covered a broad range of topics related to the quark-gluon structure of nuclei and nuclear medium modification. This represents an important topic in nuclear and particle physics, as it is the confluence of the traditional nuclear degrees of freedom of nucleons in nuclei, with the underlying theory of QCD built from quarks and gluons. In the more than 30 years since the first identification that the partonic structure of protons and neutrons are modified when bound in a nuclear medium (the EMC effect), there still remains no single theory which can adequately explain present observations. While there have been great strides in improving the coverage of nuclei within these measurements, there are still many opportunities and specific experiments which are critical in unraveling the many different possible components and mechanisms of medium modification. In particular, there is a critical need for studies in the areas of flavor, spin, and momentum dependence of modification as well as formalisms and calculations for low- A nuclei.

This workshop had 26 participants with a good representation of both theory and experiment. It was clear that there exists a global effort, at many different institutions and facilities, to understand how nucleons change in the nuclear medium within the context of QCD. This workshop was timely as there are many emerging experimental and theoretical efforts to study different aspects of medium modification, including recent nucleon and nuclear parton distribution analyses, deep inelastic scattering including isovector and spin observables, Drell-Yan with fixed nuclear targets, short-ranged correlations, and nuclear generalized parton distributions.

Several major themes emerged for the global program:

- It is critical to separate local density and mean field effects which contribute in some combination to modification and new experiments with this sensitivity are needed.
- Nuclear PDF data are incomplete, have notable inconsistencies in data sets, and published data often have assumptions made in their analysis which cannot be removed.
- Studies of a more complete set of nuclei with attention to isovector observables and varying local densities will probe new dimensions of modification along with measurements reaching into the $x > 1$ regimes are planned for Jefferson Lab.
- Tagged spectator measurements offer new dimensions to modification momentum and isovector dependence.
- Proposals for isovector observables using parity-violating electron scattering with SoLID at Jefferson Lab and fixed-target Drell-Yan at COMPASS were highlighted, with these two approaches identified as complementary with different systematic uncertainties.

- The spin-dependence of modification in polarized nuclei with sufficiently large A has not been studied and any new data will represent ground-breaking work. A novel spin-dependent program which was approved for CLAS12 at Jefferson Lab was presented.
- New theory results on developing the GPD formalism for deuterium are available. The deuteron is interesting because it presents opportunities to measure new observables, potentially at an electron-ion collider, and relate them to, for example, matrix elements of the QCD energy-momentum tensor available with a spin-1 object.

Also highlighted were experimental and theoretical developments for nuclear generalized parton distributions (GPDs). New experimental results on ^4He GPDs, which represent the simplest spin-0 nuclear system, were presented.

Tagged spectator experiments, deeply-virtual Compton scattering, and deeply-virtual meson production (both of which may access GPDs), were identified as important directions in adding new degrees of freedom to access different aspects of nuclear modification. For example, using missing momentum as a metric for off-shell effects, one may help disentangle the role of local density effects and mean field effects. By adding isotope identification in the tagging process, isovector observables may be included. Plans for such measurements have been made for CLAS12 at Jefferson Lab in the ALERT program.

This workshop was organized by Ian Cloët (Argonne National Laboratory), Raphaël Dupré (IPN Orsay, France), and Seamus Riordan (Argonne National Laboratory) with support from the ECT* in Trento, Italy and additional financial support from the Argonne Medium Energy Group and IPN Orsay.

7.3 INT Program on Multi-Scale Problems Using Effective Field Theories

(Communicated by N. Brambilla (nora.brambilla@ph.tum.de), E. Braaten (braaten@pacific.mps.ohio-state.edu), T. Schaefer (tmschae@ncsu.edu), and A. Vairo (antonio.vairo@ph.tum.de)).

The program was organized by Eric Braaten (Ohio State), Nora Brambilla (TU Munich), Thomas Schaefer (North Carolina State) and Antonio Vairo (TU, Munich) at the INT from May 7 to June 1, 2018.

The program focused on some of the contemporary most interesting open problems at the frontiers of nuclear and particle physics characterized by the existence of a separation of scales and therefore suitable for description by effective field theories (EFTs). The EFT method treats the low-energy degrees of freedom as dynamical fields and systematically takes higher-energy scales into account through matching conditions. The choice of the low-energy degrees of freedom that remain dynamical depends on the physical observables that are to be described. Many state-of-the-art applications of EFTs involve multiple effective field theories to deal with several different scales. Examples include sequences of EFTs in which the dynamical degrees of freedom have increasingly lower energies. Other applications involve very different EFTs that are combined in innovative ways to systematically separate the scales.

The objectives of this program were to bring together experts with different backgrounds, from EFT practitioners to lattice experts to phenomenologists, to focus their efforts on concrete problems of great impact for current progress in nuclear and particle physics and possible spin-offs to atomic, molecular, and condensed matter physics. The research focus of

the program attracted a lot of attention and many researchers with different expertise, seniority and geographic origin convened to discuss and work together toward these goals.

Each week was shaped to emphasize a particular direction. The first week focussed on understanding fluid dynamics and kinetic theory as effective field theories, with applications to the physics of processes at finite temperature and determination of transport coefficients, with an emphasis on Quark-Gluon Plasma and cosmology. Week two was dedicated to dark matter theory models, their construction, how to use EFTs to solve the bound state problem or take advantage of simplifications, and a discussion of phenomenological impacts. Week three was oversubscribed, focusing on a subject of great current interest: open systems and their description. Contributors reported on an array of different problems from EFTs such as the Lindblad equation applied to the suppression of heavy quarkonium in a Quark-Gluon Plasma and classical conservation properties in open systems; from open systems with dissipation at the black hole horizon to nuclear physics applications. The fourth week focused on the study of the exotic X , Y , and Z states observed by the LHC experiments, B - and tau-charm factories. Heated discussions took place among effective field theorists, lattice practitioners, and phenomenologists.

The participants interacted very coherently. In the morning, two talks were scheduled that, together with the associated ample discussion, filled the morning. In the afternoon, discussion sessions were regularly organized, steered and well attended.

7.4 ECT* Workshop on Foundational Aspects of Relativistic Hydrodynamics

(Communicated by Ulrich Heinz (heinz.9@osu.edu))

Preceding the 2018 Quark Matter Conference in Venice, a 5-day international workshop on “Foundational Aspects of Relativistic Hydrodynamics” was held during May 7-11, 2018, at the ECT* in Trento, Italy, organized by Guy D. Moore (Technische Universitt Darmstadt), Michal Heller (Max Planck Institut fr Gravitationstheorie, Potsdam) and Ulrich Heinz (Ohio State University). The workshop aimed at exchanging recent developments in the theory of relativistic hydrodynamics, from its fundamental underpinnings to its domain of validity to its applications in heavy-ion collisions. Through a week of intense discussion among leading representatives with different backgrounds (weakly vs. strongly coupled systems, formal theorists vs. phenomenologists, theories formulated in four vs. more space-time dimensions, nuclear vs. particle theorists, etc.), the 28 participants sought to make conceptual advances towards understanding the transition to hydrodynamics in quantum field theories, the mathematical foundations of that theory, and the problems and successes in applying it to describing heavy ion data. A list of participants, the schedule, and the presentation slides can be found at <https://indico.ectstar.eu/event/11/>.

The main topics were:

- Excitations of equilibrium plasmas in quantum field theories: excitations at weak coupling through kinetic theory, at strong coupling through holographic methods, and the role of long-time tails and thermal fluctuations of hydrodynamic degrees of freedom.
- Validating hydrodynamics with ab-initio simulations of quantum field theories, and especially understanding “hydrodynamization, the transition of a system into displaying the same behaviors as a hydrodynamical system even if it is far from local isotropy.

- Different formulations of hydrodynamics and its behaviors. This includes attempts at accelerated convergence of the hydrodynamic expansion, a better understanding of the microscopic non-hydrodynamic degrees of freedom, and an understanding of why the hydrodynamic expansion is asymptotic and whether it might be resummed using trans-series.

In talks of 30 minutes length, plus an additional 30 minutes for discussion each, every participant (except for the organizers) presented some of their work. Additional discussion time between seminars made for a lively workshop spirit and an efficient exchange of ideas. Since the workshop brought together scientists with very different backgrounds and expertise, ranging from phenomenology to mathematical physics and computer science, these discussions were important and very useful. Many of the participants were exposed to areas of theoretical physics in which they had no prior personal experience and the workshop helped them to bridge the gaps of knowledge and intuition between their own areas of expertise and those represented by participants from other subfields. Major guiding themes were:

- What are the processes driving a many-particle system towards thermal equilibrium?
- How do these processes manifest themselves in relativistic heavy-ion collisions and elsewhere in the cosmos?
- What are the conditions under which hydrodynamics is applicable, and does hydrodynamics manifest itself in relativistic heavy-ion collisions and elsewhere in the cosmos?
- How can hydrodynamics be derived from microscopic dynamics, how precise are the hydrodynamic approximations derived in this way, and how can we tell?
- How accurate are numerical codes for solving the hydrodynamic equations in realistic situations and what are the most efficient modern algorithms for solving hydrodynamics?
- What are hydrodynamic attractors, how do they arise mathematically, and how, or to what extent, does their existence explain the rapid approach towards hydrodynamic behavior in realistically expanding systems even far from equilibrium?
- How can we use hydrodynamic modeling to extract information about the transport coefficients of very hot and dense matter (such as the quark-gluon plasma created in ultra-relativistic heavy-ion collisions) by comparison with experimental data collected at RHIC and the LHC?
- What is the role of thermal fluctuations in hydrodynamic evolution and how can we implement them in numerical simulations?
- How are quantum anomalies, magnetic fields, and the dynamics of critical fluctuations in the neighborhood of phase transitions and critical points in the phase diagram of strongly interacting matter interconnected?

To each of these themes we heard excellent reports on the latest insights, breakthroughs, and remaining or newly open questions. In the closing session the participants were asked what they thought were the most exciting and/or important questions and problems on which they will (or would like to) spend time in the coming months and years. The resulting list of “homework problems was distributed to the participants after the workshop (please contact the author at heinz.9@osu.edu if you would like a copy). The organizers expect that some of

these problems will already be solved by the time of a follow-up workshop with similar goals that will take place in Banff, Alberta, in November 2019.

7.5 LIGHT CONE 2018 (LC2018)

(Communicated by Chueng Ji (crji@ncsu.edu))

The 2018 edition of the Light-Cone Conference took place at Jefferson Lab in Newport News, Virginia on 14-18, May (<https://www.jlab.org/conferences/lightcone2018/index.html>).

The local organizing committee consisted of Wally Melnitchouk, chair (Jefferson Lab), Raul Briceno (ODU/Jefferson Lab), Andrea Signori (Jefferson Lab) and Chueng Ji (NCSU). This series of meetings is held under the auspices of the International Light Cone Advisory Committee (ILCAC), Inc. <http://www.ilcacinc.org>. LC2018 was supported in part by the Jefferson Science Associates (JSA) Initiatives Fund and generous contributions from Jefferson Lab, Old Dominion University, and Argonne National Lab. The support for LC2018 allowed ILCAC to award McCartor Fellowships to seven promising young physicists, see <http://www.ilcacinc.org/newsILCACSTURA20180612.pdf>), enabling them to attend the conference and present the results of their research.

LC2018 attracted 104 participants, including many young researchers who attended this annual meeting for the first time. There were 53 plenary talks and 41 parallel talks in 8 parallel sessions, focusing on a number of topics (hadron structure, meson and baryon spectroscopy, parton physics, and few- and many-body physics) and methodologies (light-front field theories, lattice field theory, effective field theories, phenomenological models, as well as present and future facilities).

All the presentations from LC2018 are available at <https://www.jlab.org/indico/event/252/timetable/#all.detailed>. The talks stimulated many discussions and promoted research towards a rigorous description of hadrons and nuclei based on light-front quantization methods. In particular, there was keen interest in the dedicated session on the structure of the vacuum, resulting in an effort to compile a summary document on this topic.

Light Cone 2019 will be held at Ecole Polytechnique (Palaiseau) in France, September 16-20, 2019.

7.6 Hypernuclear and Strangeness Physics Conference: HYP2018

(Communicated by R. A. Schumacher (schumacher@cmu.edu) and L. Tang (tangl@jlab.org) (co-chairs))

A worldwide community of physicists met for the “Thirteenth International Conference on Hypernuclear and Strange Particle Physics”. The meeting was held at the Renaissance Portsmouth-Norfolk Waterfront Hotel in southern Virginia, on the shore of the Elizabeth River, from June 24 to 29, 2018. Close to 100 physicists from Asia, the United States, and Europe attended the triennial event. Light quark nuclear and particle physics was the unifying thread of the conference, which allowed a wide range of physics topics to be presented and discussed.

The topics included: the multifarious methods of hyperon production and their baryonic

interactions, including strangeness in heavy-ion collisions; the production of hypernuclei, including multi-strange systems; the structure of hypernuclei, from few-body systems to heavy hypernuclei and to multi-strange systems; the decays of Lambda hypernuclei and the associated spectroscopy; strangeness in nuclear matter and neutron stars; the structure of strange hadrons; and the interactions of strange mesons with baryons and nuclei. There were also talks on charmed or other flavor systems as well as future experiments and facilities for strangeness nuclear physics. Two topical sessions were held, one on neutral baryonic systems with strangeness and the other on hypernuclear charge symmetry breaking.

In all, a total of 35 plenary talks, 13 topical session talks, and 28 contributed talks, plus 19 posters, were presented. The complete program of talks can be found at . Proceedings will be published by AIP.

A lively conference excursion was organized, featuring a dinner cruise aboard the “Spirit of Norfolk” ship. It toured the Norfolk harbor area, which is home to many large ships of the American Navy. H. Tamura of Tohoku University ably summarized the wide-ranging talks at the end of the conference. The technical staff for organizing the conference, both on-site and on-line, was provided by nearby Jefferson Laboratory. It was announced that the next HYP conference will take place in 2021 in Prague, in the Czech Republic.

7.7 ECT* Workshop on Nucleon Spin Structure at Low Q - A Hyperfine View

(Communicated by Alexandre Deur (deurpam@jlab.org) and Jian-ping Chen (jpchen@jlab.org))

Nucleon spin structure study at low Q explores the strong interaction in the non-perturbative region. Advances on this front were reported at the ECT* workshop on “Nucleon Spin Structure at Low Q - A Hyperfine View” (<https://indico.ectstar.eu/event/18/>) from 2-6 July 2018.

The information on the nucleon spin structure obtained from inclusive polarized lepton scattering off nucleons is encoded in the spin structure functions g_1 and g_2 . Spin sum rules -which relate moments of g_1 and g_2 to global hadron properties such as their spins or anomalous magnetic moments, or calculable quantities such as Compton amplitudes- provide powerful tools to study and test our understanding of non-perturbative QCD. In particular, spin sum rules can extensively test chiral effective field theory (χ EFT), the leading analytical approach to strong interaction at large distance. While early χ EFT calculations had some successes in predicting the lower moments involved in spin sum rules, there were significant disagreements with data for higher moments.

Recent χ EFT calculations, with improved treatments of $\pi - \Delta$ interaction, much improved the comparisons between data and calculations. These new theoretical advances were summarized in the talks at the workshop.

New measurements at very low Q on the proton and neutron polarized either longitudinally or transversely were performed at JLab. Some of the preliminary results reported at the workshop, showed that the challenge to resolve the discrepancies between data and χ EFT calculations continues. Related measurements from MAMI, HI γ S and JLab were also presented.

The nucleon structure affects the hyperfine splitting (HFS) of atomic energy levels because the

atom's electron wave functions reach inside the nucleon. With muonic hydrogen, the influence from the nucleon structure becomes significantly more important since the muonic Bohr radius is much smaller than the electron one. Three new muonic HFS experiments, planned for the next few years at JPARC, PSI and RIKEN RAL, were discussed at the workshop as well as their theoretic framework. Knowledge of g_1 and g_2 at low Q is needed to compute the splitting precisely, but such data have been scarce. The new JLab data fulfill this need. A related topic is the proton radius puzzle. The value measured precisely from muonic hydrogen Lamb shift is significantly smaller than the radius extracted from electron scattering experiments. A new experiment at JLab, PRad, measured electron scattered with much lower Q than previous experiments in order to help resolve the puzzle. PRad's preliminary results were presented at the workshop.

The workshop was organized by Alexandre Deur and Jian-ping Chen from JLab, Vladimir Pascalutsa and Marc Vanderhaeghen from Mainz, and Aldo Antognini from Zurich and PSI. The workshop was supported in part by contributions from ECT*, JLab and Mainz.

7.8 The 36th International Symposium on Lattice Field Theory

(Contributed by Huey-Wen Lin (hwlin@pa.msu.edu))

The 36th International Symposium on Lattice Field Theory (Lattice 2018), <https://web.pa.msu.edu/conf/Lattice2018/>, took place at Michigan State University, East Lansing, MI, during July 22-28, 2018. This annual conference brings the entire worldwide lattice field theory community together to share new results, developments, methods, and experiences; it is the most important event every year in lattice QCD. The conference venue generally rotates between the US, Europe and Asia, but this year was the first since 2014 for the conference to be back on US soil. This year's conference was organized by three lattice theory faculty at Michigan State (Chair: Huey-Wen Lin; co-Chairs: Alexei Bazavov and Andrea Shindler) together with six senior faculty from nearby institutions (Aida X El-Khadra, Steven Gottlieb, Keh-Fei Liu, Randy Lewis, Yannick Meurice, and James Osborn) and with input from a 25-member international advisory committee. The number of participants this year was around 350.

The Lattice 2018 scientific program encompassed topics in nuclear physics, particle physics and computational physics; in particular, it focused on Algorithms and Machines, Applications beyond QCD, Chiral Symmetry, Hadron Spectroscopy and Interactions, Hadron Structure, Nonzero Temperature and Density, Physics beyond the Standard Model, Standard Model Parameters and Renormalization, Theoretical Developments, and Vacuum Structure and Confinement.

Given the close proximity of the Facility for Rare Isotope Beams (FRIB) at the MSU campus, the conference opened with a talk titled "From FRIB to Lattice QCD" given by Dean Lee, followed by talks on connecting lattice QCD to nuclear calculations and effective-theory approaches, as well as more traditional review talks concerning nuclear calculations on the lattice.

To reflect excitement about a possible Electron-Ion Collider (EIC) starting soon after FRIB, there was a one-day plenary series focusing on proton structure and the EIC. Xiangdong Ji gave an EIC-physics overview talk, followed by reviews on recent precision lattice nucleon matrix elements, progress on proton spin and mass decomposition, and the rapid developments made in direct lattice calculations of the Bjorken- x dependence of parton distribution

functions. These calculations are exciting in terms of their connection to the EIC physics program to access the sea quark structure, and also have strong connections to the ongoing Jefferson Lab 12-GeV and RHIC spin-physics programs.

Further plenary series covered highlights and reviews of lattice nonzero-temperature and density calculations, hadron spectroscopy, precision quark-mass determination and heavy-flavor physics. The Saturday plenary session featured recent algorithm developments, GPU-accelerated systems, and machine learning, ending with prospects for quantum computing given by John Preskill.

Multiple new special events were introduced at this year's conference for graduate students and young researchers, included in the regular registration fee. A pre-conference workshop seminar (<https://web.pa.msu.edu/conf/Lattice2018/ProfSeminar.html>) focused on professional skills that women need to effectively perform research and thrive in physics. Multiple career-advising events were held during lunch breaks, with various groups gathering at different lunches throughout the conference week. Sessions focused on graduate students looking for postdoctoral positions, advice for postdocs on how to build their careers and stand out during interviews, and one session with former lattice theorists giving advice related to their success in landing industry positions. All these events were tailored for these young researchers with similar background, making them more effective than generic physics-career advice. In addition, a special lunch event sponsored by Intel presented the topic of "Gender inequality in STEM" (<https://web.pa.msu.edu/conf/Lattice2018/WLBGT.html>) by keynote speaker: Dr. Elizabeth Simmons, addressed to all conference participants; this event received great positive feedback.

The lattice conference proceedings will be published in Proceedings of Science (<http://pos.sissa.it/>) later this year or in early 2019.

7.9 The XIIIth Quark Confinement and the Hadron Spectrum

(Contributed by Jon-Ivar Skullerud (jonivar@thphys.num.ie) and Sinead Ryan (ryan@maths.tcd.ie))

The 2018 Quark Confinement and the Hadron Spectrum conference was held in Maynooth University, Ireland from the 31st July to 6th August. This was the thirteenth edition of this conference series which was inaugurated in 1994 in Como, Italy.

The Confinement conferences are an important forum for scientists working on strong interactions, facilitating stimulating discussions across related disciplines and between theorists and experimentalists. The conference aims to bring together scientists working on aspects of strong interaction physics and using different approaches from lattice QCD to perturbative QCD, from models of the QCD vacuum to QCD phenomenology and experiments, from effective theories to physics beyond the Standard Model.

This year, Maynooth University campus provided a peaceful and relaxed backdrop for 313 participants to present their results and to hear about the latest progress, new ideas and recent results. The conference web page at <https://indico.cern.ch/event/648004/> includes the detailed scientific programme as well as links to slides from the talks at <https://indico.cern.ch/event/648004/timetable/#20180731>.

The conference was supported by Irish institutes and agencies including Maynooth University, the Hamilton Mathematics Institute, the Dublin Institute for Advanced Studies, Science

Foundation Ireland, the Institute of Physics in Ireland and Failte Ireland and internationally by the Universe Excellence Cluster and EMMI in Germany. The support was used primarily to support the participation of young researchers, and 46 benefitted from subsidised conference fees and reduced accomodation costs. The local organisers were drawn from the Dublin-wide QCD community and the international advisory committee provided valuable suggestions and guidance for the plenary programme (<https://indico.cern.ch/event/648004/page/11347-organisation>).

The 2018 Confinement conference programme included 12 plenary sessions where 32 invited talks were presented covering theoretical and experimental aspects of QCD and strongly coupled theories. A special plenary talk dedicated to the memory of Mike Pennington was presented by Ayse Kizilersu. 3 round table plenary sessions included 12 short presentations and stimulating discussion and Q&A on the topics

- *What can neutron star and heavy ion physics learn from each other?* Chaired by David Blaschke.
- *Determining the strong coupling - status and challenges.* Chaired by Antonio Pich.
- *Axion physics: status, prospects and challenges.* Chaired by Paolo di Vecchia.

The conference also included a public lecture delivered by Manjit Dosanjh from CERN on Ions for Cancer Therapy. This took place at Trinity College Dublin, giving delegates an opportunity to explore the city. The scientific programme comprised 8 parallel sessions covering the following topics: Vacuum structure and confinement (with a focus subsection on emergent gauge fields and chiral fermions); Light quarks; Heavy quarks; Deconfinement; QCD and new physics; Nuclear and Astroparticle physics; Strongly coupled theories; Statistical methods for physics analysis in the XXI century. The topics' convenors organised the sessions with a mix of invited and accepted talks to reflect the diversity of methods and approaches being used which led to fruitful discussions.

A half-day excursion - for which a choice of 6 locations was offered - gave delegates the opportunity to explore Ireland's ancient history and contemporary culture. Conference participants were also invited to a specially organised organ recital in the University's 19th century chapel. The recital on the recently restored organ by internationally esteemed musicologist and organist Prof. Gerard Gillen included a short introduction on the physics and art of the organ making for a unique event.

The proceedings of the conference will be refereed, and published by Proceedings of Science.

7.10 ECT* Workshop on Mapping Parton Distribution Amplitudes and Functions

(Contributed by Cedric Mezrag (cedric.mezrag@roma1.infn.it))

The workshop on "Mapping Parton Distribution Amplitudes and Functions" was held at the European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*) from September 10th to 14th 2018. It is part of a worldwide effort to shed light on the possibilities offered by current experimental programs such that the one of COMPASS at CERN, or the 12GeV agenda at Jefferson Lab (JLab 12), to increase our knowledge of basic 1D QCD quantities that are Parton Distributions Amplitudes (PDAs) and Functions (PDFs). This

effort is extended to the study of the impact on these 1D quantities of future experiments (such as SeaQuest at Fermilab) and facilities like the Electron-Ion Collider (EIC). The key-role played by PDAs and PDFs in hadron physics motivated the organization of the workshop. Their (x, Q^2) -dependence reveals basic facts about the emergence of mass scales in the Standard Model, provides insights into confinement and bound-state structure, and delivers critical inputs to hard-scattering formulas and cross-sections for deep-inelastic scattering and Drell-Yan processes. On top of the forthcoming experimental results, new theoretical techniques have been developed and yield novel and much-needed predictions for the x -dependence of PDAs and PDFs. Their correlation with measurable quantities will allow for experimental validation at existing, upgraded and planned facilities. It is crucial to exploit these developments, building on synergies between different sub-disciplines.

The workshop was organized by G. Bali (Regensburg U.), C. Keppel (Jefferson Lab.), C. Mezrag (INFN Roma 1) and C.D. Roberts (Argonne National Lab.). It was supported both by ECT* and the Jefferson Science Associates fund (JSA). The workshop attracted 29 participants from worldwide institutions, and all of them received financial supports to cover parts of the local expenses. The program consisted in 29 talks of 45 minutes each together with two discussion sessions. More information can be found on the ECT* website <https://ectstar.fbk.eu/node/4223>.

This meeting was an excellent opportunity to shed light on the state of the art of PDFs and PDAs experimental extractions and theoretical calculations. The most recent calculations of the Mellin moments of PDFs using lattice-regularized QCD techniques were shown from different collaborations, highlighting the recent progress and the compatibility between the results. The community focuses on reducing the systematic uncertainties, in order to keep improving the reliability of the moment evaluation. Direct access to the x -dependence using the LaMET technique was also discussed, both in terms of reliability and results. It appears that the LaMET technique should be able to yield a trustful description of PDFs within a range of x between 0.2 and 0.6, although some caveat concerning the renormalization procedure have been raised during the discussions. On the other hand, PDFs studies based on continuum techniques are able to compute the x -dependence of the latter in the valence-quark domain. These studies are therefore capable of assessing the behavior of PDFs and their ratio at large- x whose prediction is an important outcome of QCD, as emphasized during the workshop.

On the phenomenological side, multiloops extractions of PDFs keep gaining precision. New data from the LHC help to constrain light-flavor sea quarks, although HERA data seem to remain the one having the strongest influence on the extraction. A possible issue concerning the s -quark in recent LHC data was also pointed out. On top of the PDFs themselves, their ratios were also discussed. SeaQuest and JLab 12 should be able to greatly improve our experimental knowledge of these ratios. On a longer time-scale, the EIC is expected to have a critical impact on PDFs extractions. Discussions explored how complementary non-perturbative techniques and phenomenology could improve our understanding of PDFs. Both including the lattice Mellin moments in the phenomenological fitting machineries together with constraining the large- x behavior of the fitting parametrizations following continuum technique predictions, were suggested.

Concerning PDAs, strong efforts have been made through the continuum techniques to compute them in the meson heavy-heavy and heavy-light sectors. From these computations, an interesting picture tends to emerge: the PDA of light-quark mesons are broader than the asymptotic PDA, while in the heavy sector, PDA are narrower. In parallel, lattice-regularized computations have improved the precision on the evaluation of the second moment of the pion

PDA and phenomenological progress has been made using the notion of non-local condensates. Strictly speaking, the lattice-QCD results for the second Mellin moment are compatible both with unimodal and bimodal pion PDAs. However, both the global lattice-QCD data and the non-local condensate approach seem to favor the unimodal nature of the pion PDA, in agreement with continuum computations. Baryon PDAs were also discussed, together with the possibility to describe the Form Factors using hard scattering formulas. The discussions highlighted the possibility of computing higher twist PDAs. It was concluded that this is desirable, as they should dominate the calculations of the Form Factors at experimentally achievable energies. Discussions on the redaction of an EIC white paper dedicated to the structure of light-quark pseudoscalar mesons have been carried on informally. A first publicly available draft is anticipated soon. It will highlight the importance of the EIC in the determination of both the PDFs and the PDAs of these mesons. This was received enthusiastically by the participants. Other related topics were briefly highlighted, during fruitful discussions between the speakers and the audience.

All contributions can be found on ECT* Indico website:
<https://indico.ectstar.eu/event/22/contributions/>.

7.11 ECT* Workshop on Emergent Mass and its Consequences in the Standard Model

(Communicated by Craig Roberts (cdroberts@anl.gov))

The “Workshop on Emergent Mass and its Consequences in the Standard Model (QCD-TNT-5) was held at the European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*), Trento, Italy, 17-21 September 2018. Organized by Cristina Aguilar (Universidade Estadual de Campinas, Brazil), Daniele Binosi (ECT*, Italy), Joannis Papavassiliou (Universidad de Valencia, Spain) and Craig Roberts (Argonne National Laboratory, USA), the workshop was the fifth in the QCD-TNT series, which began at ECT* in September 2009. It was also a complement to the workshop that ran immediately beforehand, *i.e.* “Mapping Parton Distribution Amplitudes and Functions, 10-14 September 2018, and canvassed a range of themes that provide crucial background for much of what was discussed at QCD-TNT-5. Both workshops were planned (and scheduled together by the ECT* team) in anticipation of progress toward the construction of an electron ion collider (EIC) in the USA.

The basic premise of TNT-5 was that the most fundamental emergent phenomena in Quantum Chromodynamics (QCD), *e.g.* confinement, dynamical chiral symmetry breaking, mass generation for both gluons and quarks, and bound state formation, can only be tackled using non-perturbative methods. It then proceeded to observe that, in the last decade, our theoretical understanding of these issues has improved considerably, owing to major advances in the approaches used to address them. For example, marked progress in continuum functional methods now enables one to investigate, with quantitative accuracy, the complicated dynamics of QCDs basic Green functions; establish subtle connections between them and interpret their field-theoretic origin; and combine this information to obtain verifiable predictions for observables. At the same time, high-precision lattice simulations are furnishing valuable information on some of the most theoretically intractable facets of QCD, and new generation experiments and facilities (such as BESIII, GlueX, LHCb, PANDA, SoLID, EIC) promise to expose the structure of hadrons with unprecedented detail. The hadron physics community is thus on the edge of a new era in studying strong interactions within the

Standard Model. The aim of the workshop was therefore to gather a group of experimentalists and theorists, heavily invested in these efforts, to discuss recent developments, identify new goals, and lay a path toward completion of some of the most pressing tasks in strong QCD.

Much can be gathered from the workshop website <https://indico.ectstar.eu/event/23/overview> which lists the 31 participants and provides access to their presentations. The pattern of each full day was the same, with the kick-off being a theme-setting experimental presentation, which was followed by a string of theory talks and associated discussions that explored questions related to the days general themes. Monday began with Rolf Ent (JLab) sketching the possibilities for charting the origin and distribution of mass in QCDs Nambu-Goldstone modes, which can be realized at JLab 12 and with an EIC; and describing progress toward a White Paper that details these ideas. Wednesday's opening was delivered by Zein-Eddine Meziani (ANL), who described the potential for revealing the origin and distribution of the nucleons mass using heavy-quarkonium production near threshold at JLab 12 and an EIC. Additional themes were added on Tuesday (Ralf Gothe, U. South Carolina) and Thursday (Victor Mokeev, JLab), which saw detailed analyses of the capacity of JLab 12 to expose fundamental structural features of baryon ground- and excited-states using the anticipated wealth of high- Q^2 data on nucleon elastic and transition form factors. The theory presentations complemented these themes and additionally addressed issues such as gluon and light-quark confinement and dynamical chiral symmetry breaking; the role of an emergent gluon mass-scale in stabilizing the infrared properties of QCD; exploiting synergies between continuum and lattice methods in the computation of propagators, vertices and observables; and novel approaches to the prediction of the spectrum and properties of hybrid mesons. Ample time was provided for discussions and they were lively.

Christian Fossi (ECT*) provided excellent assistance with local arrangements for all participants; he and the other members of the ECT* team ensured that all went smoothly; and Trento displayed all its beauty in warmth under sunny skies for the entire week.

8 Forthcoming Hadron Physics Meetings

Meetings of interest to GHP's membership are listed at Mark Manley's page: <http://cnr2.kent.edu/manley/BRAGmeetings.html>. In this connection, if there is a meeting you feel should be included, please send the appropriate information to John Arrington (johna@anl.gov) or Mark Manley (manley@kent.edu).

The following list is based on Mark's page:

- INT Program INT-18-3: Probing Nucleons and Nuclei in High Energy Collisions (1 October - 16 November, 2018, INT, Seattle, WA, USA) <http://www.int.washington.edu/PROGRAMS/18-3/>
- ECT* Workshop on Electromagnetic Radiation from Hot and Dense Hadronic Matter (26-30 November 2018, ECT*, Trento, Italy) <https://indico.ectstar.eu/event/28/>
- QNP2018: 8th International Conference on Quarks and Nuclear Physics (Tsukuba, Japan, 13-17 November 2018) <http://www-conf.kek.jp/qnp2018/>
- NN2018: 13th International Conference on Nucleus-Nucleus Collisions (Omiya, Saitama, Japan, 4-8 December 2018) <http://nn2018.riken.jp>

- ECT* Workshop on The spectroscopy program at EIC and future accelerators (19-21 Dec 2018, ECT*, Trento, Italy) <https://indico.ectstar.eu/event/29/>
- Excited QCD 2019 (30 January - 3 February, Schladming, Austria) <https://indico.cern.ch/event/720726/overview>
- INT Workshop INT-19-73W: Weak Elastic Scattering with Nuclei, (4-8 March, 2019, INT, Seattle, WA, USA)
- FF2019: Workshop on Novel Probes of the Nucleon Structure in SIDIS, e^+e^- and pp (Durham, NC, USA, 14-16 March 2019) <https://sites.duke.edu/ff2019/>
- INT Program INT-19-1b: Origins of Correlations in High Energy Collisions (INT, Seattle, WA, USA, 29 April - 24 May 2019) <http://www.int.washington.edu/PROGRAMS/19-1b/>
- QWG 2019: 13th International Workshop on Heavy Quarkonium (Torino, Italy, 13-17 May 2019) <https://agenda.infn.it/conferenceDisplay.py?confid=15632>
- MENU 2019: 15th International Conference on Meson-Nucleon Physics and the Structure of the Nucleon (Pittsburgh, PA, USA, 2-7 June 2019) <https://events.mcs.cmu.edu/menu2019/>
- RHIC & AGS Annual Users Meeting (Upton, NY, USA, 4-7 June 2019)
- SQM 2019: 18th International Conference on Strangeness in Quark Matter (Bari, Italy, 10-15 June 2019) <http://sqm2019.ba.infn.it/>
- Initial Stages 2019 (New York City, NY, USA, 24-29 June 2019)
- INPC 2019: 27th International Nuclear Physics Conference (Glasgow, UK, 28 July - 2 August, 2019) <http://inpc2019.iopconfs.org/home>
- HiX2019: 5th International Workshop on Nucleon Structure at Large Bjorken x (Kolymbari, Crete, Greece, 16-21 August 2019)
- INT Program INT-19-2b: Heavy Quark Physics and Fundamental Symmetries (INT, Seattle, WA, USA, 12 August - 6 September 2019) <http://www.int.washington.edu/PROGRAMS/19-2b/>
- INT Workshop INT-19-74W: Hadronic contributions to $(g - 2)_\mu$ (9-13 September, 2019, INT, Seattle, WA, USA)
- Quark Matter 2019: 28th International Conference on Ultrarelativistic Nucleus-Nucleus Collisions (Wuhan, China, 3-9 November 2019)

GHP members might also be interested in other conferences and workshops listed at the following sites:

- ECT* ... www.ectstar.eu
- INT ... www.int.washington.edu/PROGRAMS/programs_all.html
- JLab ... www.jlab.org/conferences
- NuPECC ... <http://www.nupecc.org/index.php?display=events>

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