GHP Newsletter February 2012

American Physical Society Topical Group on Hadron Physics

http://www.aps.org/units/ghp/

Executive Officers

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1 Thesis Prize

In April 2010, motivated by a desire to recognize the outstanding accomplishments of talented young scientists in our field, the GHP Executive Committee began working on the creation of an

American Physical Society
Dissertation Award in Hadronic Physics.

Here we are pleased to announce that have now succeeded in endowing and establishing the Dissertation Award!

Reaching this milestone was enabled by significant contributions from

- Brookhaven National Lab,
- 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:

1. Christine Aidala,
2. David Armstrong,
3. John Arrington,
4. Stan Brodsky,
5. Robert Edwards,
6. Ron Gilman,
7. Ulrich Heinz,
8. Curtis Meyer,
9. Gerald Miller,
10. Xin Qian,
11. Craig Roberts,
12. Eric Swanson,
13. Ramona Vogt, and
14. Bin Zhang.

In order to maintain the endowment and, perhaps, to expand the Award, the Executive encourages our members to contribute to the endowment. For information on how to proceed, please see: https://www.aps.org/memb-sec/profile/DonationFunds.cfm

The first GHP Dissertation Award will be given at the
April 2013 GHP Meeting

in Denver, Colorado. Nominations should be sent by
October 1, 2012

to Ramona Vogt, Chair of GHP.

If you know of a deserving student who has or will graduate in the 2 year period preceding the nomination deadline, please see
http://www.aps.org/programs/honors/dissertation/hadronic.cfm

for more details about eligibility and what should be included in the nomination.

As chair of GHP, Ramona Vogt will lead the Dissertation Award Committee, whose full composition is:

Volker Crede	Mike Leitch	Wally Melnitchouk	Jianwei Qiu	Ramona Vogt
FSU	LANL	JLab	BNL	LLNL & UCD
crede@fsu.edu	leitch@rcf.rhic.bnl.gov	wmelnitc@jlab.org	jqiu@bnl.gov	rlvogt@lbl.gov

The dissertations will be evaluated based on: the quality of the written dissertation (40%), the contribution of the student to the research (30%), the impact of the work (15%), and the broader involvement of the student in the community (15%).

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2 Elections

Elections for two posts in the GHP Executive closed on 9th December 2011. The new Executive Committee is listed at the top of this newsletter.

On behalf of GHP, the Executive thanks the people who entered their names on the ballots.

In addition, we thank Stanley Brodsky and Robert Edwards for their efforts in the GHP Executive on behalf of hadron physics and beyond.

Elections will open again this year in November. We will fill three positions on GHP's Executive Committee:

- Vice-Chair (John Arrington will become Chair and Matthias Burkardt will become Chair-Elect, leaving the position of Vice-Chair vacant. Naturally, Ramona Vogt will become Past-Chair and Ron Gilman will return to his family and friends, not that the GHP Executive is necessarily excluded from the latter.)
- Secretary/Treasurer (Craig Roberts' three-year term will be at an end.)
- and one Member-at-Large (Volker Crede will by then have completed his stint.)

It is planned that in September, 2011, the Nominating Committee will solicit input from the GHP membership. The nomination of candidates will likely close on Fri. 5 October and an electronic ballot will subsequently be held over a five week period: 5 November – 7 December.

Our rules state that: *the Committee shall nominate at least two candidates for the offices of Vice-Chair and Secretary/Treasurer, 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*, who is

Ron Gilman (rgilman@physics.rutgers.edu)

this year; *and shall include three members in addition to its Chair, one of whom shall be appointed by the APS.*

We urge GHP members now to begin considering whom they would like to see filling the three open positions in 2011 and encourage members with ideas to contact the *Chair of the Nominating Committee* and pass on their suggestions. There is strength in diversity and so the Executive would like to see nominations from across the entire spectrum of GHP's membership.

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3 Membership

As of January, 2012, the GHP had 496 members, which represents 0.99% of APS membership. Of these people, 267 are also in DNP (Division of Nuclear Physics) and 271 are in DPF (Division of Particles and Fields). Membership in DNP (2663, grew by just 5 members) and DPF (3486, grew by 21 members) is static, so our growth is good news: we have captured the attention of 3% more of the DNP community and 14% more of the DPF. Notwithstanding this, it is certain that there are still many Hadron Physics researchers who are not involved with GHP.

Importantly, we have raised our membership to almost 500! So long as it remains at this level, we will be able to make two regular-fellowship nominations each year. This is an excellent boost for Hadron Physics. (More on the 2011 Fellows below.)

There are now twelve Topical Groups, of which the GHP is the 8th largest. We've dropped two positions. Comparing end-2010 membership with that at end–2011, in relative terms, the GHP grew 12.5%. Neglecting the newest Group, *Physics of Climate*, GHP is the third most rapidly growing, behind *Shock Compression of Cond Matter*, with 408 members, which grew 23% and *Energy Research & Applications*, with 539 members, which grew 16%.

Membership in a strong GHP brings many benefits. A vital GHP

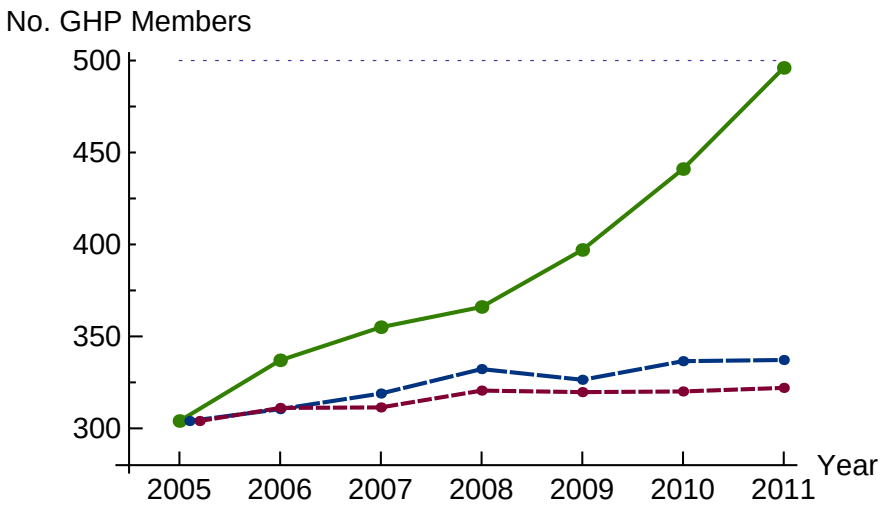

Figure 1: *Solid line* – GHP membership, true value, with "2011" representing the current APS Official Count; *long-dashed* – DNP membership normalized to GHP's value in 2005 (2401 → 304); and *short-dashed* – DPF membership normalized to GHP's value in 2005 (3291 → 304).

- establishes and raises the profile of Hadron Physics in the broader physics community, e.g., by nominating members
  - to APS governance committees,
  - to APS prize and award selection committees,
  - for election to Fellowship in the APS
- has a greater role in planning the program for major APS meetings;
- and provides a vehicle for community action on topics that affect the way research is conducted and funded.

Whether one considers the APS alone, or takes a broader perspective, the impact GHP can have is primarily determined by the number of members. (It is also influenced by the energy of the Executive, which exhibits quantum fluctuations.) The Executive urges existing members to encourage their colleagues to join us. We know there are absent-minded people who have overlooked the opportunity to join GHP but many will react positively to a little gentle prodding.

Membership is only $8. Of this, GHP receives $5 from the APS. (The remainder stays with the APS and covers the many services they provide. They were very helpful, e.g., in connection with GHP11.) With this support we can be an active force for Hadron Physics. The money can be used, for example, to assist with: the GHP Dissertation Award – see above; the organization of meetings – such as the forthcoming GHP2013, see below; the preparation of publications that support and promote the GHP's activities; and participation in those fora that affect and decide the direction of basic research.

Hence, if you are reading this newsletter but are not a member of GHP, please join. On the other hand, if you're already a member, please circulate this newsletter to your colleagues and encourage them to join.

Current APS members can add units online through the APS secure server by following a link on the lower-right of our web page; namely, http://www.aps.org/units/ghp/index.cfm.

4 Fellowship

Harut Avagyan and Chueng-Ryong Ji, GHP's 2011 Fellows.

We take this opportunity to congratulate Harut Avagyan (JLab) and Chueng-Ryong Ji (NCSU), both of whom in 2011 were elected to Fellowship in the APS under the auspices of the GHP:

Harut "For pioneering studies of Single Spin Asymmetries in electroproduction of hadrons in deep inelastic scattering, providing access to orbital motion of quarks;"

and Chueng-Ryong "For his remarkable and pioneering contributions in QCD applying light-front dynamics to fundamental aspects of hadron physics, including spectroscopy, wave functions, and form factors."

This is a good time to 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 have reached almost 500 members, we are allocated TWO Regular nominations.

The Executive urges members of GHP to be prepared in 2012 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.

The instructions for nomination may be found at
http://www.aps.org/programs/honors/fellowships/nominations.cfm
The entire process is now performed on-line.

A few things to know before proceeding, however. One must

- Ensure the nominee is a member of the Society in good standing. The on-line site will do this for you but it's best to check beforehand, to save yourself time or get your nominee to join APS and GHP.
- A nomination requires a sponsor and a co-sponsor. During the on-line nomination process, you will be required to provide details for a co-sponsor. After you complete a nomination, the co-sponsor will be notified by EMail. It would be best to coordinate with the co-sponsor beforehand.
- You will require supporting letters, that will need to be up-loaded to the APS web site. Two letters of support are sufficient. Individuals providing letters of support do not have

to be members of the APS, however, in practice it is preferable that sponsors be APS Fellows.

- The nomination process should be complete prior to GHP's deadline:

Monday 2nd April 2012

The APS will subsequently forward the nominations to the GHP Fellowship Committee, which this year is

2012 GHP Fellowship Committee

Matthias Burkardt	Les Bland	Eric Swanson
mburkardt@physics.nmsu.edu	bland@bnl.gov	swansone@pitt.edu

Matthias Burkardt is Chair. Do not hesitate to contact Matthias or his colleagues on the committee if you have questions.

The Executive urges members of GHP to react quickly to this call for nominations.

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5 APS April Meeting, 2012

5.1 GHP Program

A topical group is invited to participate in planning the program of major APS meetings. At this year's meeting in Atlanta, we have one full invited session and two shared sessions (one with DAP (astrophysics) and one with DNP). They are:

GHP/DNP: Hard Hadronic Probes of Nuclear Collisions
Saturday, March 31 at 13:30, Chair: Peter Petreczky (BNL)

- Bjoern Schenke (BNL) *Interpreting Jet Results from RHIC and the LHC*
- Raphael Granier de Cassagnac (Ecole Polytechnique) *Quarkonium Production and Thermal Radiation*
- Alexei Bazavov (BNL) *Recent Finite Temperature Lattice Results*

GHP/DAP: Cosmic Rays and Hadronic Physics
Sunday, April 1 at 13:30, Chair Amy Connolly (Ohio State)

- Lisa Gerhardt (LBNL) *Cosmic Ray Muons in QCD*
- Klaus Wernser (Subatech, Nantes) *Collision Modeling in Air Showers and Accelerators*
- Ralph Engel (Forschungzentrum Karlsruhe) *Hadronic Physics and Air Shower Detectors*

GHP: Parton Density Studies at an Electron-Ion Collider
Monday, April 2 at 13:30, Chair: Ramona Vogt (LLNL and UC Davis)

- Raju Venugopalan (BNL) *The Physics of Strong Color Fields in Nucleons and Nuclei at High Energies*

- Dennis Sivers (Portland Physics Institute) *Border Posts: Transverse Spin and the Study of Color Confinement at the Electron Ion Collider (EIC)*
- Ernst Sichtermann (LBNL) *Experiments at an Electron-Ion Collider*

In addition, GHP has

- a single contributed session *Spin Structure of the Nucleon*, chaired by Ernst Sichtermann (LBNL) Sunday, April 1 at 15:30;
- and two shared contributed sessions with DNP:
  - *Photoproduction and Dynamics of Light Nuclei*, chaired by William Briscoe (George Washington University) Monday, April 2 at 10:45;
  - and *Partonic Structure in Nucleons and Nuclei*, chaired by John Arrington (ANL) Tuesday, April 3 at 10:45.

5.2 Business Meeting

We will have a business meeting after the awards session on Sunday April 1, to present our new fellows and discuss other business, including the new, recently endowed, Dissertation Award, sponsored by Jefferson Science Associates, Brookhaven National Laboratory, University Research Associates (Fermi National Laboratory) and members and friends of the GHP. We will also have presentations by

- Steve Vigdor (BNL),
- Ted Barnes (DOE),
- and Bob McKeown (JLab).

5.3 Lunch with the Experts

Finally, the GHP will sponsor two tables at "Lunch with the Experts" on Sunday, April 1 from 12:30 to 14:00. The experts in question are John Arrington, GHP Chair-Elect, on *Nuclear Physics: nuclei, nucleons and quarks* and Ramona Vogt, GHP Chair, on *Creating Charm and Bottom from Lead and Gold*. If you have students interested in either of these topics, encourage them to sign up for our tables so we won't have to eat lunch alone.

5.4 April 2013

Moving on to next year, **John Arrington** will serve as Chair of the GHP's 2013 Program Committee:

2012 GHP Program Committee, preparing for April 2013

John Arrington	Matthias Grosse Perdekamp	Peter Tandy
johna@anl.gov	mgp@illinois.edu	tandy@kent.edu

The 2013 April Meeting is scheduled for

April 13-16, 2013 – Denver, CO.

http://www.aps.org/meetings/meeting.cfm?name=APR13

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6 GHP 2013: 5th Workshop of the GHP

The Executive has begun planning for the Fifth Meeting of the APS Topical Group on Hadron Physics. If we follow the pattern of our previous successful meetings, it will take place over 2.5 days:

10-12 April 2013

i.e., just before the APS April Meeting, being held at the same hotel in Denver, CO.

John Arrington and Matthias Burkardt are co-chairing the Organising Committee, which will be constituted from the entire Executive and selected members of GHP.

Topics to be discussed include:

- Light and heavy quark mesons and baryons
- Exotic hadrons
- Nucleon spin physics and hadronic structure
- AdS/QFT, novel phenomena
- Future facilities
- Lattice QCD
- Physics of the quark gluon plasma
- Physics of gluon saturation

As past meetings have demonstrated, the GHP workshop offers a very good opportunity for nuclear and particle physicists to meet and discuss their common interests in hadronic interactions. So please mark these dates and the location in your calendar, and plan on attending.

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7 Unit Convocation

The Convocation is the gathering of unit officers. It provides for their familiarization with the ways of the APS, and is also an excellent opportunity for unit officers to learn from each other. This year, the Convocation will be held at the American Center for Physics (APS Headquarters) in College Park, Maryland on

Friday 20th April – Saturday 21st April.

The Convocation is being extended by a half day this year in order to engage unit leadership with the APS Executive Board and Presidential Line in discussing the Strategic Plan for the Society. For the past year, the APS Presidential Line, Executive Board and Staff have been working to prepare a Strategic Plan for the APS to guide the direction of the Society through the years 2013 - 2017. Starting late Friday afternoon through Saturday morning, led by the Presidential Line and Operating Officers, the unit leadership will have an opportunity to hear about the major APS goals and objectives, to ask questions, and provide input in terms of implementation.

As a highlight of the meeting, there will also be a special scientific lecture (title to be announced), by this year's winner of the APS Lilienfeld Prize, Professor Gordon Kane from the University of Michigan.

This year three members of the GHP's Executive are volunteering their time and will take part: John Arrington, Matthias Burkardt and Jianwei Qiu.

In addition, APS is urging Convocation participants to spend Thursday, April 19, before the Unit Convocation, on Capitol Hill, meeting with their Congressional representatives to discuss the contributions that physics and physical science make to the nation. For those involved, this is not always entertaining but usually enlightening.

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8 Science Funding

Each of us has our own horror story about the level to which funding for basic research in the USA has sunk. A couple of recent articles highlight this:

1. Science 27 January 2012: Vol. 335 no. 6067 pp. 392-393
   http://www.sciencemag.org/content/335/6067/392.full
2. Inside the Beltway, Michael S. Lubell, APS Director of Public Affairs
   http://www.aps.org/publications/apsnews/201202/beltway.cfm

as does the plight of JLab described in Sec. 11.1.

Our experiences might be contrasted with the 20%/year increases in China (see Sec. 8.3 of the Sept. 2011 GHP Newsletter); or with the 5% increase/year in funding for Forschungszentrum Jülich over recent years and the second phase of the Excellence Initiative, which allocates Euro-2.5 billion to promote top-level research in Germany; etc.

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9 Meeting Summaries

9.1 NSTAR2011

(Communicated by V. Burkert – burkert@jlab.org.)

NSTAR2011 – one in the long-running series of International Workshops on the Physics of Excited Nucleons – was held at Jefferson Laboratory from 17th to 20th May 2011,
http://www.jlab.org/conferences/nstar2011/program.html.

With over 125 participants, this workshop was larger than most in this series, which began with the 1st workshop held in 1988 at Troy, New York, organized by the late Nimai Mukhopadyay. It was the 2nd workshop of its kind held at Jefferson Lab.

The four day long workshop focused on the subject of nucleon and light-quark baryon excitations. The excited nucleon spectrum and the electro-excitation amplitudes (electrocouplings) determined in a wide area of photon virtualities provide a powerful theatre in which to hone our understanding of the strong-coupling regime, in particular confinement in the baryon sector. Thus the plenary presentations focused on major experimental, theoretical and computational efforts that aim to explore both the spectrum and the structure of excited nucleons using photon or electron beams as a probe.

Impressive advances have been evident in all areas: (1) experimental efforts are now making use of the full slate of available tools to measure single, double and even triple polarization observables in a broad effort to carry out a complete set of measurements that will allow for the extraction of production amplitudes in a model-independent fashion, at least for the process of single pseudo-scalar meson production. Results from several experiments were reported, in particular at CLAS, GRAAL and CBELSA, which demonstrated that this goal is close to being achieved for several reactions. (2) New results on electrocouplings of prominent resonances with masses less than 1.6 GeV have become available from independent analyses of major single and double pion electroproduction channels, measured with the CLAS detector. The precise mapping of the resonance transition form factors in the lower mass range gives access to the charge and current transition densities on the light front in transverse impact parameter space. (3) The development of complex procedures in the analysis of the data now includes dynamically coupled multi-channel processes. They were presented in several plenary and parallel talks. (4) On the theoretical side, lattice-QCD has made great strides and now is able to predict the excited nucleon and Δ baryon spectrum, for the first time and with complete spin assignments for all states. Also, the first computations of resonance transition form factors with dynamical quarks have been performed. Notable progress was evident in the application of QCD's Dyson-Schwinger Equations, which offers a conceptually different approach to explore the complexity of non-perturbative strong interaction physics, in particular to observe the manifestation of the dynamical running quark mass and structure in the evolution of N^* electrocouplings with photon virtuality. Predictions from holographic models of QCD are also becoming available for resonance transition form factors.

The N^* program has clearly come a long way from the early attempts to determine fundamental quantities from rather incomplete data sets to today's complete or over complete measurements of several processes. Subsets of these data have already been included in coupled channel analyses and have led to the confirmation of several weakly excited nucleon states and claims of new resonances. The series of "International Workshops on the Physics of excited Nucleons" has been an important companion in our quest to come to a fundamental understanding of the complex dynamics of the nucleon's inner workings.

Proceedings of the workshop will be published in 2012 by AIP.

A one-day satellite workshop "Nucleon Resonance Structure in Exclusive Electroproduction at High Photon Virtualities with the CLAS 12 Detector" was held before the regular workshop
http://www.jlab.org/conferences/electroproduction/index.html.
Its main objective was to facilitate the development of QCD-based approaches for the analysis of forthcoming results on N^* excitations from the CLAS12 detector, and to initiate the development of reaction models for extraction of N^* electrocouplings at very large photon virtualities: $5 < Q^2 < 12\,\mathrm{GeV}^2$, which can be achieved after the JLab 12 GeV energy upgrade.

At these unexplored kinematics, the N* excitations are expected to probe the transition from the dressed quark to the bare quark degrees of freedom, and to reveal how the dressed quark mass, its structure and interaction, which create resonances as bound quark-gluon systems, emerge from QCD.

A dedicated experiment to study N* electrocouplings at large photon virtualities was approved for early running after the completion of the 12 GeV Upgrade in 2015. It is not too early to begin sharpening the phenomenological tools that will be needed to extract the fundamental electrocoupling amplitudes, and for their QCD-based physical interpretation.

The prospects in lattice-QCD for the description of N* electrocouplings from first principles of QCD were discussed, as well as the conceptually different Dyson-Schwinger equation approach. New developments were outlined in the quark model sectors and ideas that may lead to the development of a reaction model that incorporates quark degrees-of-freedom in the extraction of resonance electrocouplings.

The results of this workshop will be published as a White Paper in 2012.

9.2 Partons in Nucleons and Nuclei: PINAN 2011

(Communicated by K. Hafidi – kawtar@phy.anl.gov.)

The first workshop on Partons in Nucleons and Nuclei took place in Marrakesh, south of Morocco: 26 30 September 2011 (http://quarks.temple.edu/ partons). The PINAN 2011 workshop received generous contributions from Argonne National Laboratory, Duke University, Jefferson Lab and Jefferson Science Associates, MIT, Mississippi State University, Rutgers University, Santa Maria University (Chile) and Temple University.

PINAN 2011 had approximately 60 participants, and featured around 50 invited and contributed presentations with no parallel sessions. Each half-day covered a specific topic, with themes ranging over:

- Nucleon electromagnetic structure
- Parton distributions in nucleons and nuclei
- Tomography of nucleons and nuclei
- Nucleon spin and quarks angular momentum
- Quark-quark and quark-gluon correlations in nucleons and nuclei
- Hadronization, color transparency and short range correlations

The objective behind having this broad range of nuclear physics topics was a desire to bring together different communities, to share, discuss, and hopefully learn from and collaborate with each other. Another goal of the workshop was to introduce the local nuclear and high-energy researchers in Morocco to Jefferson Lab Physics. The workshop went well, and stimulated fruitful interactions between the participants, including the locals.

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10 Forthcoming Hadron Physics Meetings

10.1 Photonuclear Gordon Conference

(Communicated by R. Gilman – rgilman@physics.rutgers.edu.)

The 2012 Gordon Research Conference (GRC) on Photonuclear Reactions is a forum for presentation and discussion of the most recent results on frontier studies of the fundamental structure of matter, both visible and dark, using photon, electron and neutrino probes. The topics of the 2012 meeting will include recent advances in studies of the quark/gluon structure and excitation spectrum of nucleons, the spectroscopy of exotic hadrons, the structure of few-body and hyper nuclei, hadrons in the nuclear medium, nuclear structure at short distances and its quark-gluon dynamics, and astrophysical implications of photonuclear studies. Considerable time will be given for discussion of ideas, new trends and future opportunities of research in photonuclear reactions and related processes.

Since 1959, the Photonuclear GRC has been an arena for new ideas and provided ample and unique opportunities for young scientists and leading researchers to interact in the most scientifically stimulating environment. The meeting is special in the large European participation, the large number of students attending, and in being the only GRC that addresses the area of hadronic physics.

The Photonuclear GRC will be held

Holderness, NH
August 5-10, 2012.

More information including a program and deadlines can be found at
http://www.grc.org/programs.aspx?year=2012&program=photonuc

10.2 Hadron Physics Summer School 2012

The 2012 Hadron Physics Summer School (HPSS2012) will take place at the *Physikzentrum Bad Honnef (PBH)*, in two sections: Preschool – August 24-26, 2012 (Friday to Sunday); and School – August 27-31, 2012 (Monday to Friday).

The school comprises lectures and working groups on theoretical, experimental, and accelerator aspects of hadron physics. The focus is on topical issues in hadron physics, with emphasis on the latest programs at the accelerators COSY (Jülich) and ELSA (Bonn), and also addressing future FAIR projects like HESR/PANDA and PAX. During the school, guided tours to the accelerator facilities are offered.

The schools are typically attended by 60-80 graduate and advanced undergraduate students from various countries. This year, the school is directly preceded by a Hadron Physics Summer Preschool (HPSP2012) with the aim of preparing a limited group of undergraduate students for participation in HPSS2012.

HPSS2012 is organized jointly by scientists from the Institut für Kernphysik, Jülich Center for Hadron Physics, Forschungszentrum Jülich, and by DFG Transregio TR 16 (Subnuclear Structure of Matter) of the Universities Bonn, Bochum and Giessen. The preschool is sponsored by the European Commission HadronPhysics3/MesonNet project.

For more information and instructions on registration, see
http://www2.fz-juelich.de/ikp/hpss/hpss2012/info.shtml

10.3 Meetings on Hadron Physics

N.B. For other meetings of interest to GHP's membership, don't forget Mark Manley's page: http://cnr2.kent.edu/ manley/BRAGmeetings.html.

In this connection, if there is a meeting you feel should be listed, please send the appropriate information to John Arrington (johna@anl.gov) or Mark Manley (manley@kent.edu).

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11 State of the Laboratories

11.1 Highlights from JLab

(Communicated by R. D. McKeown – bmck@jlab.org.)

Thomas Jefferson National Accelerator Facility (JLab) is maintaining an active physics program at 6 GeV while construction has continued on its 12 GeV upgrade. The CEBAF accelerator was restarted in November 2011 after a 6 month installation period, and the experimental programs in Hall B and C were successfully started. The present run will continue until May 18, 2012, when we will begin a long shutdown to complete the installation of the remaining hardware in the accelerator tunnels. In this update, the current status of the presently running experiments will be reported, followed by a report on the 12 GeV construction project. Finally, the outlook for the 12 GeV science program is briefly discussed.

Hall A

Hall A is presently configured to run with a transversely polarized proton target to enable measurements of g_2^p and G_E^p/G_M^p at low Q^2. These measurements will provide critical new data related to the recent controversy surrounding the determination of the proton radius. The recently reported value from muonic hydrogen studies at PSI differs by 5σ from the values obtained from fits to atomic physics data and previous electron scattering data.

Unfortunately, the superconducting coils for the polarized target quenched during tests last summer leading to irreparable damage. The Jefferson Lab target group has been modifying coils from the Hall B polarized target to enable the Hall A experiment to successfully operate during this run cycle. This rather extensive modification of the Hall B coils is expected to be completed in time to start the experiment in March. The collaboration has revised their run plan to re-optimize the physics with particular attention to the high-impact low-Q^2 region, and should be able to achieve their most important physics goals.

Hall B

The CLAS will be employed with the HDice target to study baryon resonance parameters with a polarized deuterium target. These data will provide crucial information on polarized neutrons to complement previous studies on polarized protons and complete the approved 6 GeV dataset for the baryon resonance program.

The HDice target has been a significant technical challenge. However, the HDice target group completed the preparation of the target apparatus in time for the start of running in

November. They have been successfully acquiring data with a polarized photon beam and polarized target (although with reduced polarization) and anticipate testing the capability of the target with a low intensity electron beam. The demonstration of operation of a polarized HDice target with electron beam would be a very significant technical milestone and would enable important experiments in the future 12 GeV program.

Hall C

The *Qweak* experiment has continued to run successfully since the November startup, routinely taking data with the full 180μA of polarized beam, setting records for both the beam and the high power cryogenic hydrogen target. The experiment is on track to run until the May shutdown date and generate a dataset with the proposed statistical precision. We anticipate that *Qweak* will determine the weak charge of the proton to unprecedented precision and provide stringent constraints on the standard electroweak theory and its proposed extensions.

12 GeV Upgrade

The 12 GeV upgrade project made excellent progress during 2011. The goal of this project is to double the beam energy to 12 GeV, implement enhanced experimental hardware in the existing experimental halls, and construct a new Hall D to include the GlueX experiment. The civil construction for Hall D has been completed and installation of equipment in the hall has begun. In addition, the new Technology and Engineering Development Facility, a modernization and enlargement of the existing Test Lab building, is nearing completion.

During the 6 month shutdown in 2011, the magnets for arcs 2,4,6,7,8,9 were refurbished to enable the higher energy 12 GeV running. They were re-installed in the arc tunnels, along with the magnets for the new 10th arc (for feeding 12 GeV beam to the photon tagger for Hall D). This was an extremely successful effort that significantly exceeded the goals for the shutdown.

In addition, two high performance cryomodules of the new "C-100" design for 12 GeV were installed in the south linac tunnel and commissioned. These cryomodules have delivered 50μA of cw beam at up to 95MV during recent testing. Presently, one is being used for production beam to the *Qweak* experiment. The successful acceleration of beam with the high quality standards for *Qweak* is a major accomplishment for the 12 GeV project that bodes well for continued excellence in polarized beam delivery for the future 12 GeV physics program.

In May 2012 we will begin a planned long shutdown to complete the refurbishment and installation of arc magnets, the installation of the remaining set of 8 C-100 cryomodules in fully powered zones, and commissioning of the new Central Helium Liquefier. We now anticipate beginning beam commissioning in FY14 in preparation for the successful completion of the CD-4A DOE milestone "accelerator project completion and start of operation" on schedule in December 2014.

The actual FY12 budget appropriation ($50M) for the 12 GeV project was significantly below the project funding profile ($66M). Even so we are hopeful that because the accelerator project is well advanced, it will proceed without significant delays. However, the experimental hardware schedule requires nearly $20M in additional procurements and other critical expenditures during these last few years of the project. Jefferson Lab management is in discussion with DOE's Office of Nuclear Physics to assess the impact of the current budget situation on the project.

The experimental equipment scope includes the new spectrometer for Hall B (CLAS12) replacing the current CLAS, the new 11 GeV spectrometer for Hall C (SHMS) that will complement the existing 8 GeV HMS spectrometer, and the GlueX experiment in Hall D.

The CLAS12 project requires fabrication of two superconducting magnets: a solenoid for charged particles at large scattering angles and a toroid for forward angles. The delivery schedule for these magnets is on the critical path, and efforts are underway to place the necessary contracts. On a positive note, the Silicon Vertex Tracker (SVT) has undergone a successful internal project technical review. The review team had constructive comments to help the team continue to develop the construction plan for these critical detectors, and overall this subsystem is on a good track for success. Construction of the 18 new drift chamber sectors is one third complete, with work done at Old Dominion U, Idaho State U, and JLab. The PreShower Calorimeter is nearing a similar point at JLab. The Forward TOF is well underway at U. South Carolina, and the Central TOF and High Threshold Cerenkov Counter are underway at JLab. Reconfiguration of the existing CLAS will start during the long shutdown this summer.

The SHMS project is proceeding well, with the five sets of superconducting magnet coils and cold masses under fabrication and the support structure design now finalized and under construction. Detector construction is underway at Hampton U. on the drift chambers, James Madison U. on the scintillator hodoscopes, North Carolina A&T State U. on the quartz hodoscopes, U. Regina on the heavy gas Cerenkov counter, and College of William and Mary on the support structure for it all.

For GlueX, a major item is the superconducting solenoid. The Jefferson Lab team has successfully refurbished and tested all 4 of the coils for this solenoid (originally constructed at SLAC in the 1970's). The coils are now mounted in place in Hall D and the support hardware is being installed. The detector hardware construction is well advanced at several institutions, notably U. Regina (barrel calorimeter), Indiana U. (forward lead-glass calorimeter), Carnegie Mellon U. (central drift chambers), and JLab (forward drift chambers). Upcoming projects include the tagger hodoscope at Catholic U., tagger fine-grained microscope at U. Connecticut, forward Time of Flight at Florida State U., start counter at Florida International U., photo-sensor and light guide work for the barrel calorimeter at U. Technica de Santa Maria, and electronics and target work at U. Massachusetts.

12 GeV Physics Program

During the last few years, the JLab user community, in collaboration with JLab staff, has developed an impressive set of experiment proposals for the 12 GeV program. These have been reviewed by the Jefferson Lab Program Advisory Committee (PAC), resulting in a total of 47 experiments being approved. All of these experiments have been assigned a nominal recommended beamtime allocation and scientific priority. These proposed experiments represent over 3000 PAC-days of approved beamtime which translates into more than 5 years of running at full simultaneous 3-hall operation during the 12 GeV era of CEBAF.

This exciting program of approved experiment spans the major science topics associated with the 12 GeV era of nuclear physics at Jefferson Lab:

Meson Spectrosopy and Structure: especially the search for exotic mesons in photoproduction that may provide direct evidence for gluonic degrees of freedom in mesonic structure.

Baryon Structure and Spectroscopy: providing the first high precision measurements of Generalized Parton Distributions (GPD) and Transverse Momentum Dependent (TMD) distributions that will help elucidate the spin structure of the nucleon and provide dramatic new $2+1$-D images of the nucleon.

QCD and Nuclei: further elucidating the origins of the EMC effect, exploiting parity-violating electron scattering to provide precise model-independent measurements of neutron radii in nuclei, and exploring hadron formation and transmission in the presence of nuclear matter.

Beyond the Standard Model: precise tests of the standard electroweak theory using parity violating electron scattering and searching for new neutral vector gauge bosons with masses greater than 10 MeV.

This physics program, enabled by the 12 GeV upgrade at Jefferson Lab, represents an exciting new opportunity for the international community and a significant expansion of the capability of the CEBAF facility. Jefferson Lab is enthusiastic about implementing this program and working with the user community to realize the goals and aspirations of a large segment of the world's nuclear physics community. We are presently engaged in the development of a white paper to provide a comprehensive description of the Jefferson Lab 12 GeV science program. In future GHP newsletters, we will present a more detailed discussion of this physics program and the new opportunities that become available with these new facilities.

Acknowledgment: I would like to thank Rolf Ent, Allison Lung and Glenn Young for their assistance in preparing this report.

11.2 Highlights from RHIC in 2011

(Communicated by Jianwei Qiu – jqiu@bnl.gov.)

The Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL) is a facility for basic nuclear physics research serving well over 1000 international users. RHIC was the first machine in the world capable of colliding heavy ions with various species, such as deuteron, copper, gold, as well as uranium, and is the world's only machine capable of colliding beams of polarized protons. The energy and versatility of RHIC enables a very rich research program to explore the nature of nuclear matter in terms of the properties of quarks and gluons.

The collider and two major detectors, PHENIX and STAR, began operations in 2000, and have steadily been improved and upgraded every year, while two smaller detectors, PHOBOS and BRAHMS, completed their missions in 2005 and 2006, respectively. The RHIC program has been very productive and is marked by many important discoveries. With the collisions of gold ions at center-of-mass energies up to 200 GeV per nucleon pair, RHIC created a state of matter called the quark-gluon plasma (QGP) that apparently behaves as a nearly perfect quantum fluid, not at an extra cold temperature but at 4 trillion degrees Celsius. Using collision energy scans, RHIC is capable of exploring the thermodynamic phase diagram for QCD matter, and is discovering a new, exciting and rich branch of nuclear physics that some describe as "condensed matter physics with a force of multiple color charges". RHIC's scientific productivity and impact continued at a high level in 2011, as summarized in the Annual State of RHIC Report (http://www.bnl.gov/rhic/inside/news.asp?a=2813&t=today). Summarized below are a few highlights.

In 2011, RHIC Run 11 established new records for instantaneous luminosity and beam

polarization in 500 GeV proton-proton collisions. RHIC also had an outstanding collider performance for gold-gold collisions in Run 11, far exceeding expectations for luminosity buildup. This allowed completion of the first stage of the beam energy scan in connection with the search for a critical point in the QCD phase diagram.

Although the W-boson was discovered many years ago at CERN and studied at Fermilab in unpolarized proton-antiproton collisions, the first W-boson event in proton-proton collisions was observed at RHIC. In 2011, both the PHENIX and STAR collaborations published their first measurement of parity-violating longitudinal single-spin asymmetry for W-boson production in polarized proton-proton collisions at RHIC with 500 GeV center-of-mass energy [Phys. Rev. Lett. 106, 062001 (2011); 106, 062002 (2011)]. With additional statistics from future running, the measurement of parity-violating asymmetry in W-boson production at RHIC will provide critical light-front information on the antiquark helicity contribution to the proton's spin.

The observation of a very strong (factor of 10) suppression of back-to-back hadron pairs at forward rapidity in the central region of deuteron-gold collisions in comparison with the yield in proton-proton collisions at 200 GeV center-of-mass energy was reported by the PHENIX Collaboration [Phys. Rev. Lett. 107, 172301 (2011)]. The observed suppression occurred in a kinematic region where the yield is dominated by coherent multiple scattering with small-x gluons from the gold ion, and the pattern of observed suppression is consistent with predictions of the color glass condensate model. However, the predicted broadening of the Gaussian width of the away-side correlation peak was not observed. The measurement challenges our knowledge of the properties of high density gluons and hadronization in a dense medium.

It has been a challenge to probe and diagnose the properties of a QGP that lives only $\sim 10^{-23}$s. On the other hand, the relatively short-lived expansion in heavy ion collisions allows antimatter to decouple quickly from matter and thereby avoid annihilation, which makes RHIC an efficient machine for producing and studying antimatter. Following its observation of a piece of exotic antimatter known as an antihypertriton (Feb. 2011 GHP Newsletter), the STAR Collaboration at RHIC observed the first anti-^{4}He, containing two antiprotons and two antineutrons, the heaviest antimatter nucleus ever observed. The observation was published in Nature [473, 353 (2011)] and was highlighted by Discover Magazine as number 20 among its top 100 science achievements of the year.

RHIC has just started Run 12. Owing to budget constraints, RHIC will run about 20 weeks in 2012, instead of the 26 weeks it ran in 2011. It will start with collisions of polarized proton beams at 200 and then 500 GeV center-of-mass energy, followed by heavy ion collisions with asymmetric copper-gold or new uranium-uranium beams. Run 12 will provide transverse spin asymmetry data for probing (2+1)-D motion of quarks and gluons inside a polarized, rapidly moving hadron, and longitudinal spin asymmetry data for better determining both gluon and sea antiquark polarization. Run 12 at RHIC will also explore new kinds of heavy ion collisions – interactions between ions of different size (copper on gold) and collisions between football-shaped uranium isotopes.

For the future of RHIC, BNL is actively involved in the community-wide effort to make a science case for a future Electron-Ion Collider (EIC). BNL established an EIC task force to investigate the optimum capacity of EIC by organizing discussions and workshops, and performing simulations. The design of eRHIC – BNL's version of the EIC – advanced considerably in 2011, and is in the midst of a full cost estimation, which will be reviewed by an external panel in Spring 2012. In 2011, BNL launched a generic EIC detector R&D program, which has led to an expansion of the user community actively involved in EIC planning.

However, the current funding cuts have cast a shadow over the future of RHIC – the only collider still running in the United States, as explained in the article mentioned in Item 1 of Sec. 8.

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