

American Physical Society New York State Section



Physics Newsletter Zohreh Parsa, Editor

Editor's Foreword

Greetings from the editor: Our Dec 03 Newsletter was extended to cover Jan 04 events/news. Thanks for the overwhelming response to the inaugural edition of our Newsletter. We hope you like this issue, and look forward to your comments. The purpose here is to provide information and communicate physics related events and current New York State (NYS) affairs that would be particularly interesting to local members. In this issue: a brief on the recent Symposia, a comment from the chair, and outreach program, will provide you with an overview of our NYSS and its activities. The section on "Physics Highlights and News in NYS" includes: the latest "g-2" results; "More Muons on Long Island:" (envisioning a general user facility that would make more than 10^{11} very low energy muons per second available for a multitude of experiments in condensed matter physics, chemistry, biology and other areas of science); "Electric Dipole Moments" (a New Sensitive Method, that works well for particles with small anomalous magnetic moment values such as the deuteron and muon.); "Cosmic Accelerators and the High-Energy Cosmic Rays"; "New Technology for X-ray Sources" (Energy Recovery Linacs (ERL) are being explored as next generation synchrotron light sources); and "Physics at the Large Hadron Collider (LHC). In the "NYS Prize Winners" section we list the information received on physics prizes. My personal congratulations to: Alfred Mueller, George Sterman for winning the 2003 Sakurai Prize, and William J. Willis for winning the Panofsky Prize. We also provide information on the upcoming (2004) and Recent (2003) Symposia including photos received (from spring and fall 2003 conferences). The NYSS Executive Committee members listing, are also given for your convenience.

We would appreciate getting feedback from our readers, including input on additional areas/fields of physics that we can cover in our future issues. We encourage you (let us know) to participate as "visiting editor(s)" in your specific field(s) of physics and to assist us in covering more areas of physics. Physics topics and News included here exemplify the types of information you can send to us to be included in the upcoming issues of our Physics Newsletter. Please send your comments, suggestions, physics highlights, news, and information you consider important, that may make the newsletter more informative and interesting to the address given below.

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Particle Accelerator Frontiers and New Physics Potentials

After 11 Years, the New York State Section of the American Physical Society (APS) topical symposium was held on "Particle Accelerator Frontiers and New Physics Potentials" at BNL on October 17 and 18, 2003. The meeting was organized by Dr. Zohreh Parsa of the BNL Physics Department, and was attended by more than 200 registered participants from New York State, neighboring states and overseas. There were also 62 student attendees including 23 cadets from West Point Military Academy accompanied by their physics instructor. At the symposium, distinguished speakers from across the U.S. and abroad gave presentations covering major projects and forefront plans for the physics of the coming decades. Featured projects included new light sources such as the National Synchrotron Light Source II, achievements at the Relativistic Heavy Ion Collider, and the Large Hadron Collider (LHC). Two highlights of the program described new BNL based initiatives: plans for the muon-to-electron conversion experiment, MECO, which will probe charged lepton flavor conservation well over 1,000 times more precisely than is currently possible, and "Future Neutrino Physics" and our very long baseline neutrino oscillation studies using a neutrino superbeam.



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A baseline of some 2,500 kilometers – for instance, BNL to the Homestake mine used by the Lab’s Raymond Davis for his Nobel prize-winning work on solar neutrinos – would allow an experiment to probe all neutrino-mixing parameters*. Another highlight was the presentation by Albrecht Wagner, Director General of DESY, Germany, who described plans for a global project to build a high-energy electron-positron linear collider, which would build upon, complement, and extend the LHC program. “P. Paul, BNL Deputy Director said in the News Bulletin Nov 03 issue “Statistically, the APS only meets at the Lab once every 11 years or so and she (Zohreh Parsa) organized a truly successful event.” It was worth noting, that the topics in our program featured prominently in the Long Range Plans issued weeks, well after our symposium, by the United States Secretary of Energy Spencer Abraham. (*see Z. Parsa, Physics of an Intense Neutrino Beam from BNL to a very Long Baseline Detector, CP No.698, 307-313, AIP 2003; Also Phys ReV D68, 01 2002; hep-ph/0108181, 2001; and refs. thereins.)



From the Chair

Welcome to our second Newsletter We have been working hard arranging for interesting and stimulating symposia in sites all across New York State. Since our last newsletter, we have had two meetings. Our Spring 2003 symposium, held at SUNY Geneseo, featured the “physics of everyday phenomena.” It was very well attended despite a nasty ice storm! In the Fall we went to Long Island for a meeting at Brookhaven National Lab on “Particle Accelerator Frontiers and New Physics Potentials.” The selection of speakers and talks in these symposia was superb. I would like to thank all of the volunteers who put so much of their time in organizing them, and in particular, Savi Iyer, Kurt Fletcher, Charlie Freeman and James McLean from SUNY Geneseo, and Zohreh Parsa, Peter Paul and Bill Kilgore from Brookhaven National Lab.

This Spring we will go to Buffalo for a symposium on “physics education.” Next Fall we will go to Brooklyn for a symposium on “physics from quarks to nanostructures.” We also hope to offer a symposium devoted to Albert Einstein in 2005. We encourage you to attend these symposia and to encourage your students to do so too, as the talks are explicitly aimed at general audiences. The symposia include a poster session, where we give cash awards to the best student posters.

Twice a year we give outreach grants. We are proud to say that we have funded most of the proposals that have been submitted, impacting K-12 science teaching in some projects and the general public in others. In this newsletter we give you a summary of the most recent ones. Our website has the guidelines and application form.

Next fall(05) we will start the process of identifying candidates for election to our Executive Committee. Please consider getting involved, and let us know if you wish to be nominated. We want to have a good balance of members from our constituencies in the various types of academic institutions and industry. If you are interested in organizing a topical symposium we would like to hear from you. I hope you enjoy reading our newsletter!

–Enrique Galvez, Colgate University

APS Unit Convocation

Three NYSS-APS executive committee members: Z. Parsa, J. Owen, and L. Josbeno, attended the 2004 American Physical Society Convocation meeting, held at the APS Headquarters in Maryland on January 24, 04. We met with APS staff and heard short presentations made by representatives/officers of all the APS Units/Divisions/sections etc. The meeting was headed by Dr. Franz (APS) and Dr. Helen Quinn Present chair, both are seen in the photo (below) taken by APS with Dr. Parsa (in the middle), of our New York State Section.

–L. Josbeno



Acknowledgements

Thanks to those who assisted and made contributions for this newsletter. Thanks also to T. Corsa, C. Weaver, R. Casella, Keith Lally (for computer, web help); and P. Paul, W. Kilgore, and J. Hannon for assisting before or at the APS NYSS Symposium I hosted/ and organized at BNL October 17-18, 2003. We acknowledge E. Galvez, J. Owens and our executive committee members’ full support of the Newsletter. Also thanks to G. Vidali, R. Galick, and L. Josbeno, J. Owens, and others for their strong supports and for congratulatory e-mails on publication of the Inaugural Newsletter, etc. We appreciate those who sent photos from various Symposia. The photos in this issue were provided, courtesy of: S. Iyer for the SUNY, Geneseo Symposium 4/03; from the participants for the CIPANP03 held in NYC, 5/03; and from BNL, L. Seubert and participants for the NYSSAPS03 Symposium held at BNL, 10/03. Also we appreciate E. Buchan-Higgen’s assistance.

–Z. Parsa

For Students and Science Teachers

Outreach Program

The NYSS-APS Outreach Program provides small grants to support projects that bring physics-related learning principles to the general public, with particular emphasis on projects designed for K-12 students and teachers. In October and April of each year the Outreach Committee reviews proposals and makes recommendations to the regional board. For reports of past projects, guidelines and applications see www.aps.org/units/nyss/index.html, or e-mail to: nuness@newpaltz.edu.

—Stacie Nunes, SUNY-New Paltz

2003 – Fall Awards

- Robert Forties, Department of Physics and Astronomy, University of Rochester, Rochester, N.Y., to purchase materials for a set of physics demonstrations.
- Jesse Chvojka, Department of Physics and Astronomy, University of Rochester, Rochester, N.Y., to provide equipment and air time for experiments in particle physics to be designed by high school students.

2003 – Spring Awards

- Joseph Sundermier, Deer Park High School, Deer Park, N.Y., to purchase materials and equipment to construct “thermos bottle” muon detectors for use in particle physics experiments in a high school classroom.
- Tom Dunbar, Corning Community College, Corning, N.Y. to support construction of a vector scan laser light projector to expand the current Planetarium show.

NYS Prize Winners

2003 J. J. Sakurai Prize

Alfred Mueller (Columbia Univ.) and George Sterman (SUNY)

“For developing concepts and techniques in QCD, such as infrared safety and factorization in hard processes, which permitted precise quantitative predictions and experimental tests, and thereby helped to establish QCD as the theory of the strong interactions.”

2003 W. K. H. Panofsky Prize

in Experimental Particle Physics to **William J. Willis Columbia Univ.**

“For his leading role in the development and exploitation of innovative techniques now widely adopted in particle physics, including liquid argon calorimetry, electron identification by detection of transition radiation, and hyperon beams.”

More prize winners from New York State:

2003 Broida Prize

George Flynn, Columbia

2003 Davisson-Germer

Rudolph M. Tromp, IBM Watson

2003 Einstein Prize

Peter G. Bergmann, Syracuse U.

2003 Dannie Heineman Prize

James W. York, Cornell U.

2003 Irvin Langmuir Prize

Phaedon Avouris, IBM Watson

2004 Panofsky Prize

Arie Bodek, U. Of Rochester (see our next Newsletter)

2005: The World Year of Physics

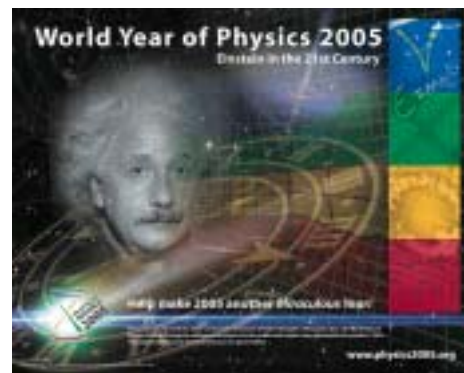


The world’s scientific societies have agreed to call 2005 the “World Year of Physics.” This is to commemorate the 100th anniversary of Albert Einstein’s landmark works on relativity and the photoelectric effect. The various societies, including the American Physical Society, are encouraging all physicists to get involved. The idea is to use the event to promote interest in physics. We urge you to get involved too. For more information go to: www.physics2005.org.

Our Section is also planning activities for this event. The topic of our Fall 2005 symposium will be Albert Einstein and his works. We are currently coordinating with colleagues at Princeton University to host the symposium there. Since New

Jersey does not have a Section of APS, this event will be an opportunity to extend our reach to outside New York State. Stay tuned, as this symposium promises to be a very special one.

—E. Galvez,



g-2 Announces a New Measurement



“The muon g-2 experiment at Brookhaven has announced a new measurement of the anomalous magnetic moment of the negative muon. A total precision of 0.7 parts-per-million was achieved, which is over an order of magnitude improvement with respect to the previous measurement. As expected from CPT invariance, the anomaly of the negative muon is statistically compatible with that for the positive muon, which is known to

0.7 ppm as well. The combined result differs from the theoretical prediction by 1.4 or 2.7 standard deviations, depending on the input of the calculation (resp. hadronic tau-decay data or electron-positron annihilation data).”

– Gerco. Onderwater, KVI, Netherlands, (left in the photo, Zohreh Parsa (BNL) and Lee Roberts (Boston Univ) on the right, at the announcement meeting).

Electric Dipole Moments

The electric dipole moments (EDM) of fundamental particles are excellent probes of physics beyond the standard model (SM), e.g. SUSY, since they allow for values within experimental reach whereas the SM predictions are several orders below them.

A conceptual breakthrough in studying spin precession in magnetic storage rings is very promising in improving the electric dipole moment (EDM) sensitivity of deuterons and muons by several orders of magnitude thereby bringing them at the forefront of EDM research. In a storage ring with a magnetic field (\vec{B}) the total spin precession vector ($\vec{\omega}$) of a particle with anomalous magnetic moment (a), and EDM (d) is the vector sum of the g-2 precession (proportional to $a\vec{B}$) plus the EDM precession (proportional to $d(\vec{u} \times \vec{B})$, where (u) is the particle’s velocity). Searching for the EDM means looking for the angle between the vector ($\vec{\omega}$) and the magnetic field \vec{B} , a very small angle.

The new method proposes to cancel the g-2 precession by applying a radial E-field thus making the angle larger by several orders of magnitude. This method works well for particles with small anomalous magnetic moment values such as the deuteron and muon. E.g., the promised Deuteron EDM at the 10^{-27} e cm, improves the EDM sensitivity by a factor of up to 100 over all other current EDM limits and the muon EDM at the 10^{-24} e cm level puts severe restrictions to SUSY models.

For more information see <http://g2pc1.bu.edu/~leptonmom/talks/fortsonhg.pdf> or <http://www.bnl.gov/edm/>.

–Yannis Semertzidis, EDM collaboration

More Muons on Long Island: “for experiments in condensed matter physics, chemistry, biology and other areas of science”?

The E821 Collaboration at Brookhaven National Laboratory recently announced their new measurement of the muon anomalous magnetic moment (see “g-2”...above). Taken together with earlier data, the experimental uncertainty has been reduced to $\pm 6 \times 10^{-10}$, a spectacular accomplishment. The value obtained differs from theoretical expectations by about 2.4 sigma, perhaps hinting at additional effects from new physics such as supersymmetric quantum fluctuations, an exciting possibility.



William Marciano

A separate approved experiment at Brookhaven called MECO (Mu~~o~~n-E~~l~~ectron C~~o~~nversion), also had some recent good news. Funding for its construction start is included in the proposed FY05 budget of the National Science Foundation. That experiment (discussed in our last Dec 03 Newsletter see J. Sculli on RSVP/MECO) would search for the muon number violating transition of a bound muon (in Aluminum) to a monoenergetic electron with energy of about 106 MeV. A single event sensitivity of 2×10^{-17} is envisioned. Such unprecedented exploration capability, by 3 to 4 orders of magnitude, is also sensitive to supersymmetry quantum fluctuations; so, discovery of that rare transition would provide a new window to supersymmetry effects or perhaps other new physics that might be unveiled.

Given Brookhaven’s ability to produce so many muons for the MECO program, about 5×10^{11} muons/second, other utilizations of that high flux are being studied. One idea, put forward, by Senior Physicist William Marciano, envisions a general user facility that would make more than 10^{11} very low energy muons per second available for a multitude of experiments in condensed matter physics, chemistry, biology and other areas of science. The extreme muon intensity would allow measurements at microscopic scales never before possible and would usher in an era of innovative muon technology that could not have been even be imagined in the past.

An answer to I. I. Rabi’s famous question “who ordered that?” when told of the muon’s discovery confirmation in 1947 may finally be at hand. It was ordered by the experimenters of the 21st century who may be finding exciting new applications for that once cryptic particle.

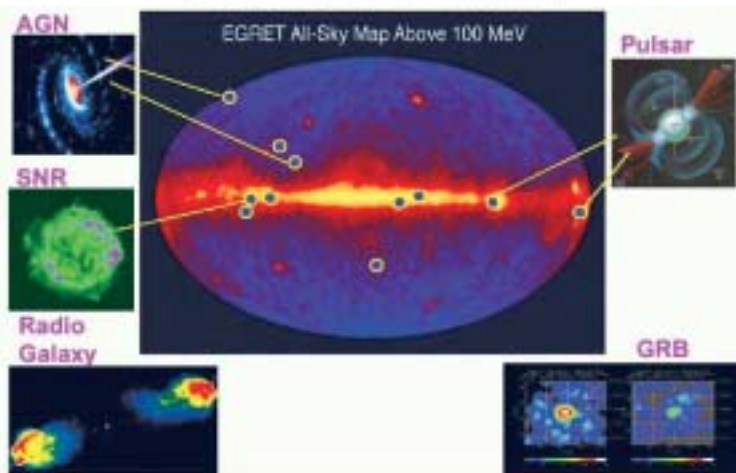
–Z. Parsa

Cosmic Accelerators and the High-energy Cosmic Ray

A dramatic progress in experimental techniques has made the cosmic rays experiments sensitive to very small fluxes of extremely energetic particles. The highest-energy cosmic rays can be produced by the most powerful objects in the universe, such as active galactic nuclei, gamma ray bursts, and black holes, which can be discovered and studied using the cosmic ray data. However, observations by Fly's Eye, Hi Res, and AGASA experiments have reported some puzzling events with energies so high that the interactions with the cosmic background radiation should have stopped them long before they reached the Earth. The puzzling events may be signals of new physics, which can be discovered by the new generation of experiments, such as Pierre Auger and EUSO. Regardless of the origin of the most energetic events, the new experiments can study interactions of protons and neutrinos at energies far beyond the reach of terrestrial accelerator experiments. These experiments are opening a new window on fundamental physics and start a new chapter in neutrino astronomy.

—Alexander Kusenko <kusenko@ucla.edu>

Cosmic accelerators



New Technology for X-ray Sources:

Energy Recovery Linacs (ERL) are being explored as next generation synchrotron light sources. The fundamental x-ray beam properties from storage ring sources, such as the source size, brilliance, and pulse duration are limited by the dynamic equilibrium characteristic of the magnetic lattice that is the storage ring. Importantly, the characteristic equilibration time is long, involving thousands of orbits around the ring. Advances in laser-driven photoelectron sources allow the generation of electron bunches with superior properties for synchrotron radiation. ERLs preserve these properties by acceleration with a superconducting linac, followed by transport through a return loop hosting insertion devices, similar to that of a 3rd generation storage ring. The loop returns the bunches to the linac 180° out of accelerating phase for deceleration through the linac and disposal. Thus, the electron beam energy is recycled back into the

linac RF field for acceleration of new bunches and the equilibrium degradation of bunches never occurs. The superior properties of ERLs beams include extraordinary brilliance and small source size, with concomitant high transverse coherence, x-ray pulse durations down to ~100 femtoseconds, and flexibility of operation. ERLs are capable of hosting practically all experiments now being carried out at storage rings while also enabling new types of experiments. New applications enabled by ERL technology are new materials and biological sciences. For more information send e-mail to smg26@cornell.edu.

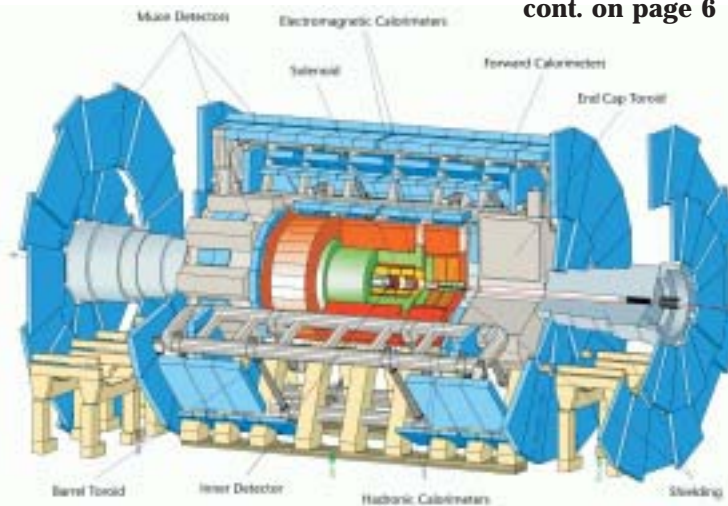
—Sol M. Gruner, (CHESS) Cornell University

Physics at the Large Hadron Collider

The Large Hadron Collider (LHC), currently under construction at CERN (in Geneva, Switzerland), will collide two proton beams head-on, with a center-of-mass energy of 14 TeV. The LHC, which will become the highest energy collider in the world when it turns on in 2007, will be home to two large general-purpose experiments (ATLAS and CMS), as well as dedicated b-physics (LHCb) and heavy ion (ALICE) experiments. The massive experiments (see the figure) are being constructed by large international collaborations. The LHC was designed to give access to the energies required to investigate the foremost question of high energy physics, namely the source of electroweak symmetry breaking (EWSB) (ie. the fact that the W and Z bosons are massive while the photon is massless), and the related issue of the sources of the masses of the other particles of the Standard Model (SM).

According to the SM, the Higgs mechanism is responsible for EWSB, with a necessary implication being that there should exist a fundamental scalar, dubbed the Higgs boson; to date, there is no clear experimental evidence that the Higgs boson actually exists. Indeed, many alternative "Beyond the SM" scenarios for EWSB have been proposed on theoretical grounds, including supersymmetry, possible new strong dynamics, or even the existence of additional spacetime dimensions. ATLAS and CMS should be able to discover the SM Higgs boson if it exists, or else investigate the signatures which arise

cont. on page 6



Drawing of a cross-section of the ATLAS detector.

Physics at the Large Hadron Collider, cont.

from whatever the actual source of EWSB turns out to be. This will either complete the spectrum of particles of the SM or, even more exciting, point in the direction of a more fundamental theory of the elementary building blocks of our universe.

—John Parsons, Columbia U.



Status of the ongoing installation of the ATLAS detector in its underground cavern at CERN in Geneva, Switzerland. (From NY State participants include: BNL, Columbia, Albany and Rochester, etc.)

Joint APS-AAPT Meetings

In recent years the New York State Sections of AAPT and APS have had several successful joint Symposiums. The spring of 2000 witnessed a return of this concept with a meeting on Astrophysics and Astronomical Instruments held at Corning Community College in Corning, New York. It was at this meeting that Rich Galik introduced the concept of a tutorial based seminar, with the focus on presenting these topics at a level to interest and educate physicists and physics students. Thanks to a sponsoring system introduced by Robert Pompei, a large number of students were attracted. A recent trend that continues.

Subsequent joint meetings in Buffalo, Oneonta and Geneseo have attracted educators and students with very positive results. APS has led the way with no Conference fees for students and available financial aid. AAPT has followed this lead and the efforts of both organizations have produced very successful. The programs have been tailored to provide meeting time to the Executive Committees of both organizations and to provide meaningful and diverse programs for physicists from all areas of education and industry.

At the summer meeting of AAPT national, (the Sections meeting) the topic of joint participation, (AAPT and APS) was discussed at length and the level of cooperation that we have in New York is not found elsewhere. APS/NYSS and AAPT/NYSS have both demonstrated the commitment and dedication necessary for enthusiastically presenting topics of interest and of importance to these diverse groups. The Spring Symposium held at Buffalo State, on Friday and Saturday, April 16&17, is a jointly sponsored meeting dealing with Physics education. A tremendous amount of effort has been expended to make this a meaningful experience. The future of these collaborations is bright and any suggestions for topics or locations that would be germane to both organizations should be passed on to James Owen (jcowens@post.harvard.edu), or Larry Josbeno, (josbenlj@corning-cc.edu).

—L. Josbeno, President of NYSS of AAPT

About the Editor

Dr. Zohreh Parsa is a Theoretical Physicist, has been at Brookhaven National Laboratory (BNL) since 1985-present; and her physics interest spans from non-linear physics/dynamics, high energy, collider physics, Muons, to present work Neutrino oscillation physics (very long baselines), and LHC/ATLAS physics. Before going to BNL, she was a (tenured) Physics Faculty at NJIT from (77-84); Physics Lecturer, Hunter College of CUNY (74-76); Director of Physics and Engineering Laboratories, Essex County College (72 -74). Received her PhD and M.S. in Physics from New York Polytechnic and New York Univ. (77); and has been visiting scientist at many Universities and Institutes, including: Aspen Physics Institute, Los Alamos National Laboratory, Northwestern University (80-81); Nuclear Theory Institute, Washington University, Seattle (summer 95); Institute for Theoretical Physics, University of California, Santa Barbara (July-Dec. 96); Univ. of Karlsruhe, Germany, (summer 02), etc.

Dr. Parsa has organized/ coordinated/ and chaired major physics meetings, workshops and conferences very successfully including: the “New Ideas for Particle Accelerators”, a 5 months workshop at the Institute for Theoretical Physics in Santa Barbara July-Dec 1996 (funded by NSF); the 8th Conference on “Intersection of Particle and Nuclear Physics”, in New York City, May 19-25, 2003; and the APS New York State Section topical Symposium on “Particle Accelerator Frontiers and New Physics Potential” at Brookhaven National Laboratory, October 17-18, 2003. She has authored numerous research publications, programs and manuals; Referee and Editor for Physics Journals and Conference Proceedings. Chairperson for BNL Particle-Accelerator seminars (1987-1999) and Digital Equipment Corporation Local Users Group; member of Cyber Administration (2000-present). US team leader in a project with Ukraine scientists, funded by STCU/US State Dept. Member of “Muon Colliders & Neutrino Factory Collaborations; member of the Neutrino working group collaboration, and member of a LHC/ATLAS collaboration, in anticipation of physics analysis of the LHC (2007) data.

Dr. Parsa is an elected Executive committee member of American Physical Society (APS) New York State Section (2001-2005). The editor of the “physics Newsletter”, she started in 2002 (first Newsletter for APS-NYSS since this section came into existence in 1938) 4,000 copies were published and circulated through APS to NYS Physics members; She also organized/ and hosted the Symposium on “Particle Accelerator Frontiers and New Physics Potential” (APSNYS2003) at Brookhaven National Laboratory, October 2003, Etc.

Since she joined the NYSS Executive committee, with her participation, Newsletter, Symposium etc., she has truly promoted the benefits of science and technology, and has increased the interest and awareness of students and the general public in Physics. We hope you enjoy this newsletter.

—James C. Owens, Vice Chair, of NYSS of APS

Please send to the editor a write up and photo of someone of your choice for “About...” column to be used in future issues.

Meetings Information

Recent Symposia 03

Fall 2003 [NYSS Symposia]

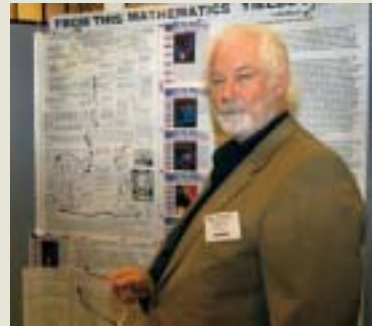
Particle Accelerator Frontiers and New Physics Potential

Contact/Chair: Dr. Zohreh Parsa

Brookhaven National Lab

Oct 17-18, 2003

<http://www.nysaps2003.bnl.gov>



Spring 2003 [NYSS Symposia]

Physics of Everyday Phenomena

Contact/Chair: Dr. Savi Iyer

SUNY Geneseo

April 2003

<http://physics.geneseo.edu/APSAAPT/2003.htm>



Spring 2003 CIPANP2003

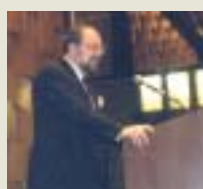
Intersection of Particle and Nuclear Physics

8th conference, held in NYC

Contact/organizer Dr. Z. Parsa

May 19-25, 2003

<http://www.cipanp2003.bnl.gov>



Fall 03 Symposium

Particle Accelerator Frontiers and New Physics Potential



Upcoming Symposia 04

Spring 2004 Symposium [Joint NYSS and AAPT-APS]

What Physics Education Research says to Physicists & Physics Educators

Buffalo State College • April 16-17, 2004

DEMARCO@BuffaloState.edu

www.buffalostate.edu/depts/physics/symposium04/

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The newsletter will be posted at www.nysaps.bnl.gov
and www.aps.org/NYSS

Providing information
and communicating physics
related events and current NYS affairs.

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