Chair's colloquium  Sept. 6, 2011
The State of the Department
Department Staff

László Mihály, Chair  
Nathan Leoce-Schappin, Assistant to Chair  
Jacobus Verbaarschot, Director of Graduate Studies  
Sara Lutterbie, Assistant Director of Graduate Studies  
Abhay Deshpande, Director of Undergraduate Studies  
Diane Diaferia, Assistant Director of Undergraduate Studies  
Frank Chin, Interim Director of Physical Labs  
Rich Berscak, Building Manager  
Socoro Delquaglio, Grant Manager  
Maryanne Lodato, Grant Manager  
Joe Feliciano, Instructional Labs.  
Chuck Pancake, Gene Shafto, Electronics Center  
Walter Schmeling and crew, Machine Shop
New faculty

Angela Kelly has a Ph.D. in Science Education from Columbia University, and M.A. and Ed.M. degrees from Teacher's College, Columbia University. She has extensive experience in secondary school (7-12) chemistry and physics teaching, including AP courses and courses to gifted and talented students. Before joining us she was Associate Professor (tenure track) in Science Education at Lehman College, CUNY. She will be 50% at the Center for Science and Mathematics Education (CESAME) and 50% at the Department
Angela Kelly

• Recent Publications:

• Recent Invited Colloquium:

• Future Work:
  – Physics Teacher Education Coalition Committee on Quality in K-12 Physics Education
  – Research on physics education in Long Island public schools (factors affecting enrollment and quality)
New faculty

Johanna Kiryluk received her PhD from Warsaw University working in the Spin Muon Collaboration (SMC) at CERN measuring the spin-dependent structure functions of the proton and deuteron. Following this she was working on nucleon spin in the STAR experiment as a postdoc at UCLA and later at MIT. Since 2006, she has been a Project Scientist working at LBNL on neutrino physics with the ICE CUBE experiment.
A 1 km$^3$ telescope in the South Pole ice to search for the highest energy neutrinos from the astrophysical sources in the Universe

www.icecube.wisc.edu

We recently searched for diffuse flux of high-energy extraterrestrial neutrinos

$$\nu_e + N \rightarrow e + X \quad \text{and} \quad \nu + N \rightarrow \nu + X$$

Contact: Joanna.Kiryluk@stonybrook.edu

A collaboration of ~250 scientists, 36 institutions from the US, Belgium, Germany, Sweden, Switzerland, UK, New Zealand, Australia and Japan

Primary Founding Source: National Science Foundation, USA

arXiv:1101.1692 accepted for publication in Phys. Rev. D
Rouven Essig, working on dark matter, LHC phenomenology and supersymmetry. Rouven will join the YITP in October, from SLAC.

He is Co-spokesperson of the A’ EXperiment (APEX), co-organizer of the LHC New Physics Working Group, a member of the Heavy Photon Search (HPS) experiment and an affiliated Scientist with the Fermi-LAT Collaboration.
Christopher Herzog, working on the AdS/CFT Correspondence and gauge/gravity dualities, with applications to QCD and condensed matter physics. He has a Ph.D from Princeton, and he was postdoc at KITP, Santa Barbara, and at the University of Washington. He is currently Assistant Professor at Princeton, and he will start in the YITP in January.
Tzu-Chieh Wei, working on quantum information, AMO and condensed matter physics. His Ph.D is from the University of Illinois at Urbana-Champaign. Tzu-Chieh will join the YITP in September, from the University of British Columbia.
Ilan Ben-Zvi is Associate Chair for Accelerator R&D and Division Head at BNL’s Collider-Accelerator Department. His current research interests are RF superconductivity, electron cooling, high-brightness beams, energy recovery linacs and high-power free electron lasers. He is a Fellow of the APS, AAAS, and IEEE. He served as the Director of the Accelerator Test Facility for 15 years and past chair the BNL Council. He is currently advisor to 2 Ph.D. students from our Department. He also served as Ph.D. advisor to 5 Ph.D. students and 5 MSI students.
Vladimir Litvinenko is Deputy Head of the Accelerator R&D Division in BNL. His primary area of interest is the fundamental physics of accelerators and free electron lasers. He is Head, Electron-Hadron Collider (eRHIC) group and also Head, Accelerator Physics Group. He is currently the co-Director (together with Tom Hemmick) of the Center for Accelerator Science and Education. He is a Fellow of the APS and he is the recipient of the 2004 International Free Electron Laser Prize. He is advisor to 2 Ph.D. students and one MSI student. Vladimir taught a very popular Accelerator Physics graduate course several times.
Welcome back to those on the faculty who were on leave last year:
Ken Lanzetta
Tom Kuo

On leave this year:
Gene Sprouse, Editor in Chief, APS
Emilio Mendez, Director, Center for Functional Nanomaterials, BNL
Peter Stephens (Fall)
Chang Kee Jung (Spring)
Hal Metcalf

Retired or resigned:
Chris Jacobsen
Jim Lukens
Passed away

Jack Marburger, 1941–2011
Memorial service September 16, 3:30pm, Staller Center.

Mike Marx, 1946–2011
Memorial service planned for October 26, time and place TBA.
News of the faculty

Abhay Deshpande was elected Co-Chair/Spokesperson of the Steering Committee of the Electron Ion Collider Collaboration

Axel Drees serves as Interim Dean of the College of Arts and Sciences

John Hobbs started a three year term on HEPAP, the congressionally mandated joint NSF/DOE High Energy Physics advisory panel.

Dmitri Kharzeev has been elected fellow of the AAAS

Chang Kee Jung was elected international Co-Spokesperson for the T2K experiment.

Peter Paul is advising the President and the Provost on Brookhaven affairs

Fred Walter was elected the President of the University Senate
News of the faculty

Dmitri Tsybychev is the winner of the first US ATLAS Fellowship. The Fellowship was established to enhance US presence in ATLAS, and it is managed by Brookhaven National Laboratory on behalf of the 44 U.S. institutions contributing to the project. The Fellowship will allow Dmitri to spend full time on research for one semester and it also covers expenses related to stay at CERN.

One of the other three winners is a former post doc in the HEX group, Junjie Zhu.
News of the staff

Elaine Larsen, Assistant
Undergraduate Program
Director Chair, retired.

Her successor is Diane
Diaferia
Pam Burris, Assistant to Chair retired after more than 20 years of service. Her successor is Nathan Leoce-Schappin.
News of the staff

Bob Segnini, Director of Physical Laboratories, retired. His position is temporarily filled by Frank Chin.
“New” staff in the Main Office

Nathan Leoce-Schappin, Assistant to Chair
Socoro Delquaglio, Grant Manager
Maryanne Lodato, Grant Manager
Simons Center opening
DONE

Sculpture is being installed. IN PROGRESS

Renovation of the “Concrete deck”, the area around the building NEXT YEAR
Building and other infrastructure (this year’s slide)

New WEB page (IN PROGRESS)

S-240 Renovation (DONE)

New displays in the main hallway

Mass (DONE)

Time

Distance

“Old” instruments for time and distance are needed!

Replacement of the air-conditioning units on the roof to stop leaks on D-level (scheduled this Fall)

Stop water leaks to S-level (IN PROGRESS)
December, 2010 Ph.D.s

- Jacqueline Faherty (Fred Walter) The Brown Dwarf Kinematics Project (BDKP)
- Itai Ryb (Martin Rocek) Generalized Isometries in Superspace
Graduate student PhDs awarded

May, 2011 Ph.D.s

• Stephen Webb (Vladimir Litvinenko) Theoretical Considerations for Coherent Electron Cooling
• Zhongkui Tan (Kostya Likharev) Experimental Study of Transport through Few-nm Metal Oxide Tunnel Barriers
• Zvi Citron (Tom Hemmick) Probing the Nucleus with d+Au Collisions at RHIC
• Xiaxu Lu (Harold Metcalf) Excitation of Helium to Rydberg States Using STIRAP
• Yan Zhang (Emilio Mendez) Electronic Transport Properties of Semiconductor Nanostructures
• Jie Ren (Vasili Semenov) Physically and Logically Reversible Superconducting Circuits
Graduate student Ph.Ds awarded

**May, 2011 Ph.D.s**

- Li Li (Phil Allen) Theoretical and Computational Studies Related Solar Water Splitting with Semiconductor Alloys
- Ning Chen (Robert Shrock) A Study of Beyond Standard Model Physics
- Megumi Kinoshita (Emilio Mendez) Optoelectronics with Carbon-Nanotube Devices
Graduate student PhDs awarded

August 2009 Ph.D.s

- Hyunoo Shim (Tom Bergeman) Dynamics of Two-Component Bose-Einstein Condensates in an Optical Lattice
- John Durham (Tom Hemmick) Cold Nuclear Matter Effects on Heavy Quarks at RHIC
- Chee Sheng Fong (Concha Gonzalez-Garcia) Soft Leptogenesis as a Viable Model of Barygenesis
- Kathryn Tschann-Grimm (Paul Grannis) Search for the Standard Model Higgs Boson at D0 in the final state jet
- Aaron Jackson (Alan Calder) Exploring Systematic Effects in Thermonuclear Supernovae
- Manas Kulkarni (Sasha Abanov) Hydrodynamics and transport in low-dimensional interacting systems
- Sarah Campbell (Tom Hemmick) Dielectron Mass Spectra in 200GeV Cu-Cu Collisions at PHENIX
Graduate student Ph.Ds awarded

August 2011 Ph.D.s

• Tatjana Vavilkin (Aaron Evans) Properties and Distribution of Luminous Stellar Clusters in a Large Sample of Luminous Infrared Galaxies
• Christopher Malone (Michael Zingale) Multidimensional Simulations of Convection Preceding a Type I X-ray Burst
• Tom Berlijn (Wei Ku) Structure of Functional Materials: Wannier Function-Based First Principles Methods for Disordered Systems
• Abhijit Gadde (Leonardo Rastelli) Aspects of Superconformal Field Theories
• Joshua Schlieder (Michal Simon) New Low-Mass Members of Nearby Young Moving Groups
• Regina Caputo (John Hobbs) A Search for First Generation Leptoquarks at the ATLAS Detector
• Chen-Hao Chen (Barbara Jacak) Jet-Medium Interaction in Quark-Gluon Plasma
• Megan Connors (Barbara Jacak) Direct Photon Tagged Jets in 200 GeV Au+Au Collisions at PHENIX
President's Award

2011 Distinguished Doctoral Students

- **Christian Holzner**: “For the discovery of scanning Zernike phase contrast in x-ray microscopy, and its application to 3D imaging of trace elements at sub-micrometer resolution.” Christian who worked with Chris Jacobsen defended in Summer 2010 and is now working as a Staff Scientist with Xradia Inc. in California.

- **Jacqueline Faherty** “For creating the largest extant catalog of uniform astrometric data on brown dwarfs, and for making significant contributions to our understanding of the nature and physics of brown dwarfs based upon this astrometric data.” Jacky worked with Fred Walter, Adam Burgasser and Michael Shara and defended her thesis in November 2010. Jacky is currently a postdoc at the American Museum for Natural History and will begin an NSF International Postdoctoral Fellowship in Chili this Summer.
Other Thesis Awards

**RHIC and AGS Thesis Award:**

Michael McCumber for his Thesis “Measurement of Fast Parton Interactions with Hot Dense Nuclear Matter via Two-Particle Correlations at PHENIX.” Michael worked with Barbara Jacak and defended in September 2010. Now he is postdoc at the University of Colorado continuing his work with the Phenix collaboration.

**Gertrude Scharff-Goldhaber Award:**

Megan Connors for: “Substantial Promise and Accomplishments in her Thesis Research at Brookhaven Lab” Megan who is advised by Barbara Jacak defended her thesis a few minutes ago and will continue her work on heavy ion collisions as postdoc at BNL.
Departmental Awards

- Postdoctoral Achievement Award: Shlomo Razamat
- Jonathan Kaufman Student Excellence Prize: Bryce Gadway
- H.B. Silsbee Award: Daniel Stack
- Di Tian Prize: Tianmu Xin
- Edward Lambe Prize: Jason Clough
- Nathaniel and Fanie Soroff Prize: Manas Kulkarni
- Peter B. Kahn Fellowships: John Elign, Paul Kline and Manas Kulkarni
- David Fox Prize: Tyler Corbett and Wolfgar Peelaers
Incoming graduate students 29 total

Brian Arnold (Rowan University)
You Quang Chong (Singapore)
Ramani Harikishnan (Stony Brook)
Kendra Kellogg (AU Flagstaf)
Raghjav Kunnawalkam (Cornell College)
Jean-Paul Nery (Buenos Aires)
Yutong Pang (Beijing)
Abhishodh Prakash (Birla)
Yihong Wang (Perimeter)
Xinyu Zhang (Beijing)
Benjamin Bein (Stony Brook)
Alexander Dire (Brown University)
Michael Hazoglou (Brooklyn Polytech)
Ludwig Krinner (Würzburg)
Jian Liu (Harbin)

Hans Niederhausen (Würzburg)
Arturo Pazmino (Ecuador)
Kenneth Schaefer (Stony Brook)
Donald Willcox (Letourneau)
Zhedong Zhang (Colorado)
Martins Bruvelis (Riga - Latvia)
Simon Divilov (City College)
Johannes Hofmann (Würzburg)
Lukas Kürten (Karlsruhe)
Mathew Madhavacheril (Oxford)
Justin Owen (Florida Atlantic)
Martin Polacek (Bratislava)
Thomas Videbaek (Stony Brook)
Stephanie Zajac (Pomona)
Donald Willcox holds a Turner Fellowship
Arturo Pazmino a Fulbright Award
Lukas Kürten a Fulbright Award
Hans Niederhausen a DAAD Fellowship
Ludwig Krinner a DAAD Fellowship
Johannes Hofmann a DAAD Fellowship
Jian Liu a CSC Scholarship
Jean Paul Nery a Fundación Bunge y Bon Fellowship
Martin Bruvelis has an NICOP Office of Naval Research Fellowship
Xinyu Zhang has a Sinopacific Shipbuilding Group Scholarship
# Incoming graduate students - where are they coming from?

<table>
<thead>
<tr>
<th></th>
<th>Degree</th>
<th>Nationality</th>
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</thead>
<tbody>
<tr>
<td>US</td>
<td>14</td>
<td>10</td>
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<tr>
<td>Germany</td>
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<td>5</td>
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<td>China</td>
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<td>1</td>
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<tr>
<td>India</td>
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<tr>
<td>Argentian</td>
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<tr>
<td>Ecuador</td>
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<td>Canada</td>
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<td>0</td>
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<tr>
<td>UK</td>
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<tr>
<td>Latvia</td>
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<td>1</td>
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<tr>
<td>Slovakia</td>
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<td>1</td>
</tr>
</tbody>
</table>
Undergraduate Degrees

Physics majors
Justin Bird
Chetan Chauhan
David Cuffari
Richard Darienzo
Yixin Geng
Imran Ishtihar
Tiago Marinheiro
Michael Meeker
Gaku Nagashima (John Toll Prize Winner)
Thomas Rao
Erica Rosenblum
Manshi Shah
Adam Siegal
Arun Tadepalli
Thomas Videbaek
Matthew Wahl (Award for outstanding achievement and leadership)
Di Wu

Physics Minors
Jason Chung
Vadim Pozin
Manushi Shah

Astronomy Minor
Veronica Natale
<table>
<thead>
<tr>
<th>STUDENT</th>
<th>HOME INSTITUTION</th>
<th>MENTOR(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jason Chaves</td>
<td>Stanford University</td>
<td>Tom Hemmick, Rich Lefferts</td>
</tr>
<tr>
<td>Yoonji Choe</td>
<td>Wellesley College</td>
<td>John Noé</td>
</tr>
<tr>
<td>Benjamin Chonigman</td>
<td>Stony Brook</td>
<td>Tom Hemmick, Rich Lefferts</td>
</tr>
<tr>
<td>Camilla Dagum</td>
<td>Cornell University</td>
<td>Tom Hemmick, Rich Lefferts</td>
</tr>
<tr>
<td>David Meltzer</td>
<td>Stony Brook</td>
<td>John Noé</td>
</tr>
<tr>
<td>Matthew Murray</td>
<td>Dickinson College</td>
<td>Tom Weinacht</td>
</tr>
<tr>
<td>Peter Schnatz</td>
<td>Stony Brook</td>
<td>Phil Allen</td>
</tr>
<tr>
<td>Carrie Segal</td>
<td>Stony Brook</td>
<td>John Noé</td>
</tr>
<tr>
<td>Michele Silverstein</td>
<td>Cornell University</td>
<td>Michal Simon</td>
</tr>
<tr>
<td>Lauren Taylor</td>
<td>Juniata College</td>
<td>John Noé</td>
</tr>
</tbody>
</table>
Giovanni Milione is one of many flourishing LTC alumni. He continues his undergraduate research on optical vortices as a PhD student at CCNY. He has won a prestigious NSF Fellowship and was recently first-author of a PRL on his work.

2011 summer group, all but one a Simons or REU Fellow, with mentor Marty Cohen. Their projects included studies of acousto-optics, evanescent waves, holography, and optical vortices. SBU physics majors David Meltzer and Carrie Segal will present their research at upcoming conferences.

We provide research opportunities for undergraduate physics students at all levels.
CASE: Center for Accelerator Science and Education

Leading Faculty:
Tom Hemmick, Vladimir Litvinenko, Derek Lowenstein.

Students:
Andrey Elizarov (Vladimir Litvinenko) Collective effects and beam dynamics in eRHIC with coherent electron cooler
Lee Hammonds (Vladimir Litvinenko) Higher-Order Mode Damping in the ERL
Elliott Johnson (Ilan Ben-Zvi) Higher Order Mode damping in a superconducting accelerating cavity
Tianmu Xin (Ilan Ben-Zvi) High quantum efficiency photocathode, diamond amplified photocathode
Omer Rahman (Ilan Ben-Zvi) Polarized Electron funneling photocathode gun
Elizabeth Gangone (Triveni Rao) Diamond amplified photocathode
Nathan Cook (Axel Drees) Ion beam based therapy
Stephen Webb (Vladimir Litvinenko) Theoretical Considerations of Coherent Electron Cooling. Defended on May 12, 2011
CASE: Center for Accelerator Science and Education

SBU Engineering School Students at CASE

Mengjia Gaowei (Material Science Eng. Dept., Prof. Michael Dudley), John Smedley:
High quantum efficiency photocathode, diamond amplifiers

Liang Xue (Material Science Eng. Dept., Prof. Michael Dudley), Ilan Ben Zvi;
High quantum efficiency photocathode, multi-alkaline photocathodes

Prachi Chitnis (Computer Eng. Dept., Prof. Thomas Robertazzi), Kevin Brown;
Machine Protection Improvements for RHIC and eRHIC

SBU Physics and Astronomy Post Docs

Puneet Jain (Ilan Ben-Zvi) High-current superconducting accelerating cavity

Miguel Ruiz Oses (Ilan Ben-Zvi) High quantum efficiency photocathodes

Jin Dai (Ilan Ben-Zvi) High quantum efficiency photocathodes
Teaching:
Established MOU with John Adams Institute for Accelerator Science (JAI) at the University of Oxford including sharing accelerator web-courses. Graduate curriculum committee approved such courses assuming that one CASE professors will the local host responsible for quality of the course and checking home-works.

Mei Bai: Introduction to Accelerator Physics (undergraduate)

Sergey Belomestnykh: Superconducting RF (graduate)

The Department and CASE hosted the US Particle Accelerator School, June 13-24, 2011 Many students from all over the US and outside. Supported 9 matriculating SBU students. Student photos: http://uspas.fnal.gov/about/11SBU/11SBUClassPhotos.shtml
Previous USPAS: MIT. Next USPAS: Univ. of Texas at Austin
Structure of matter at 4 trillion K?
Quark gluon plasma is a strongly coupled liquid!

Where is proton’s spin of 1/2?
Quarks account for only about 1/3 of it!

We’re the biggest university group in PHENIX
6 postdocs
14 grad students
+ undergrads
Measure temperature of the plasma

Shine is brightest when the matter is hottest!
To find temperature: play the movie backwards
(using hydrodynamical models of the collision)

Match the data when \( T_i = 370 \text{ MeV} \) (~ \( 4 \times 10^{12} \text{ °C} \) or 4 trillion degrees)
Last seen in nature when universe was a few microseconds old
**Data from new detectors in PHENIX**

- **Hadron Blind Detector**
  - Assembled at SBU
  - Reject Dalitz decays
  - e⁺e⁻ pairs exit QGP undisturbed
  - Thermal radiation. Chiral symmetry restoration?

- **Data analysis underway**

- **Silicon Vertex Detector**
  - Data analysis underway
  - SBU helped construct it
  - Measure displaced vertex e± from heavy mesons
  - c, b energy loss in QGP – same as u, d, s?
  - Probe gluon polarization
Spin of the proton

- 3 spin $\frac{1}{2}$ quarks coupled isn’t it!
- Gluons have the rest? seems not!

- What about the sea quarks?
- We’ll find out next year!

$W^+ \rightarrow e^+ + \nu_e$  $W^- \rightarrow e^- + \bar{\nu}_e$

2009 result

2012
Nucleon decay and Neutrino (NN) Group
(Super-Kamiokande, and **T2K**)

- **Faculty**: C.K. Jung, C. McGrew, P. Paul, C. Yanagisawa
- **Postdocs**: J. Imber, I. Taylor,
- **Grads**: D. Beznosko, K. Gilje, J. Hignight, J. Jo (new), G. Lopez
- **Undergrads**: J. Kim

**T2K Long Baseline Neutrino Oscillation Experiment**

- Took two successful data taking runs in 2010 and 2011.
- Jung, elected to the International Co-Spokesperson position in Feb. 2011
- Survived March 11 earthquake in the east coast of Japan (RS 9.0)
  → No tsunami at Tokai, no loss of lives and no major damages to the experiment
The first result with > 2 sigma significance for non-zero $\theta_{13}$
→ If confirmed, enables CPV measurement in the lepton sector
→ Extensive media coverage: Science, Nature, LA Times, etc.

Best fit and 90% C.L. assuming:
$\Delta m^2_{23} = 2.4 \times 10^{-3}$, $\sin^2 \theta_{23} = 1$ & $\delta_{CP} = 0$

→ Provides a comprehensive description of the T2K experiment
→ Effort led by Stony Brook

Jung: Chief Editor
Paul: Member, Paper Committee
Taylor: Technical Support
2 TeV $\bar{p}p$ collisions at Fermilab

Recent Highlights:

55 publications in last year

Tevatron will shut down after 26 years of operation on Sept. 30, 2011 with a great legacy of new understanding.

Observe $\#(\mu^-\mu^-) > \#(\mu^+\mu^+)$ (more matter than antimatter). Anomalous (non SM) CP violation seen at $3.9\sigma$.

Companion CDF experiment reported an unexpected dijet mass bump in $W+2$jets at $\approx 145$ GeV. DØ analysis rules this out with probability $5\times10^{-4}$. Having 2 experiments is again shown to be necessary!

Tevatron now rules out a SM Higgs boson for $M_H < 108$ GeV and $156 \leq M_H \leq 177$ GeV. The Stony Brook analysis of $\tau\tau jj$ final state (K. Tschann-Grimm thesis) contributes. (Plot shows ratio of observed 95% C.L. limit to the SM prediction.)
7 TeV pp collisions at CERN

37 Physics papers
+21 submitted
+7 detector papers

Full physics program already: W/Z, jets, top quark, b-quark, ….

Jet $p_T$ in W+jets events

… searches for Higgs and SUSY

Higgs search excludes (GeV)
146 < $M_H$ < 232
256 < $M_H$ < 282
296 < $M_H$ < 466

SM preferred mass $M_H = 115$ GeV

… and for other possibilities

Leptoquark search

1st thesis defense with LHC data Aug. 12, (on to a post doc w/Mainz Atlas group) expect more defenses this academic year.
CrossNets: Nanoelectronic Neuromorphic Networks

K. K. Likharev
(collaboration: UC Santa Barbara, U. Colorado Boulder, NYU)

**Basic idea:**
use hybrid CMOS/nanoelectronic circuits...

...with “memristive” crosspoint devices...

... to imitate cortical networks:

$$x_i = \sum_j w_{ij} y_j$$

**Main advantages (over cortex and usual ANNs):**
- potentially, very high density
  (up to $10^{11}$ synapses per cm$^2$, higher than in bio)
- enormous estimated speed at manageable power
  (intercell latency ~30 ns, cf. 10 ms in cortex)

**Main challenges:**
- reproducible crosspoint devices
  (to be pursued by our collaborators)
- architectures for advanced cognitive tasks
  (our group’s objective)

Earlier P&A graduate students: S. Fölling, Ö. Türel, J. H. Lee, X. Ma
J. Joseph, J. E. Thomas, M. Kulkarni and A. G. Abanov
*Observation of shock waves in a strongly interacting Fermi gas*

A. G. Abanov, A. Gromov and M. Kulkarni
*Soliton solutions of Calogero model in harmonic potential*
Photocatalysis in GaN (10-10) surfaces. Ab initio molecular dynamics of water and GaN surface reveal the strong acidity of the surface. Water dissociation barriers are shown. This acidity is hypothesized to favor efficient photocatalytic activity.

Wang, Poissant, Pedroza, Fernandez-Serra, in prep.

---

Anomalous isotope effect in Ice:

Hbond properties make H\textsubscript{2}O be denser than D\textsubscript{2}O. This subtle effect can only be understood when quantum mechanics is applied both to electrons and ions in water. Here shown ab initio results derived from the free energy of ice within the quasi-harmonic approximation.

Betul Pamuk, Phil Allen and MV Fernandez-Serra (in prep).

\begin{equation}
F(V,T) = E_0(V) + \sum_k \left(\frac{\hbar \omega_k(V)}{2} + k_B T \ln(1 - e^{-\hbar \omega_k(V)/k_B T})\right)
\end{equation}

FIG. 11. Unit cell volume as a function of temperature calculated with quasi-harmonic approximation for PBE functional.
P. B. Allen – Solid state physics and nanoscience

Li Li, PhD May 2011

Peter Schnatz
BS, December 2011

Ice - similar crystal structure proton disorder “frozen in”

GaN/ZnO alloy
used for solar water splitting
Predicted phase diagram

Predicted vapor pressure agrees with experiment if D₂O remains frozen while H₂O has protons equilibrating

Close collaborations with Marivi Fernandez-Serra and Artem Oganov.
2 students now, needs more!
Ferroelectrics Group
Matt Dawber, Sara Callori, John Sinsheimer, Benjamin Bein, Mohammed Yusuf (also with Xu Du), Lukas Kuerten, Juli Coraor

New Publication
Nanosecond Dynamics of Ferroelectric/Dielectric Superlattices
*Phys. Rev. Lett*

Exciting New Discoveries by the Group!
• Compositional inversion symmetry breaking and a metal-insulator transition in PbTiO₃/SrRuO₃ superlattices (Sara, with Judith Gabel in Marivi Fernandez Serra’s group).
• Engineered polarization rotation with greatly enhanced piezoelectricity in PbTiO₃/CaTiO₃ superlattices (John)
• Enhanced photocatalysis on ferroelectric surfaces (Benjamin)

New Funding
**NSF** - CAREER: Engineered Ferroic Superlattices for Science, Technology and Education

NSF - Hybrid Graphene-Ferroelectric Devices (with Xu Du), we are looking for another student to join this project!
Graphene: synthesis and experiment
Faculty: Xu Du, Opening for one graduate student.

Bolometric response in graphene superconducting tunnel junctions
Heli Vora, Piranavan Kumaravadivel, Bent Nelson, and Xu Du
Manuscript to be submitted

Ballistic suspended graphene devices
By: Piranavan Kumaravadivel

High quality crystalline graphene and devices
By: Peter Beierle, Michael Mienko, Naomi Mizuno
Rick Darienzo

Mobility dependent Low frequency Noise in Graphene Field Effect Transistors
Y. Zhang, E. Mendez and X. Du, to appear in ACS Nano
Ultracold atomic physics

Faculty: Dominik Schneble
Students: Daniel Pertot, Bryce Gadway, Jeremy Reeves (PhD) Matthias Vogt (MA)

**Diffraction of a coherent matter wave from an atomic crystal**


- a novel method to probe strongly correlated lattice gases *in situ*
- analogous to neutron diffraction from solids, but at 9 orders of magnitude smaller energy (table-top expt.!) 

**Glassy behavior in a strongly interacting disordered 1D lattice gas**

[Phys Rev Lett, accepted]

- atomic disorder leads to a gapless, strongly correlated Bose-glass phase with flat excitation spectrum and zero transport.
- correlations in the disorder distribution play an important role.

Bragg peak

Randomly localized atomic impurities
Understanding Electron Correlation in Molecules via Strong Field Ionization

Weinacht Group

1. Deep UV pulse excites the molecule

2. Strong field laser pulse ionizes

3. Map $\Psi(p)$ to $\Psi(x)$

 Dominik Geißler, Chien-Hung Tseng, Péter Sandor, Marija Kotur, Oumarou Njoya, Matt Murray, Martin Cohen & TW
Looking for new students!

Funding: DoE and NSF
Dr. Xaioxu Lu

Precision Stark Spectroscopy
Biophysics: Amyloid Landscape and water interactions

Faculty: Ken Dill
Laufer Center


Stan Metchev’s group: Kerstin Geißler (postdoc), Rahul Patel and Kendra Kellogg (grads), Shannon Hicks and Owen Vail (undergrads). Searching for: 1 postdoc + 1 undergrad

1. An Imaging Search for Extrasolar Planets

Palomar’s pioneering exo-planet imaging adaptive optics system is undergoing commissioning. First light was attained in June 2011.

2. Weather on Other Worlds

Commencing an 870-hr Exploration Science program with the Spitzer Space Telescope.

$530k, three years.

← Cloud decks in giant planets and brown dwarfs induce ~0.01% photometric variability detectable with Spitzer.
The STONY BROOK / SMARTS Spectral Atlas of Southern Novae

High temporal cadence photometry and spectroscopy of classical novae

Goals:

• To understand the supersoft X-ray phase of classical novae
• To determine whether the accretion disk survives in recurrent novae

Lattimer and team (all with SBU affiliation past or present) discover superfluidity in Cas. A neutron star.


- **Faculty:** Alan Calder, Jim Lattimer, Doug Swesty, Mike Zingale
- **Graduate students:** Adam Jacobs, Brendan Krueger, Yeunhwan Lim, Harikrishnan Ramani
- **Undergraduate students:** Eric Blaney, Ryan Orvedahl
- **Graduations:** Chris Malone and Aaron Jackson (Ph.D), Charlotte Mielke (M.S.)

**Highlights of 2010-2011 research.**

A 2-d simulation of convective thermonuclear burning.

C. Malone, Ph.D. dissertation

Transition from subsonic to supersonic burning in a type Ia supernova.

Krueger et al. in prep. 2011
C.N. Yang Institute for Theoretical Physics

Faculty growing in 2011/12
Tzu-Chieh Wei: quantum info; condensed matter
Rouven Essig: collider physics & dark matter
Christopher Herzog: strings for field theory and condensed matter.

Institute research covers a wide range in theoretical physics. There are currently about 15 students working in a variety of areas. Study is arranged in the same way as with other DPA faculty and research groups.

-- Collaborating with the Simons Center for Geometry and Physics (SCGP), with ties to Brookhaven theory groups, including opportunities for student research.
Some recent topics & titles of pubs featuring students:

**Particle Physics & Field Theory:**
“Majorana Neutrinos from Inverse Seesaw in Warped Extra Dimension”,
“Patterns of Dynamical Gauge Symmetry Breaking”,

**Fields & Strings:**
"Diagrammatic Exponentiation for Products of Wilson Lines”
“Orientifold daughter of N=4 SYM and double-trace running”,
“Massive Scalar Hypermultiplet in Projective Hyperspace”.

**Solvable Models & Quantum Information:**
“Factorization of the Ising model form factors”,
“Exact Potts/Tutte Polynomials for Polygon Chain Graphs,”
“Entanglement in bipartite pure states of an interacting boson gas obtained by local projective measurements.”

+ many ongoing projects in “beyond standard model”; dark matter & astroparticles; neutrino and QCD phenomenology; field & string theory, solvable models, quantum information . . .
Two is good, four is better

Four Dimensional Superconformal Index from a Deformed Two Dimensional Yang-Mills Theory
Abhijit Gadde, Leonardo Rastelli, Shlomo S. Razamat, and Wonbin Yee
Phys. Rev. Lett. 106, 241602 (Published June 16, 2011)
QCD and Quark-Gluon Plasma
Faculty: Dmitri Kharzeev, postdocs: G. Basar, Y. Burnier, H.-U.Yee
students: J. Ilany, F. Loshaj

Last year: 10 papers (including 4 in Phys. Rev. Lett.); 5 invited talks
Co-organized 3 conferences and workshops

Work on the topologically induced effects in QCD vacuum and Quark-Gluon Plasma using weak and strong coupling methods; chiral fermions in QCD and in graphene

Examples: the “Chiral Magnetic Wave”
with H.-U.Yee, PRD83:085007, 2011;
with Y.Burnier, J.Liao, H.-U.Yee PRL107:052303, 2011

“QCD string dynamics and jet fragmentation scaling in heavy ion collisions”
(with F. Loshaj, to appear)
1. Characterize energy density with ellipse
   - Elliptic Shape gives elliptic flow
     \[ \nu_2 = \langle \cos 2\phi_p \rangle \]

2. Around almond shape are fluctuations
   - Triangular Shape gives \( \nu_3 \)
     \[ \nu_3 = \langle \cos 3(\phi_p - \psi_3) \rangle \]

3. Hot-spots give correlated higher harmonics
   - Systematized and simulated

Hot spots give many new predictions, e.g. for three particle correlations

\[ \langle \cos(\phi_{p1} + 2\phi_{p2} - 3\phi_{p3}) \rangle \]

Experiments vastly over constrain transport coefficients QGP!
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Topology and Wilson Dirac Spectra at $a \neq 0$

Faculty: Jac Verbaarschot, postdoc: Kim Splittorff, Mario Kieburg, Student: Savvas Zafeiropoulos

The Wilson Dirac operator at nonzero lattice spacing is nonhermitian with both real and complex eigenvalues. We have obtained analytical results for both the complex and real eigenvalue densities at fixed index. Our results are currently tested by lattice simulations and agreement has been reported at the Lattice-2011 conference.


M. Kieburg, J.J.M. Verbaarschot and S. Zafeiropoulos, [arXiv:1109.xxxx[hep-lat]]

Log-log-plot of analytical results and Monte-Carlo simulations of the additional real eigenvalues versus $\tilde{a}$ for various $\nu$. 
i’m in ur fizx lab

testn ur string therry
THE END