

# NBIA NEWSLETTER

## NEWS IN BRIEF

### BARRY SIMON JOINS BOARD

Barry Simon, IBM Professor of Mathematics and Theoretical Physics at Caltech joins the NBIA Scientific Advisory Board. Simon is a dominant figure in mathematical physics and has received numerous scientific honors, including the Henri Poincaré Prize, the Bolyai Prize, and the Steele Prize.

### VILLUM YIP GRANT

Jacob Bourjaily, Assistant Professor at NBIA, obtained a prestigious Young Investigator Programme Grant from the Villum Foundation. His research program will improve our ability to compute scattering amplitudes. It exposes deep and important aspects of fundamental physics.

### CARLSBERG GRANT

Emil Bjerrum-Bohr, NBIA Associate Professor, received a Distinguished Associate Professor Fellowship from the Carlsberg Foundation. His project will improve the quality of theoretical high-precision predictions and help on-going particle scattering experiments at the LHC at CERN.

### PRESTIGIOUS FELLOWSHIPS

David McGady and Pablo Benitez-Llambay, two young NBIA postdocs, have received, respectively, a Distinguished Postdoctoral Fellowship from the Carlsberg Foundation and a prestigious Marie Skłodowska-Curie Fellowship. David's project is in the area of relativistic Quantum Field Theory, whereas Pablo's entails the study of dynamical processes in the early stages of planetary formation.

## A MESSAGE FROM THE DIRECTOR

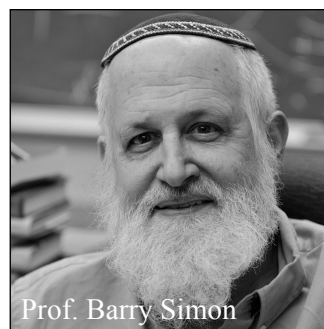
**Poul Henrik Damgaard**

One of the most promising research directions these years is in the overlap between Astrophysics and Particle Physics. Known already by its own name, Astroparticle Physics, it uses exciting links between typically violent astrophysical phenomena and the fundamental laws of physics at the level of elementary particles. The interplay is reciprocal, and both fields have benefited enormously from this connection. At the NBIA, we are getting a new boost to Astroparticle Physics this spring: Markus Ahlers, currently John Bahcall Fellow at the University of Wisconsin and member of the IceCube experiment at the South Pole, takes up a position as Assistant Professor. Later in the spring, Condensed Matter Physics will very much be on the agenda at the NBIA, when we roll out the second Simons Program. This semester's will be centered around distinguished Simons Visiting Professor Steve Simon, who will spend three months at the NBIA in connection with the Simons Program. There will be focused workshops, a visitor program, colloquia and seminars — and also a public talk. Finally, the schedule for our successful series of public lectures organized jointly with Folkeuniversitetet is already available. Tickets will soon be available online. An exciting series of events lies in front of us this spring!

## THE VIEW FROM THE BOARD

**Andrew D. Jackson**

There is little doubt that mathematics is the most powerful tool that theoretical physicists have. We all use it. Great physicists — Newton, Heisenberg, and Wigner among others — have invented or, more often, reinvented the mathematics they needed to solve their problems. Today, the interplay between quantum physics, quantum information, and quantum computation presents fertile ground for advances in both physics and mathematics. The NBIA Scientific Advisory Board has included distinguished mathematical physicists and mathematicians such as Jakob Yngvason and Herbert Spohn with the aim of encouraging such collaborations between mathematics and physics. We are extremely pleased that Professor Barry Simon (Caltech) has agreed to join the NBIA Board. With more than 600 papers on spectral theory, functional analysis, and other mathematical topics relevant for quantum mechanics, his insight will be of great value in establishing even closer ties between mathematics and physics at the NBIA.



Prof. Barry Simon

## UPCOMING EVENTS AT NBIA

### Workshops & PhD Schools

- West-Baltic Meeting on Computational and Theoretical Astrophysics (May 4-5)
- Simons Program on Condensed Matter Physics (May 21-24)
- Dark Matter: Beyond WIMPs (July 31-August 4)
- Kavli Summer Program in Astrophysics 2017 (July 10-August 18)
- Current Themes in High Energy Physics and Cosmology (August 21-25)
- NBIA Summer School on Astrophysical Plasmas (August 28-September 1)

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The Niels Bohr  
International Academy

## RESEARCH HIGHLIGHT on Theoretical Astrophysics

Oliver Gressel

There are few concepts in theoretical physics that are as fundamental as the conservation of angular momentum. One consequence of this is the formation of gaseous accretion disks around a wide range of astrophysical objects. Such disks play a vital role in the formation process and evolution of nearly every type of object in the universe, from gas-giant planets to stars to black holes in active galactic nuclei. Understanding the structure of accretion disks is the key to interpreting astronomical observations of the radiation emanating from these objects. This entails an accurate description of the underlying physical processes. Yet models that go beyond a simple parametrization have remained elusive for more than four decades. The Theoretical Astrophysics group at NBIA aims to devise a new paradigm that properly incorporates our current knowledge of the turbulent dynamics thought to be ubiquitous in magnetized accretion disks. Recent theoretical progress has established a potential link between the observed time-variability in black holes accretion disks and the mean-field dynamo found in advanced computer simulations. The multi-national Event Horizon Telescope is expected to produce the first images of the inner parts of the surrounding accretion disk later this year. This opens up exciting new possibilities in confronting theoretical models to reality, boosting our knowledge about these enigmatic systems. To this end, by combining diagnostic methods applied to massively parallel computer simulations with a complex framework of effective equations, the NBIA is at the forefront of theoretical progress in understanding magnetic variability of black-hole accretion disks.



## NEWS FROM THE NIELS BOHR INTERNATIONAL ACADEMY

These public lectures are organized jointly with Folkeuniversitetet and will be held at the Niels Bohr Institute in the historic Auditorium A, from 5:00pm to 7:00pm. The talks on various topics in modern theoretical physics will be given in English by NBIA members, each on two different dates. They will give you a glimpse of the questions, ideas and approaches right now at the scientific forefront. Online registration will soon be open at <http://www.fukbh.dk>.

1. Enigmatic Protoplanetary Disks (Oliver Gressel, 7-9/11)
2. The quest for Quantum Gravity (Matt von Hippel, 14-16/11)
3. Tales of the Particle World (Ilaria Brivio, 21-23/11)
4. Gravitational Echo from the Past (Pavel Naselsky, 28-30/11)
5. Seeing the Edge of the Universe (Subir Sarkar, 5-7/12)

## NEW NBIA MEMBERS AND VISITORS

This Spring, NBIA welcomes a number of new postdoctoral members and young Assistant Professors working in a wide range of fields within Physics as described below. We also give a warm welcome to our new PhD students Leonardo Krapp and Philipp Weber as well as our new MSc students Jon Brogaard, Veronica Sølund Kirsebom, and Quentin Marolleau.



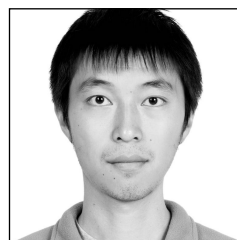
**Markus Ahlers** research area is high-energy astroparticle physics. He explores cosmic rays transport phenomena and their multi-messenger relations to gamma rays and neutrinos. He joins the IceCube group at the NBI as Assistant Professor.



**Ilaria Brivio** is a new NBIA postdoc working with Effective Field Theories. She studies the phenomenology of the electroweak interactions with a particular focus on the properties of the Higgs boson and on the origin of the electroweak symmetry breaking.



**Michele Burrello** is a new Assistant Professor at NBIA working on theoretical condensed matter physics. His main research interests include the study of topological phases of matter, the quantum engineering of anyons, and other exotic many-body states.



**Xiaoyuan Huang** is a new postdoc at the NBIA. Xiaoyuan has worked on dark matter indirect detection and high energy gamma-ray astrophysics using Fermi-LAT data. He is also interested in particle acceleration and multi-messenger Astrophysics.



**Angelo Lucia** is a new postdoc at NBIA and at QMATH. His research focuses on the connections between quantum information theory and many-body quantum physics. He has worked on open dissipative dynamics, area laws, and tensor network states.



**Subodh Patil** is a new NBIA Assistant Professor. He has broad research interests in Early Universe Cosmology and related aspects of string and beyond the standard model phenomenology.