



# NBIA NEWSLETTER

## NEWS IN BRIEF

### VILLUM YIP GRANT

Assistant Professor Michele Burrello has been awarded a Villum Young Investigator Grant for the project “Architectures for non-Abelian anyons.” The project will investigate very peculiar properties of solids and gases appearing in particular systems at very low temperatures and very small length scales. The grant will fund a Ph.D. student, four postdocs and it will cover the material costs for experiments in hybrid superconducting / semiconducting nanodevices.

### 2019 MERAC PRIZE

The 2019 MERAC Prize for the Best Early Career Researcher in New Technologies (Multi-Messenger) is awarded to NBIA's Knud Højgaard Associate Professor Irene Tamborra for her pioneering contributions to understanding the role of neutrinos in astronomy and astrophysics. The MERAC Prize is awarded by the European Astronomical Society.

### CARLSBERG FELLOWSHIP

NBIA postdoc Andrew McLeod has received a two-year Carlsberg Foundation Postdoctoral Fellowship for the project “Novel Structures in Scattering Amplitudes.” McLeod project aims to develop a deeper (and more unified) understanding of the many forms of algebraic structure that have been discovered in both supersymmetric and non-supersymmetric amplitudes in recent years.

### SAPERE AUDE STARTING GRANT & CARLSBERG GRANT

Irene Tamborra, Knud Højgaard Associate Professor and leader of the NBIA AstroNu group, has received a Sapere Aude Starting Grant from the Independent Research Fund Denmark. Irene's research project, “Compact Astrophysical Objects and Neutrinos,” aims to unveil the secrets behind extreme cosmic fireworks in our Universe by means of neutrinos. The grant will allow the hiring of two postdocs and one Ph.D. student who will join Irene Tamborra's group in 2019.

Irene also received a three-year Distinguished Associate Professor Fellowship from the Carlsberg Foundation for her project entitled “Neutrino Astrophysics.” This grant will allow the hiring of two postdocs and one Ph.D. student. It will also provide funding to support a Ph.D. School and an international conference focused on the grant subject.

## A MESSAGE FROM THE DIRECTOR

**Poul Henrik Damgaard**

Last fall we were fortunate to receive two major institutional research grants at the NBIA: One from the Aage and Johanne Louis-Hansen Foundation and one from the Novo Nordisk Foundation. Both grants allow us to offer new fixed-term appointments for young researchers who are ready to build up their own research groups. I am happy to report that the hiring process this year has been concluded with the successful appointment of four new fixed-term Assistant Professors who will take up their positions with us this coming fall: Michele Levi from Saclay in Paris; Amin Doostmohammadi from Oxford University, Johan Samsing from Princeton University, and Evert van Nieuwenburg from Caltech. Their research areas range from the physics of living cells, through condensed matter physics and use of artificial intelligence (AI) in that field, to astrophysics and analytical predictions of gravitational wave signals from black hole mergers. This represents a major extension of research topics at the NBIA and it will be exciting to see how these topics will develop. We will also be joined by three new post-docs this coming fall, extending the existing groups in particle physics, astroparticle physics and neutrino physics. I will present more details on these new members of the NBIA in the next Newsletter. We will have new opportunities for post-doctoral hires from 2020 due to the NBIA having just received an EU COFUND grant from the European Union. That grant will provide close to 50% of salary for post-docs, selected on a highly competitive basis through an independent committee of experts. Finally, I am happy to report that the NBIA now has a new Administrative Officer, Jane Elvekjær. Jane replaces Anette Studsgaard, who was with us for four years and who is now Head Secretary at the Department of Neuroscience. In an interim period former NBIA Administrator Helle Kiilerich kindly helped us out in what was a very busy period.

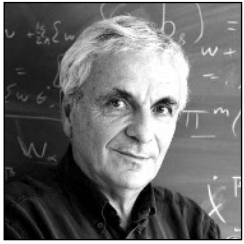
## THE VIEW FROM THE BOARD

**Andrew D. Jackson**

Since its start in 2007 the NBIA has held weekly N-talks each Friday afternoon. (N-talks were originally called T-talks. There is no explanation for either name.) Only 15-20 minutes long, these talks were meant to give new NBIA members an opportunity to introduce themselves and their work as well as to practice the delicate art of making a long story short without losing its content. We are now trying a different format for Friday afternoons with a new series of NBIA Colloquia — 11 of them in the first four months of 2019. This is to be compared with an average of 6 colloquia per year for each of the last 5 years. Topics have ranged from “Measurements beyond the standard quantum limit” to “Statistical sleuthing in criminal cases.” Speakers have been chosen with care since regular attendance is known to be extremely sensitive to the quality of the talks. The result has been a large number of engaged listeners, many of whom are not affiliated with the NBIA. This also reflects the fact that for many years the Niels Bohr Institute has not had a similar program of regular weekly colloquia. We are gratified by the response to this NBIA initiative. Since we appreciate the important role than regular colloquia of high quality can play in the life of a well-functioning physics department, it is our intention to continue them. We are nevertheless aware that an ambitious colloquium program is intended to meet needs different from those that led to the establishment of the earlier series of N-talks. The challenge for the future will be to find the best way to reintroduce them.

## NEW NBIA MEMBERS

This Spring, NBIA has welcomed a number of long-term visitors, a new postdoc and staff member. You can find a brief description of their work below. We also give a warm welcome to our new Ph.D. student, **Matthias Volk**, and our new M.Sc. students, **Christopher Andersen**, **Mads Kruse**, **Zheng Ma** and **Apollonas Matsoukas**.



**Michael B. Green** is the Simons Visiting Professor at the NBIA this spring. Michael is a leading figure in string theory and currently works on its ramifications in other subjects such as that of scattering amplitudes in field theories, as well as on mathematical developments sparked by computations in string theory.



**Ximena Ramos** works on planetary systems dynamics. In particular, she studies planet migration and its relation with the final configurations observed in exoplanetary systems, and the resulting disk-structure. She uses N-body and hydrodynamical simulations combined with analytical calculations.



**Jane Elvekjaer** is NBIA administrative officer. She is responsible for the organisation of workshops and schools, secretarial support, visa applications, and grant administration. She holds a Master's Degree of Law from the University of Århus.



**Si-Hui Tan** works on quantum information theory with a focus on creation of novel protocols for applications. She is also interested in bosonic systems, such as those implemented in integrated photonics and superconducting systems, and their realization of Lie algebras.

## RESEARCH HIGHLIGHT on Theoretical Astrophysics

**Pablo Benítez-Llambay**

We must admit that our Solar System is not typical. For example, exoplanets can be as massive as Jupiter but orbit at distances ten times closer than Mercury. Most of the thousands of planets we have observed show remarkable differences when compared to the Solar System. How is it possible to explain such diversity? We believe that processes leading to the formation of planets, combined with environmental effects associated with the protoplanetary disk in which they form play a fundamental role in sculpting planets and planetary systems. Thus, it is critical to study and characterize such mechanisms self-consistently with the dynamical evolution of the protoplanetary disk. One example is the so-called planetary migration. As a planetary embryo grows accreting material from the protoplanetary disk, it exerts a gravitational force onto the disk which, by the law of action-reaction, exerts an opposite force onto the planet. This force accelerates the planet and makes it move. So far, it is not clear, observationally, whether migration by planet-disk interaction occurs over large spatial scales in planetary systems. Given that we are not yet able to develop a unified view of planet formation in which migration does not play a significant role, it is more likely that we are still missing major aspects of this problem. Finding and characterizing the various mechanisms that set the speed and direction of planet migration demands a thorough understanding of the physics governing the gas and — as we showed recently — dust dynamics in the vicinity of the embryo. To study this problem in a variety of physical conditions, at NBIA we have been developing tools able to take advantage of the spectacular power of the Graphics Processing Units available at the High-Performance Computing Center at Copenhagen University. These tools have enabled us not only to discover and study systematically strong gravitational forces arising from the dust in protoplanetary disks but also to extend our research to other fundamental questions related to dust-growth and dust-dynamics in protoplanetary disks. Without these studies, it is, perhaps, impossible to track down the origin and evolutionary tracks of planetary systems and, in particular, the formation history of our Solar System.



## OUTREACH EVENTS AT NBIA

The Niels Bohr International Academy continues the public lecture series “News from the NBIA.” These lectures are organized jointly with Folkeuniversitetet and will be held at the Niels Bohr Institute in the historic Auditorium A, from 5.15pm to 7.00pm. The talks on various topics in modern theoretical physics will be given in English by NBIA members. They will give you a glimpse of the questions, ideas and approaches right now at the scientific forefront. Registration will open shortly at:

[www.fukbh.dk](http://www.fukbh.dk)

*“The Boltzmann Brain Problem and Quantum Information Theory”*

Charles Bennett, October 3

*“Cosmic Dawn”*

Sune Toft, October 10

*“The Birthplace of Planets”*

Pablo Benítez-Llambay, October 17

*“Active Matter: the Engines of Life”*

Amin Doostmohammadi, October 24

*“Observing Black Holes and Gravitational Waves: A New Era in Astrophysics”*

Johan Samsing, October 31

Niels Bohr International Academy

[www.nbia.dk](http://www.nbia.dk)

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## UPCOMING WORKSHOPS AND PHD SCHOOLS

- Conference: Zooming in on Star Formation (June 10-14)
- NBIA Summer School on Protoplanetary Disks and Planet Formation (August 5-9)
- Current Themes in High Energy Physics and Cosmology (August 19-23)
- Workshop: Neutrino Quantum Kinetics in Dense Environments (August 26-30)



The Niels Bohr  
International Academy