

NBIA NEWSLETTER

NEWS IN BRIEF

KVINDER I FYSIK PRIZE 2020

The Danish Network for Women in Physics (KIF) has awarded the 2020 honorary prize to NBIA's Knud Højgaard Professor Irene Tamborra. The KIF prize is awarded annually to raise awareness about the importance of women in physics and engineering. Irene receives the award because of her "exceptionally strong scientific profile," according to KIF. KIF's award committee appreciates that Irene has built a highly visible research group around her as head of her AstroNu group and that she has shown persistence when facing gender-related obstacles.

NBI MEDAL OF HONOR 2020

Paul Steinhardt has been awarded with the Niels Bohr Institute Medal of Honour 2020. The award recognizes his seminal and creative contributions to a remarkably wide range of subjects within the natural sciences, his tireless advocacy of the unity of sciences, his critical reconsideration of every scientific hypothesis that is not backed by experimental evidence, and his remarkable skills of conveying to the public the excitement of scientific discovery. Paul Steinhardt, who is Albert Einstein Professor at Princeton University, is a frequent visitor at NBIA and has served for a number of years on its Science Advisory Board.

JOHN ARCHIBALD WHEELER PRIZE 2020

The John Archibald Wheeler International Prize and Medal 2020 has been awarded to Igor Novikov, Chief Researcher at the Lebedev Physics Institute of the Russian Academy of Sciences in Moscow and long-time Associated Scientist at NBIA. Igor Novikov received the prize for his contribution to the general theory of relativity and black hole theory. The award, which Igor Novikov shares with Kip Thorne (Caltech, Nobel Prize 2017) and Roger Penrose (Oxford, Nobel Prize 2020), recognizes research and discoveries in scientific fields the American scientist John Archibald Wheeler was involved in.

VILLUM INVESTIGATOR GRANT

Vitor Cardoso, currently a Professor of Physics at Instituto Superior Técnico (IST) Portugal, has been awarded a Villum Investigator Grant from the Villum Foundation for 40M DKK to explore black holes as engines of discovery for fundamental physics with his research program "Illuminating the Dark Universe with Gravitational Waves." With the support of the Villum Investigator Grant, Vitor Cardoso will provide a strong boost for NBI to become a primary venue for gravitational physics in Europe. Vitor Cardoso will join NBIA in 2022.

A MESSAGE FROM THE DIRECTOR

Poul Henrik Damgaard

The grant from the Novo Nordisk Foundation to NBIA is devoted to establishing a strong interdisciplinary effort in physical sciences with eventual impact in life sciences. The first hire in this program brought Assistant Professor Amin Doostmohammadi to NBIA from Oxford University. With additional support from a personal Villum Young Investigator grant, Amin has rapidly been building a young research group in the burgeoning field of Active Matter. Here, physical laws are used to describe motion down to cellular level in living organisms, with a powerful combination of analytical work, numerical simulations, and experiments. With two new hires at the Assistant Professor level, the bio-group at NBIA will expand in two new directions. Weria Pezeshkian joins us from University of Groningen, and Karel Proesmans joins us from University of Luxembourg. Weria is a computational biophysicist who is currently focused on simulations of cell membranes, especially in systems far from equilibrium. Karel currently works on non-equilibrium thermodynamics of small-scale systems, as well as thermo-osmosis and the dynamics of DNA replication. In the Fall of 2021 we will also be hosts to Novo Nordisk Foundation Visiting Professors Debora Marks and Chris Sander from Harvard University. It will be exciting to see how new developments in biological sciences will transform research directions at NBIA in the coming years!

THE VIEW FROM THE BOARD

Charles M. Marcus

I have accepted the position of acting Chair of NBIA's International Science Board from 2021 because I firmly believe in the mission of NBIA and because I recognize that it is time to take the next step: to establish a center of interdisciplinary science in the famous Blegdamsvej complex. In my own field of research, quantum physics, this place is sacred. But more importantly, the idea of an "institute" fostered by Niels Bohr reaches out far beyond current boundaries of scientific disciplines. Just as we today cannot even imagine tomorrow's new challenges, we also cannot imagine where the new revolutions will happen in science. We can see promising outlines, new connections between fields, new avenues opening up in existing fields, and the emergence of completely new directions. Some of these developments will likely fail or become important on much larger time scales, but some will blossom and revolutionize our lives. To keep Denmark on the forefront of developments, as it has proudly been in the past and is still today, we must insist on an open and unrestricted approach to science. Establishing a new interdisciplinary center for basic research on the premises of Niels Bohr's Institute for Theoretical Physics would be a most brilliant way to celebrate its centenary in 2021. I will help as much as I can towards achieving this goal.

NEW NBIA MEMBERS

This Spring, the NBIA welcomes **Aleksandra Ardaseva** as our new NBIA postdoc. You can find a brief description of her work below. We also give a warm welcome to our new PhD student, **Ersilia Guarini**, and our MSc student, **Lila Sarfati**.



Aleksandra Ardaseva is a new Postdoc joining the Biophysics Group at NBIA. She previously worked on adaptation strategies of cancer cells in dynamic environments using analytical and numerical techniques. She is interested in modelling physico-chemical coupling in active biological matter.

RESEARCH HIGHLIGHT on Theoretical Astrophysics

Johan Samsing

Since the pioneering observation of gravitational waves from the collision of two black holes in 2015, more than 50 black hole mergers have been observed. Several of these have provided new insights and opened up exciting puzzles. For example, the lighter of the two objects in 'GW190814' is 2.6 solar masses, which is either the heaviest neutron star observed to date, or the lightest black hole. At the other end, 'GW190521' consists of the two heaviest black holes measured to date (65 and 85 solar masses), which are far larger than stellar evolution models can explain. In addition, the black holes in 'GW190521' seemed to have merged on a non-circular (elliptical) orbit, which hints for an exotic formation. Despite this tremendous observational success, a fundamental question remains open: How do these binary black holes form – and merge – in our Universe? At NBIA, we are building up a new initiative aimed at tackling this fundamental question, with a special emphasis on what is referred to as 'dynamical formation'. In this scenario, binary black holes are formed – and driven to merger – through multiple interactions, with at least one other star or black hole. Astrophysical environments facilitating such interactions can in particular grow black hole populations with high mass components through successive mergers, as well as leading to highly eccentric sources by chaotic chance encounters, which therefore could provide a possible explanation for 'GW190521'. I am pioneering the use of novel aspects of relativistic N-body dynamics to map out the landscape of unique gravitational-wave observables from different dynamical environments. Our main goal is to constrain the formation of binary black hole mergers throughout cosmic history using both current and future gravitational wave data.



NEWS IN BRIEF (CONTINUED)

VILLUM YOUNG INVESTIGATOR PLUS

Knud Højgaard Foundation Professor Irene Tamborra has received a grant from the Villum Foundation under its Villum Young Investigator Plus program, following up on the Villum Young Investigator grant she received five years ago. The grant is awarded for her project "Neutron stars rattling, shining, and sparkling" which aims to take a closer look at one of the hottest topics in astrophysics today: the creation of elements heavier than iron in the Universe. The new grant will allow Irene to hire one PhD student and one Postdoc to work on this project over the next three years.

CARLSBERG REINTEGRATION FELLOWSHIP

Former NBI PhD student Mathias Luidor Heltberg has been awarded with a three-year Carlsberg Reintegration Fellowship. His project with the title "Repair and regulation in DNA damage response" investigates a new hypothesis on how living organisms can create reliable responses to DNA damage. The two most fundamental mechanisms here are the repair of damage and the following regulation of cell state that guarantees that the cell does not divide while damage is still present. Mathias has specialized on these subjects during his research stays at Ecole Normale Supérieure in Paris and Harvard University.

INDEPENDENT RESEARCH FUND GRANT

NBIA Director Poul Henrik Damgaard has received a grant from Independent Research Fund Denmark to pursue a new avenue towards the computation of gravitational wave signals on the basis of general relativity. The project with the title "Scattering Amplitudes and Gravity" explores a new-found path to solving the two-body scattering problem of two massive and highly compact objects such as black holes or neutron stars. The grant allows the hire of one Postdoc and supports an active visitor program in this field.

MARIE SKŁODOWSKA-CURIE FELLOWSHIP

NBIA Assistant Professor Daniel J. D'Orazio has been awarded a two-year EU Marie Skłodowska-Curie Individual Fellowship to work on the modelling of and searches for supermassive black hole binaries. The proposed work will carry out state-of-the-art numerical hydrodynamical calculations of the interaction of these binaries with gas expected to exist at the centers of their host galaxies. Results of these calculations will be used to improve theoretical predictions of binary populations and characterize electromagnetic signatures with which to find these elusive pairs.

OUTREACH EVENTS AT NBIA

The Niels Bohr International Academy plans to continue the public lecture series "Frontiers of Physics" in Fall 2021. These lectures are organised jointly with Folkeuniversitetet and will be held at the Niels Bohr Institute in the historic Auditorium A. The speakers will give you a glimpse of the questions, ideas, and approaches right now at the scientific forefront. www.fukbh.dk

UPCOMING WORKSHOPS AND SCHOOLS 2021

Please visit our [NBIA web page](#) for details and updates.

- NBIA Summer School on Neutrinos (July 5-9)
- NBIA Summer School on Gravitational Wave Astrophysics (August 2-6)
- SAGEX PhD-School on Amplitudes (August 9-13)
- Amplitudes 2021 International Conference (August 16-20)