

NBIA NEWSLETTER

A MESSAGE FROM THE DIRECTOR

Poul Henrik Damgaard



Expansion! Expansion in itself is not a goal for NBIA and yet it is exciting to see the growth this year. More than twenty scientists will join us during the summer and fall. They come from all over the world and range from PhD-students to Assistant Professors. Topic-wise biophysics, condensed matter physics, astroparticle physics, and gravitational astrophysics dominate this year, reflecting exciting new developments in the fields of Active Matter, out-of-equilibrium many-body quantum systems, stochastic thermodynamics, neutrino physics, and gravitational wave observations of merging black holes and highly compact astrophysical objects. Funding for these major boosts in research come from a combination of new personal grants, including a Villum Investigator grant, a Villum Young Investigator grant, a Sapere Aude grant, a DFF Project grant, an NNF Project grant, and two ERC Starting Grants. It's an impressive line-up. On top of this, two post-docs have received individual EU Marie Curie Fellowships to work at NBIA. Adding to this comes the already sizeable particle physics group. NBIA is now in need of new office space, soon we will occupy all available office space in both the B and C buildings on Blegdamsvej. It is the beginning of a new era for NBIA and it will be exciting to see all the new science coming from this expansion. Reflecting this growth, we are also looking forward to a much enhanced program of workshops, PhD-schools, and conferences organized by NBIA in the coming years.

NEWS IN BRIEF

SEVERAL PRIZES AND GRANTS FOR AMIN DOOSTMOHAMMADI

NBIA Assistant Professor Amin Doostmohammadi was recognized with several prizes and grants. He has received the IUPAP Young Scientist Prize in Biological Physics "For his groundbreaking contributions applying the concepts of active matter physics and topological defects in biological contexts," as well as the Lars Kann-Rasmussen Prize, a new prize for young scientists who have made unique contributions to physics and related areas. He has also been awarded an ERC Starting Grant, under the title "Physical basis of Collective Mechano-Transduction: Bridging cell decision-making to multicellular self-organisation". He plans to combine physical modelling with biological experiments to formulate an integrated view on cellular decision-making that incorporates mechanics as an integral part. The grant of 1.5 million Euro will allow Amin to hire a number of post-doctoral researchers and PhD-students over the next five years.

NBIA GRAVITY GROUP PUBLISHES IN NATURE

NBIA Assistant Professor Johan Samsing is lead author on a paper published in NATURE together with NBIA members Bin Liu, Dan D'Orazio, Martin Pessah, and a small international team. The paper provides key insight to understand an event observed by LIGO/Virgo in 2019 (GW190521), a merger between two black holes with many unexpected properties. To explain the event, Johan Samsing and his collaborators considered scatterings of not only two, but three black holes embedded in disks of interstellar gas. The study suggests that the gas disk likely captures smaller black holes which over time move closer to each other. Modelling this environment, they find that events similar to that observed by LIGO are 100 times more likely than the estimates of older models, suggesting a clean solution to the mystery.

RESEARCH HIGHLIGHT on Particle Physics

Matt von Hippel

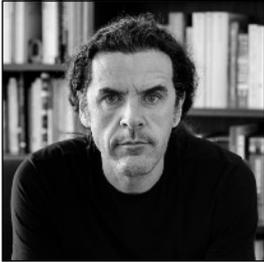


Anyone who tries to make predictions in quantum field theory encounters certain mathematical functions: logarithms, and their more complicated cousins called polylogarithms. These functions capture the physics of the theory in their branch cuts, which encode which types of particles exist. Understanding these functions has led to a revolution in our ability to make predictions

for collider physics, but that revolution has a limit: even at the second perturbative order, we must consider functions beyond polylogarithms. Some of these functions, associated with elliptic curves, are just beginning to be understood, with NBIA researchers developing new formalism to handle them. Even more complicated functions appear, with a mysterious connection to the Calabi-Yau manifolds studied by string theorists. Here the NBIA has led the field, discovering new examples that demand further study.

NEW NBIA MEMBERS

This Spring the NBIA welcomes several new staff members. You can find a brief description of their work below. We also give a warm welcome to our new PhD students, **Marina De Amicis**, **Roger Morales Espasa**, and **Evelyn-Andreea Ester**, and our new MSc students, **Lasse Bonn**, **Varun Venkatesh**, **Nikolaos Andrianopoulos**, and **Alexander John Boccaletti**.



Vitor Cardoso, a new Professor at the NBIA, is both a Villum Investigator and a DNRF Chair. His research uses black holes as engines of discovery to understand the dark content of our universe and test the tenets of General Relativity. He heads an inter-disciplinary investigation of astrophysical black holes.



Damiano Francesco G Fiorillo is a new Postdoc at the NBIA. His research interests include multi-messenger astrophysics, and how high-energy cosmic neutrinos can test particle physics and cosmic-rays astrophysics.



Julie de Molade is a new Research Coordinator with Vitor Cardoso's group, where she is responsible for onboarding, events, communication, and grant administration. For the past 9 years, Julie was a DNRF Center Coordinator at Copenhagen Business School. She holds a Master's in English and French from Roskilde University.



Michelle Westergaard replaces Jane Elvekjær as Section Secretary/Coordinator. She is at NBIA half time due to a position with DARK, but is available full time by mail and phone. She has a Bachelor's in laboratory technology. She worked in research from 2006 to 2014, then was department administrator in SUND and Rigshospitalet, then DARK in 2020.

OUTREACH EVENTS AT NBIA

NBIA is a member of SAGEX, an EU ITN supporting research in scattering amplitudes. The network recently released an online outreach exhibition, available at exhibition.sagex.org.

UPCOMING WORKSHOPS AND SCHOOLS

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

- Scientific Symposium for Andrew Jackson (April 21-22)
- Workshop on Radiation Transfer in Astrophysics (June 6-10)
- Summer School: "Neutrinos: Here, There & Everywhere" (July 11-15)

NEWS IN BRIEF (CONTINUED)

SAPERE AUDE GRANT

Assistant Professor Daniel J D'Orazio has been awarded a Sapere Aude Starting Grant from Denmark's Independent Research Fund for his project titled "Unraveling Mysteries of Supermassive Black Hole Pairs: Searches meet Simulations." The project addresses the mergers of supermassive black holes in galaxy centers. It pairs theoretical and simulation based approaches with searches in observational data, all to constrain models and enable discovery of these elusive black hole pairs. The grant of over 6 million DKK will allow Daniel to hire two post-doctoral researchers and a PhD-student over the next four years.

BERISLAV BUCA JOINS WITH VILLUM YOUNG INVESTIGATOR GRANT

Berislav Buca, currently at Oxford University, has been awarded a Villum Young Investigator grant and will be joining NBIA in the fall of 2022 as Assistant Professor. His project titled "Complex dynamics of non-stationary quantum matter" will study the fundamental algebraic relations that allow for exact calculations of long-time complex dynamics in quantum many-body systems. This will enable discovery of novel kinds of non-stationary (persistently time-dependent) phases of quantum matter out-of-equilibrium. Furthermore, the project will include a study on the theoretical feasibility of novel quantum technologies based on non-stationary quantum matter. The grant will fund the PI, a postdoctoral researcher, and a PhD student.

PROJECT GRANT FROM NOVO NORDISK FOUNDATION

Assistant Professor Karel Proesmanns has received a Project Grant from the Novo Nordisk Foundation for his project 'Stochastic thermodynamics of synthetic biological circuits'. Karel's goal is to create a framework to study non-equilibrium thermodynamics of synthetic biological systems with particular focus on synthetic circuits in cell-free environments. To this end, the project will rely on the recently developed stochastic thermodynamics which makes it possible to study the fluctuating thermodynamics of small-scale systems arbitrarily far from equilibrium. The grant will hire one PhD-student and one post-doctoral researcher.