

NBIA NEWSLETTER



A MESSAGE FROM THE DIRECTOR

Poul Henrik Damgaard

The series of books under the general title "Course of Theoretical Physics" by Landau and Lifshitz is one of the masterpieces of physics. The series covers an enormous range of topics, setting new standards for what every theoretical physicist should know.

This ambitious endeavor was clearly the brainchild of Lev Landau (the joke went that the books contained "not a word of Landau, and not a thought of Lifshitz") and it was an exceptionally clear demonstration of the high demands on theoretical physicists around the Landau school. The central assumption was that every good theoretical physicist should master at deep level a very wide array of different subjects. A century ago this was indeed the case, but before lamenting that it seems to be no longer, we should enjoy whenever cross-fertilization between different areas do take place. An excellent example is the use of quantum field theory methods to the perturbative solution of Einstein's classical field equations in general relativity. Einstein would presumably have been most surprised of such a development, and yet, over a span of just a few years these new methods have cracked problems in classical general relativity that were believed to be unsolvable in practice. The solution involves mathematical functions that Einstein could not have imagined would arise from his apparently simple-looking classical field equations. This development could not have happened if not theoretical particle physicists had become interested in general relativity, and this by itself was triggered by the need for analytical solutions to match data from recent gravitational wave detection. In this Newsletter's Research Highlight, NBIA post-doc Nabha Shah describes her work on solving problems in general relativity based on quantum field theoretical methods, a beautiful merging of two apparently disparate fields of physics.

RESEARCH HIGHLIGHT on Gravity Amplitudes

Nabha Shah

Collider experiments, routinely accessing physics at extremely small scales, have consolidated our understanding of fundamental particle interactions and proven quantum field theory to be a highly successful formulation for describing their properties. Major formal and computational advances were essential to this endeavour. In recent years, methods developed in quantum field theory and in the computation of scattering amplitudes for quantum processes have found an unexpected application at a very different physical scale. They are being actively employed to determine the classical physics of gravitational interactions. The ongoing detections of gravitational waves emitted by merging black holes and neutron stars have ushered in a new era for investigations of the fourth fundamental force and, with planned upgrades to LIGO and new future detectors like LISA, we need more accurate and extensive theoretical models to continue extracting and analysing incoming signals. Since fully analytic solutions to the general relativistic two-body problem are not known, any theoretical approach produces data by systematically approximating observable systems based on their weak gravitational fields, i.e. in an expansion in Newton's constant, slow velocities, or extreme mass ratios. At NBIA, we are computing new results for the dynamics of gravitating bodies by employing the field theory approach where the problem is recast to interactions between point particles. Additionally, we explore open questions regarding the modelling in field theory of several interesting aspects of black hole dynamics such as their spin, tidal properties, and interactions with gravitational waves as well as the strong field physics of extreme mass ratio systems.



NEWS IN BRIEF

Carlsberg's Semper Ardens Grant to Martin Pessah

NBIA Prof. Martin Pessah has received a Semper Ardens Accomplish grant from the Carlsberg Foundation, for the project "A new paradigm for black hole binary mergers". The research enabled by this Semper Ardens grant will develop a new framework that incorporates the role of turbulent gas dynamics in the evolution of black hole binaries, providing a more complete picture of how black hole binaries in disks around supermassive black holes evolve in order to shed light on the astrophysical origins of gravitational-wave events.

Villum Young Investigator Grant to Andrew Chael

Andrew Chael, who joined NBIA as Louis-Hansen Foundation Assistant Professor in March 2026, has received a Villum Young Investigator grant titled "Imaging Black Holes." His research links observations, including the first resolved images of black holes from the Event Horizon Telescope, to theory and numerical simulations to develop new methods for probing fundamental physics and measuring black hole properties. With support of this grant he will build a new interdisciplinary group to produce and interpret the next generation of black hole images.

NEW NBIA MEMBERS

This Spring, NBIA welcomes new staff members and gives a warm welcome to our new PhD student **Andrey Shusharin**.

Andrew Chael is an assistant professor of theoretical astrophysics. He is a member of the Event Horizon Telescope, developing new approaches for imaging and modeling black holes with multi-wavelength data.



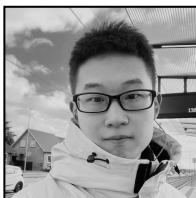
Alejandro Vigna-Gómez is a postdoctoral researcher working on the application of analytical and numerical methods to study the interplay between stellar evolution, binary interactions, and gravitational dynamics.



Brian Seymour is a postdoctoral researcher working on general relativity, tests of modified gravity, and gravitational waves, and in particular on modeling hierarchical triples and their gravitational waveforms.



Fan Yang is a postdoctoral researcher working on many-body quantum optics, including quantum nonlinear optics and quantum information processing with neutral atoms.



PUBLIC LECTURES AT NBIA

Frontiers of Physics

This series of public lectures organized by Assoc. Prof. Emil J. Bjerrum-Bohr (NBI) features Prof. Jeppe Dyre (RUC), Prof. Brian Møller Andersen (NBI), Assistant Prof. Andrew Chael (NBI), Assoc. Prof. Martin Cramer Pedersen (NBI), and Postdoc Alejandro Vigna-Gómez (NBI). These five distinguished scientists will share their fascinating research, offering an exciting opportunity to stay up-to-date with the latest news from the Niels Bohr International Academy.

The titles for the lectures for 2025 are detailed below.

1. Can Time Move Backwards in Materials? (JD)
2. Altermagnets: Magnetism without Magnetization! (BMA)
3. How Do You Photograph a Black Hole? (AC)
4. From Butterflies to Medicines: How Math Shapes Nature and Materials (MCP)
5. How Massive Stars Forge the Elements that Shape Life on Earth (AVG)

Tuesdays from 17:15 to 19:00 (6/10-10/11), except 13/10
Auditorium A, The Niels Bohr Institute, Blegdamsvej 17

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NEWS IN BRIEF (continued)

Carlsberg's Reintegration Fellowship to Alejandro Vigna-Gómez

With the support of a Reintegration Fellowship awarded by the Carlsberg Foundation, NBIA Postdoc Alejandro Vigna-Gomez returns to Denmark to undertake the project "The Chronology of Massive, Multiple-Star Systems". This research program will use state-of-the-art numerical simulations to explore how populations of massive stars lead to the formation of black hole binaries.

Brian Seymour receives Marie Skłodowska-Curie Individual Fellowship

The two-year EU Marie Skłodowska-Curie Individual Fellowship will support Brian's work on the TripleGW project titled "Comprehensive gravitational waveforms in hierarchical triples for LISA" with Johan Samsing in the Theoretical Astrophysics group. This project will model hierarchical triples near galactic nuclei, capturing precession, Doppler modulation, Lidov-Kozai, and lensing to deliver validated LISA-ready tools and detectability predictions.

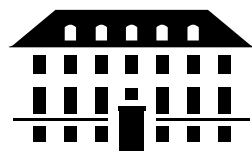
Jose Ezquiaga receives Lars Kann-Rasmussen Prize

At an award ceremony on February 24, Associate Professor Jose Ezquiaga from Center of Gravity received the Lars Kann-Rasmussen Prize 2026 "for his groundbreaking work on gravitational physics, including the implications of gravitational wave observations for dark energy and tests of gravity, the formation of black holes in the early universe and the search for gravitationally lensed gravitational waves". The Prize was presented to Jose Ezquiaga in Auditorium A, following speeches by Associate Dean of Research Lise Arleth, Deputy Head of Institute for Research Troels Haugbølle, and NBIA Director Poul Henrik Damgaard.

UPCOMING WORKSHOPS AND SCHOOLS

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

- Copenhagen Days for Active Matter (Apr 22-24)
- NBIA/DAWN Workshop on Little Red Dots (Aug 24-25)
- Current themes in Astro and Cosmology (Aug 26-28)



The Niels Bohr
International Academy