

Executive summary
of the virtual YOUNGST@RS MITP Event
Shoot for the Stars, Aim for the Axions

Organized by
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The workshop “Youngst@rs-Shoot for the Stars, Aim for the Axions” was a highly anticipated and well-attended virtual event that brought together a diverse community of scientists from around the world, including budding researchers and leading experts in the field of axion searches. It was organized by Pierluca Carenza (Stockholm University, OKC), Oindrila Ghosh (II. Institute for Theoretical Physics, University of Hamburg, DESY & Stockholm University, OKC) and Giuseppe Lucente (University of Bari “Aldo Moro”, INFN Bari) and supported by the Mainz Institute for Theoretical Physics (MITP), from 4 October 2022 to 7 October 2022.

The goal of the virtual workshop was to bridge various subfields of astrophysics, cosmology, and high-energy physics, in order to further our understanding of the properties and behavior of axions and axion-like particles. The workshop featured 11 plenary talks, as well as 9 submitted short talks, with each day dedicated to one of the key focus areas. The duration of each plenary talk was 30 minutes plus 5 minutes of discussion, while the short talks consisted of 20 minutes with 5 minutes for questions. At the end of each day, 30 minutes were dedicated to a long discussion among all the participants.

The first day, focused on the theoretical landscape of axions and axion-like particles, provided a comprehensive overview of current models and their implications for dark matter research. Researchers discussed the various ways in which axions could potentially make up all or a significant portion of the dark matter in the universe, and presented new ideas and models for explaining various properties of these hypothetical particles. The opening talk was given by Luca di Luzio (INFN Padova), followed by three short talks, given by Mario Reig (University of Oxford), Eike Müller (Stockholm University) and Leonardo Mastrototaro (University of Salerno). The session was closed by the plenary talk delivered by Joerg Jaeckel (ITP, University of Heidelberg).

The second day, dedicated to the study of axions from stars, considered the role of these particles in stellar evolution and the potential for detecting their signatures. Scientists presented new research on how axions could affect the energy production in the stars, modifying the standard stellar evolution, and discussed the various observational techniques that could be used to detect axions produced in stellar environments. The plenary talks were given by Georg Raffelt (Max Planck Institute for Physics, Munich), Maurizio Giannotti (Bari University) and Oscar Straniero (INAF and INFN Rome), while the short talks were delivered by Alessandro Lella (University of Bari) and Luca Caloni (University of Ferrara).

The third day, based on the theme of the search for axions in the laboratory, provided a detailed overview of current experimental efforts and proposed new methods for detecting these weakly interacting particles. Researchers discussed the challenges of detecting axions in the laboratory, including the need for sensitive detectors and the development of new experimental techniques, and presented new data from ongoing experiments that are searching for evidence of axions. In this session, Joshua Eby (Tokyo University IPMU), Soroush Shakeri (Isfahan University of Technology) and Andreas Ringwald (Deutsches Elektronen-Synchrotron, DESY) were the plenary speakers. The short talks were delivered by Nicholas Rapidis (Stanford University) and Xiao Xue (DESY).

Finally, the fourth day was dedicated to the search for axion signatures in cosmic photon fluxes, ranging from X-ray astronomy to sub-PeV gamma rays. Scientists presented new constraints and hints obtained from cosmic photon fluxes and discussed the various observational techniques, stressing the importance to develop detectors to probe fluxes in the MeV range. The plenary talks were delivered by M. C. David Marsh (Stockholm University), Francesca Calore (LAPTh Annecy) and Francesca Chadha-Day (Durham University), while Christopher Eckner (LAPTh Annecy) and Qixin Yu (University of Hamburg) presented the short talks.

During the workshop, best practices in equality, diversity, and inclusion were observed, and it successfully brought together scientists of various career stages from universities scattered across all over the world. Throughout the event, there were lively discussions and debates among the attendees, as well as opportunities for informal networking and the formation of new collaborations. The exchange of knowledge and expertise among the participants was invaluable, and it will be beneficial in driving future progress in the field of axion research. The workshop organizers were satisfied with the outcome and acknowledge the MITP for the support.

In conclusion, the "Youngsters Shoot for the Stars, Aim for the Axions" virtual workshop was a resounding success, providing a unique opportunity for the community of scientists working on the search for axion-like particles to share their latest research findings, and discuss new ideas in the field of axion research. The workshop played a crucial role in fostering collaborations across different fields and disciplines, and creating connections among young researchers and leading scientists. It will be a valuable resource in the years to come as searches for axions continue, leading to further development in the field.