



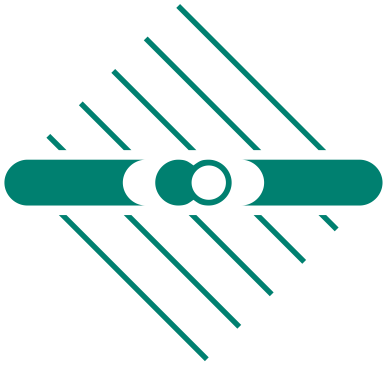
Progress Report 2017-2019

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Foreword

This report for the period of 2017-2019 is meant to give a broad general overview over the main research areas at MPIK, technological infrastructure, and some recent selected science highlights. The chapters are organized by scientific topics and fields of research rather than individual divisions, who cooperate in many areas to achieve common goals and visions.

Physics at MPIK evolves around exploring the extremes:

- from highest-precision measurements to acceleration mechanisms of cosmic particles,
- from lowest-background radiation measurements to extreme radiation intensities,
- from fastest motions of quantum matter to tests of drifts of fundamental constants,
- from cold molecular reactions in space to astrophysical processes in stars and supernovae,
- from dark matter to bright light.

The years of 2017-2019 marked the startup of two new research groups at the MPIK: Since the beginning of 2017, Florian Goertz is heading his group on New Physics, Electroweak Symmetry Breaking, and Flavor. In Spring 2019, Brian Reville kicked off his group on Astrophysical Plasma Theory. The groups thus complement the spectrum of science at MPIK spanned by the divisions of

- Klaus Blaum (Stored and Cooled Ions)
- Jim Hinton (Non-thermal astrophysics)
succeeding Werner Hofmann (retired/emeritus since June 2019)
- Christoph H. Keitel (Theoretical Quantum Dynamics and Quantum Electrodynamics)
- Manfred Lindner (Particle and Astroparticle Physics)
- Thomas Pfeifer (Quantum Dynamics&Control)

MPIK now also shines in new light: The quantum-dynamics laser labs were inaugurated in May 2017, with first lasing in February 2018, close to 60 years into the institute's foundation anniversary. This anniversary also provided an opportunity to show the public around the institute during an open-house day on 16 September 2018. Lots of hands-on activities, exhibits and posters provided insights into what nature teaches us from the (sub-)nanoscale of elementary particles, the motion of atoms and molecules to the macroscales of the universe, where the existence of dark matter and nearly non-existence of antimatter create puzzles of astronomical dimensions.

Led by MPIK Scientists, several scientific breakthroughs have been accomplished in the last three years, which are highlighted on the following pages. These successes are enabled by the close cooperation of division scientists with the excellent infrastructure, consisting of mechanics and electronics workshops, different service groups as well as by the administration. Thanks thus go to all members of the Institute, in particular our junior and senior scientists, partners at and students from Heidelberg University and outside research institutions for their dedicated and engaged work and contributions. 2019 marked also the retirement of Werner Hofmann, who lifted the MPIK internationally visible into the gamma-ray sky with H.E.S.S. and the preparation of the CTA project. We are also grateful for his essential contributions to setting the stage and transforming the entire institute from its pure nuclear past into its broad and fruitful present and future at the dynamical core of fundamental physics.

The following chapters of the report address the areas of “1 Astroparticle Physics”, “2 Quantum Dynamics”, and “3 Infrastructure”. Lists of personnel, publications, theses, invited talks, teaching activities, organised conferences, and institutional collaborations are provided online.



Thomas Pfeifer
Managing Director

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