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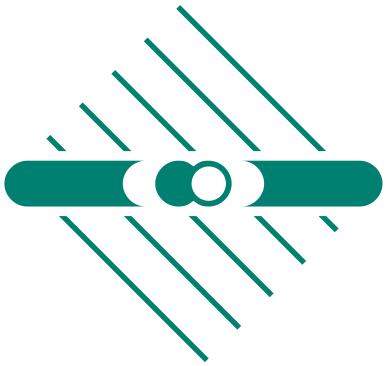

Foreword

This report for the period of 2020-2022 is intended to provide a broad general overview of the main research areas at MPIK, our technological infrastructure, and selected science highlights. The chapters are organised by scientific topics and fields of research rather than by individual divisions, which cooperate in many areas to achieve common goals.

Physics at MPIK evolves around exploring the extremes:

- from highest-precision measurements of single ions to acceleration and impact of cosmic particles on galactic scales,
- from lowest-background radiation measurements to extreme radiation intensities,
- from the fastest motions of quantum matter to tests of drifts of fundamental constants over cosmic time,
- from cold molecular reactions in deep space to astrophysical processes in stars and supernovae,
- from dark matter to ultra-bright light.

In 2020 a new independent research group on Ultrafast Liquid Crystal Dynamics was launched. Laura Cattaneo, the leader of the new group, joins group leaders Florian Goertz (New Physics, Electroweak Symmetry Breaking, and Flavor), and Brian Reville (Astrophysical Plasma Theory).

These groups complement the spectrum of science at MPIK spanned by the divisions of

- Klaus Blaum (Stored and Cooled Ions)
- Jim Hinton (Non-thermal Astrophysics)
- Christoph H. Keitel (Theoretical Quantum Dynamics and Quantum Electrodynamics)
- Manfred Lindner (Particle and Astroparticle Physics)
- Thomas Pfeifer (Quantum Dynamics & Control)

The period of this report coincides with the global COVID-19 pandemic. Despite the additional challenges raised by this situation, we are extremely happy that the scientific productivity was not negatively impacted, with many key scientific results achieved. Even more importantly, the COVID measures put in place at the institute were fully successful: with no known case of COVID transmission at the institute. Our scientific successes were enabled by the close cooperation of division scientists with our excellent infrastructure staff, consisting of mechanics and electronics workshops, scientific and technical service groups and our administration. I take the opportunity to thank all members of the institute and our partners and colleagues in the town of Heidelberg and all over the world!

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

Jim Hinton
Managing Director

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