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Weakly-coupled light new physics

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Abstract: The existence of light, weakly-interacting new particles beyond the Standard Model is a well-motivated alternative to new particles existing at the TeV scale or beyond. With the example of axion-like particles (ALPs), which offer an explanation of the puzzling absence of the electric dipole moment of the neutron, we discuss the current status of both direct searches at the LHC and in flavor experiments, and indirect searches using precision measurements of electroweak and low-energy observables. We emphasize the importance of subtle quantum effects, which generate multiple ALP couplings to the Standard Model particles even if at a high scale only a single ALP coupling is non-vanishing.

Matthias Neubert has been a Professor for Theoretical High-Energy Physics at Johannes Gutenberg University since 2006 and has been appointed Founding Director of the Mainz Institute for Theoretical Physics (MITP) in 2012. His research focus lies in theoretical elementary-particle physics, QCD and collider physics, flavor physics and CP violation, effective field theories and physics beyond the Standard Model. He has published more than 250 scientific papers. Since 2012, Neubert serves as Spokesperson of the Cluster of Excellence PRISMA+ (Precision Physics, Fundamental Interactions and Structure Matter) at Johannes Gutenberg University.

Neubert studied Physics and Mathematics at the University of Heidelberg from 1984 until 1988. After obtaining his PhD in 1990 he worked as a Research Associate at the Stanford Linear Accelerator Center (SLAC). From 1993 until 1998 he was a Senior Staff member in the theory division at CERN. In 1999, he became Professor and head of the theory group at Cornell University, and in 2003 Director of the Cornell Institute of High-Energy Phenomenology. He is an Adjunct Professor at the University of Heidelberg (since 1998) and at Cornell University (since 2006).

Neubert is a Member of the Mainz Academy of Sciences and Literature, a Corresponding Member of the Heidelberg Academy of Sciences, and a Fellow of the American Physical Society. In recognition of his research, he received the Research Award from the Alexander von Humboldt Foundation (2005) and the J. Hans D. Jensen Award from the Klaus Tschira Foundation (2010 and 2015). In 2011 and 2023, he was awarded Advanced Grants of the European Research Council (ERC).

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