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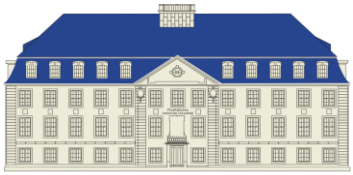

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COLLOQUIUM „OPTICS AND CONDENSED MATTER“

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Quantum logic control of molecular and transition-metal ions

Extending quantum control to increasingly complex systems is essential for advancing quantum technologies and probing fundamental physics. Molecules, in particular, serve as highly sensitive systems for detecting symmetry violations that may reveal physics beyond the Standard Model. However, their complex level structure makes quantum-state control challenging.

Quantum logic spectroscopy offers a promising path forward for molecular ions: a well-controlled atomic ion is co-trapped with a molecular ion and enables manipulation and readout of its quantum state via shared motional modes. I will present an overview of our latest results and concepts in quantum logic control of molecular ions. As we progress toward quantum logic spectroscopy of single molecular MgH^+ ions, we are also assessing the broader applicability of these techniques to other ionic species. Recently, we demonstrated quantum logic control of a single titanium ion [1,2], showing that these methods can be extended to previously inaccessible atomic systems.

By enhancing control over new classes of ions, our work opens the door to novel applications in quantum technology and fundamental physics, making an extended range of species available for precision spectroscopy.

[1] Rehmert et al., Quantum Logic Control of a Transition Metal Ion, Physical Review Letters 134, 113201 (2025)
[2] Rehmert et al., Landé g Factor Measurement of Ti+ Using Simultaneous Comagnetometry and Quantum Logic Spectroscopy, Physical Review Letters 136, 083203 (2026) …

May 12th, starting with discussion at 17:00 h, talk at 17:15 h, live IAP lecture hall or via Zoom
https://uni-bonn.zoom.us/j/98441612025?pwd=a01SSjlkY1Q3SDFhL09JQk1qc1V6dz09
Meeting-ID: 984 4161 2025
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