PRECISION SPECTROSCOPY OF A SINGLE TRAPPED MOLECULAR NITROGEN ION

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Precision spectroscopy of dipole-forbidden rotational and vibrational transitions in molecular ions could serve as a probe for detecting possible temporal variation of fundamental constants, testing fundamental physical theories, establishing new frequency standards in the mid-IR and investigating state-to-state dynamics of chemical reactions. However, until recently, it was impossible to achieve the required precision due to the lack of control over the molecular ions on the quantum level. We are developing new methods which allow us to prepare a single molecular ion in its rovibrational ground state[1], detect its quantum state with high-fidelity[2] and perform highly sensitive and precise spectroscopic experiments on dipole-forbidden transitions in N_2^+ in MHz, GHz and THz range[3]. The absolute frequency stability of the measurements is provided by referencing all radiation sources' frequencies to the Swiss primary frequency standard operated by the Swiss Federal Institute of Metrology METAS in Bern[4]. These will allow us to reach an absolute measurement precision on the level of 10^{-15}, establishing a new state-of-the-art in the spectroscopy of molecular ions and opening up new horizons for many physical and chemical applications.

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