GSI - FAIR Colloquium

Main Lecture Hall (SB1 1.120), 64291 Darmstadt, Planckstraße 1

Tuesday, 19 January, 2016, 16:15 Uhr (Tee ab 15:45)
Pre-colloquium for students at 15:30

Robert Berger / Philipps-University Marburg

Heavy elemental molecules as probes for violation of fundamental symmetries

Heavy atoms are well-established systems for the detection of violations of fundamental symmetries. Nuclear spin-independent parity violation effects, for instance, have been detected in the 1980s in atomic bismuth, lead and cesium. Nuclear spin-dependent parity violation, to which the so-called nuclear anapole moment contributes, has been measured only in atomic cesium so far, where one had to cope with a huge background stemming from the dominating nuclear spin-independent parity violation [1]. Diatomic and chiral polyatomic molecules containing heavy elements generate well defined internal fields on the atomic scale that appear favourable for observations of symmetry violations, be it as the afore mentioned parity violation (P-odd effects, see for instance Refs. 2-5) or parity and time reversal violation (P,T-odd effects, see for example Ref. 6) such as the electron electric dipole moment. In open-shell diatomic molecules, for instance, the otherwise dominating nuclear spin-independent parity violation contribution is strongly suppressed, such that experiments become particularly sensitive to nuclear anapole moments. (Traditionally) chiral molecules offer the advantage that P-odd effects can in principle be directly detected as resonance frequency differences (see e.g. Refs. 3,4), which are in general better under control than variations of cross sections. In this presentation, I will discuss specific advantages and challenges of using molecules with heavy elements for detecting violations of fundamental symmetries, outline approaches for the theoretical prediction of effect sizes, emphasize specific features such as chirality in the electron cloud, point to possibilities of cooling and trapping relevant molecules and discuss, if time permits, also some specific aspects of the chemistry of superheavy elements.

Einladender: Thomas Stöhlker

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