A NEW EXPERIMENT TO TEST PARITY SYMMETRY IN COLD CHIRAL MOLECULES USING PRECISE MID-INFRARED SPECTROSCOPY

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We are building a new-generation mid-infrared spectrometer specifically designed for precision vibrational spectroscopy of cold complex polyatomic molecules in the gas phase. The proposed technology is at the forefront of cold molecule research and frequency metrology, and opens possibilities for using polyatomic molecules to perform tests of fundamental physics and explore the limits of the standard model. The apparatus will be used in the first place for parity violation (PV) measurements in chiral molecules, i.e. for measuring the tiny energy difference between enantiomers induced by electroweak interactions.

We will present our ongoing work towards developing the technologies needed for measuring PV in chiral molecules via Ramsey interferometry in the mid-infrared[a]. This includes amongst other things developing frequency stabilised quantum cascade lasers calibrated to some of the world's best frequency standards[bc] and producing gases of organo-metallic species cooled to a few kelvin in cryogenic buffer-gas cells[d]. We will also present the results of preliminary investigations conducted on various promising heavy metal complexes exhibiting intense signatures in different regions of the mid-infrared[ef].

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[b] R. Santagata et al, Optica 6, 411 (2019)
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[d] S.K. Tokunaga et al, New J. Phys. 19, 053006 (2017)
[e] P. Asselin et al, Phys. Chem. Chem. Phys. 19, 4576 (2017)
[f] N. Saleh et al, Chirality 30, 147 (2018)