



universität
wien

Faculty of Physics

**Directorate of studies
Doctoral programme in
Physics**

<http://ssc-physik.univie.ac.at>

Univ.-Prof. Mag. Dr. Thomas Pichler
Boltzmannngasse 5, 1090 Vienna

Phone +43(1) 4277 51466
dspl.physics@univie.ac.at

To all members of the
Faculty of Physics

Vienna, 07 January 2025

Invitation to the public defense of the doctoral thesis

**“In-beam measurements of the hydrogen hyperfine
splitting to constrain Standard Model Extension
coefficients”**

by

Lilian Nowak

Monday, 13 January 2025, 13:00 p.m.
Seminarroom 1, 1st Floor, Boltzmannngasse 5, 1090 Vienna

The ASACUSA-CUSP experiment located at CERN’s Antiproton Decelerator aims at measuring the ground state hyperfine splitting of antihydrogen ($\text{H}\bar{\text{H}}$) using a Rabi-like technique to test CPT symmetry. For this purpose, a beam of cold (~ 50 K) hydrogen has been developed to characterize the antihydrogen spectroscopy apparatus. Beyond serving as a test bench for the $\text{H}\bar{\text{H}}$ experiment, the hydrogen beamline, allows for novel physics measurements especially in the context of the Standard Model Extension (SME), an effective field theory that includes potential violation of CPT and Lorentz symmetries. A new measurement campaign on hydrogen started in 2022 and focused on π_1 and σ transition measurements, using two opposite orientations of the external magnetic field aligning the atoms to constrain SME coefficients. The final results yielded constraints on a set of SME coefficients at a level of $2,3 \times 10^{-21}$ GeV. Additionally, the zero-field ground state hyperfine splitting (ν_0) was determined from the π_1 and σ transitions measured at the same static magnetic field, achieving a relative precision of 440 ppt.

Defense committee:

Klaus Jungmann, University of Groningen, NL (reviewer)

Valery V. Nesvizhevsky, European Centre for Neutron Research, FR (reviewer)

Eberhard Widmann (supervisor)

Thomas Pichler (chair)