

# Physikalisches Sonderkolloquium

Montag, 16.09.2019, 14:30 Uhr – Hörsaal 5J

## Antihydrogen spectroscopy and beyond

Prof. Dr. Niels Madsen, Swansea University, U.K.

The Standard Model of particle physics has been riding a wave of success for the last decade, latest with the discovery of the Higgs boson at CERN in 2012. However, it still falls short of explaining a number of phenomena, one of which is the apparent lack of significant antimatter in the Universe. Antihydrogen, the bound state of an antiproton and a positron, is currently the only bound system of only antiparticles and is therefore an exciting test-ground for the most fundamental symmetries in nature such as CPT symmetry and the weak equivalence principle, and perhaps elucidate the problem with the missing antimatter.

For almost a decade the ALPHA collaboration has been trapping antihydrogen with the aim of bringing the best atomic physics tools available for investigating matter/antimatter symmetries. Initially only a few could be trapped, allowing the first atomic transitions to be observed, but in the last few years, the techniques have matured to an extent that we envisage experiments on 1000's of anti-atoms. This development has already borne fruit with the first observation of the 1S-2S transition in antihydrogen, and the measurement of the transition to a precision of a few parts in  $10^{12}$ , the most accurate and precise measurement on antimatter to date.

In this talk I'll discuss how we have achieved these feats, show examples of our measurements and discuss where we plan to go from here. Additionally I'll discuss our latest upgrade that should allow the first direct measurement of the gravitational to inertial mass of antihydrogen when CERN restarts antiproton delivery in 2021.

**Für die Dozenten der Physik**  
**Prof. Dr. S. Schiller**