



TECHNION
Israel Institute
of Technology



הטכניון
מכון טכנולוגי
לישראל

SEMINAR

סמינר

Toward First Probe of Parity Violation in Chiral Molecules – Novel Molecular State Detector for Trapped Ions

Eliana Ruth Wallach

Physics Department and the Solid-State Institute
Technion

Abstract

Every chemistry student learns that chiral molecules have two enantiomers – spatial atomic configurations that are mirror images. However, parity symmetry that is broken by the weak nuclear force puts this claim into question, predicting a slight energy difference between both enantiomers. This parity violation (PV) has eluded measurement so far, partly due to its predicted tiny magnitude and the difficulty of enantiomer separation.

We are building an experiment to measure PV in cold trapped chiral molecular ions. In a recent paper, we proposed PV can be measured in a mixed ensemble of chiral molecules. This is done using a scheme which embeds Ramsey spectroscopy within the 3-wave mixing (3WM) method and imprints the PV signal onto the oscillation of the population of rotational states [1]. However, measurement of the Hz-level PV shift between the enantiomers will require longer coherence times than available in beam experiments. Hence, we plan to use trapped molecular ions, namely CHDBrI^+ [2]. One of the main challenges in this approach is the resolved detection of the rotational states for trapped molecular ions.

In my talk, I will present our new unique ion trap, which is coupled to a velocity map imaging (VMI) detector, and designed to have $\sim 2\text{m/s}$ resolution, which is sufficient to resolve individual rotational states. I will present the system design, simulations, and preliminary results demonstrating the promising coupling of the ion trap to the VMI.

[1] Erez, **Wallach**, Shagam, PRX 13, 041025 (2023)

[2] Landau, Eduardus, Behar, **Wallach**, Paštka, Faraji, Borschevsky, Shagam. JCP 159 (11), 114307 (2023)

ההרצאה תתקיים ביום רביעי, ה-11.9.24 בשעה 12:30

באודיטוריום המכון למצב מוצק, קומת כניסה

The lecture will take place on Wednesday, 11.9.24 at 12:30
at the Solid State Institute auditorium, entrance floor

M.Sc. Student of Assistant Professor Yuval Shagam