PRECISION MEASUREMENTS OF MOLECULAR IONS IN A RING TRAP - A NEW APPROACH FOR TESTING FUNDAMENTAL SYMMETRIES

YAN ZHOU, *Department of Physics and Astronomy, University of Nevada, Las Vegas, Las Vegas, NV, USA*; RODRIGO FERNANDEZ, BERNADO GUTIERREZ, *Physics and Astronomy, University of Nevada, Las Vegas, LAS VEGAS, NV, USA*; JIAQI LI, *Computer Science, University of Nevada, Las Vegas, Las Vegas, NV, USA*; JOSE DAVID MOSQUERA OJEDA, *Physics and Astronomy, University of Nevada, Las Vegas, LAS VEGAS, NV, USA*; GOVINDA BHANDARI, *Physics, University of Nevada , Las Vegas (UNLV), Las Vegas, NV, USA*; XUANYI WU, STEPHANIE LETOURNEAU, *Physics and Astronomy, University of Nevada, Las Vegas, LAS VEGAS, NV, USA*.

In this presentation, I will discuss a new experimental platform designed to facilitate quantum logic control of polar molecular ions in a segmented ring ion trap, paving the way for precision measurements. This approach focuses on achieving near-unity state preparation and detection, as well as long spin-precession coherence. A distinctive aspect lies in separating state preparation and detection conducted in a static frame, from parity-selective spin-precession in a rotating frame. Moreover, this method is designed to support both temporally and spatially localized multiplexing measurements, enhancing the ability to probe and minimize potential systematic errors. While the primary focus of this talk is on detecting the electron's Electric Dipole Moment (eEDM) using $^{232}ThF^{+}$ ions, the proposed methodology holds promise for broader applications, particularly with ion species like $^{229}ThF^{+}$ and $^{181}TaO^{+}$ that exhibit enhanced sensitivity to the nuclear Magnetic Quadruple Moment (nMQM).