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(G*) The Search for a Permanent Electric Dipole Moment

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The matter-antimatter asymmetry in the universe is one of the core physics questions that remains unsolved in the modern era. While there have been attempts to delve into the cause of this mystery, none have yet to provide a comprehensive solution. One possible explanation is linked to the combined violation of charge-conjugation (C) and parity (P) symmetry, an example of which would be the presence of a permanent electric dipole moment (EDM) of a fundamental particle or system. MIRACLS is an experiment in development at CERN and TRIUMF to identify molecules with unprecedented sensitivity in EDM searches.

Performing laser spectroscopy on atoms and even molecules is not revolutionary, but there are two components which set MIRACLS apart from previous searches. The first is its ambition to study radioactive molecules which have recently introduced as intriguing precision probes for new physics, including EDM searches. The second component is its cryogenic Paul trap and Multi-Reflection Time-of-Flight (MR-ToF) device used in the ion-trapping. Containing the radioactive ionic species exposes them to a much longer study-period, allowing the sensitivity and/or precision of the spectroscopy measurements to be much greater.

The result of this new probing mechanism is a superior sensitivity in a most intriguing research. The aforementioned techniques and concept of the experiment will be discussed in further detail. A brief outlook to a dedicated precision laboratory for radioactive molecules at TRIUMF will be given.

Author: SIMPSON, Rane Alexander (TRIUMF (CA))

Co-authors: MIRACLS COLLABORATION; RADIOACTIVE MOLECULES COLLABORATION

Presenter: SIMPSON, Rane Alexander (TRIUMF (CA))

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