Resonant Polarimetry and Magnetometry

**Electrodynamic**, DOE SBIR DE-SC0017120  SBIR Phase II, year 1.

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**DOE Phase II SBIR Topic: 25e**, Nuclear Physics Accelerator Technology, Polarized Beam Sources and Polarimeters.

**Collaborators:** Laboratory of Elementary-Particle Physics (LEPP) at Cornell University and the Thomas Jefferson National Laboratory’s (JLAB) Center for Injectors and Sources (CIS).

**Subcontractor:** Thomas Jefferson National Laboratory’s (JLAB) Center for Injectors and Sources (CIS).

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Why? The EIC needs them.
The Classic Magnet in Tube Drop Experiment

\[ F = mg = I_{ind}(B_r \ 2\pi r_{tube}), \]

\[ V_{ind} = v(B_r \ 2\pi r_{tube}) \]
\[ F = m g = I_{\text{ind}}(B_r 2\pi r_{\text{tube}}), \]

\[ V_{\text{ind}} = \nu(B_r 2\pi r_{\text{tube}}) \]
A Starting Point:

- To measure spin, energy must be exclusively extracted from the spin’s component of the passing beam’s magnetic field.

- Longitudinally polarized bunches have a magnetic field orientation that is orthogonal to the beam’s current’s magnetic field and is similar to a dipole magnet traveling North/South or S/N down a beam tube.

- Magnetized beams have the same field magnetic orientation as longitudinally spin polarized beams.
Determination of the beams Polarization and/or Magnetization by measurement of the phase and amplitude of the TE011 resonance induced.
New Polarimetry/Magnetometry Vector Processor!
Resonant Magnetometry on the GTS at Jlab
Measurement of an Unmagnetized Beam
Measurement of a Magnetized Beam
Preliminary Observations:

A non-magnetized beam centered in the bore of a TE011 mode resonant cavity produces no signal.

A magnetized and centered beam produces a signal many orders of magnitude above the noise floor.

An off-axis unmagnetized beam creates a strong signal with a constant phase.

An off-axis magnetized beam creates a strong signal and shifts the detected phase.

It is believed that the phase shift is due to the nature of the cavities induction and can be used to distinguish electric from magnetic excitation of an off axis beam.
Thank you for supporting the SBIR Program

- A 15 GHz polarimetry system is awaiting testing on the UITF, followed by a 3 GHz system
- Magnetometry will resume when GTS is operational
- Got ions? We would like to try ion polarimetry but need a partner.

web.mit.edu/8.02t/www/802TEAL3D/visualizations/faraday/FallingMagnetResistive/FallingMagnetResistive.htm [ pp 7-11