

Resonant Polarimetry and Magnetometry

Electrodynamic, DOE SBIR DE-SC0017120 SBIR Phase II, year 3.

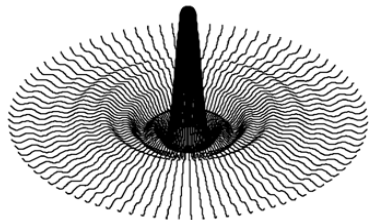
PI: Brock F. Roberts, PhD

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).

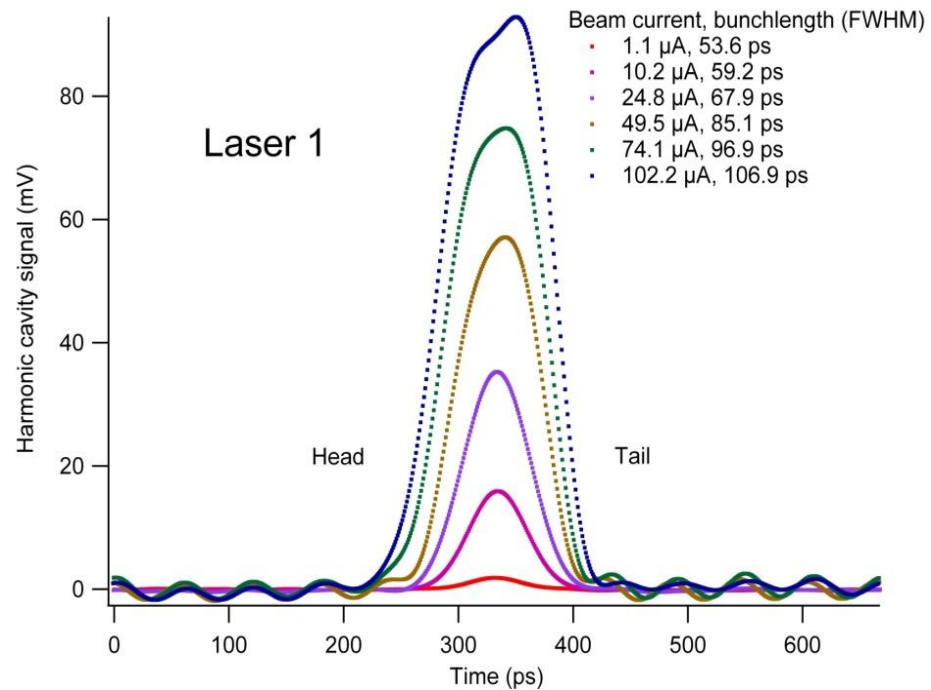
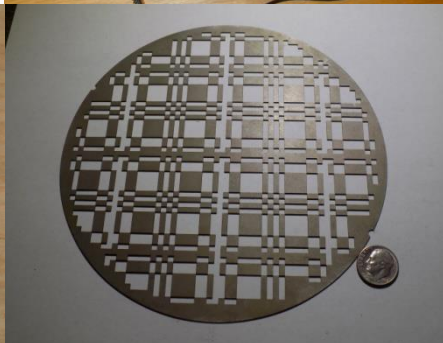
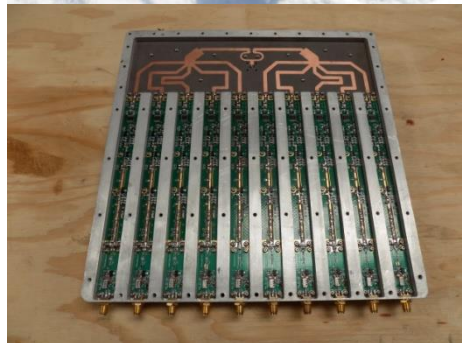
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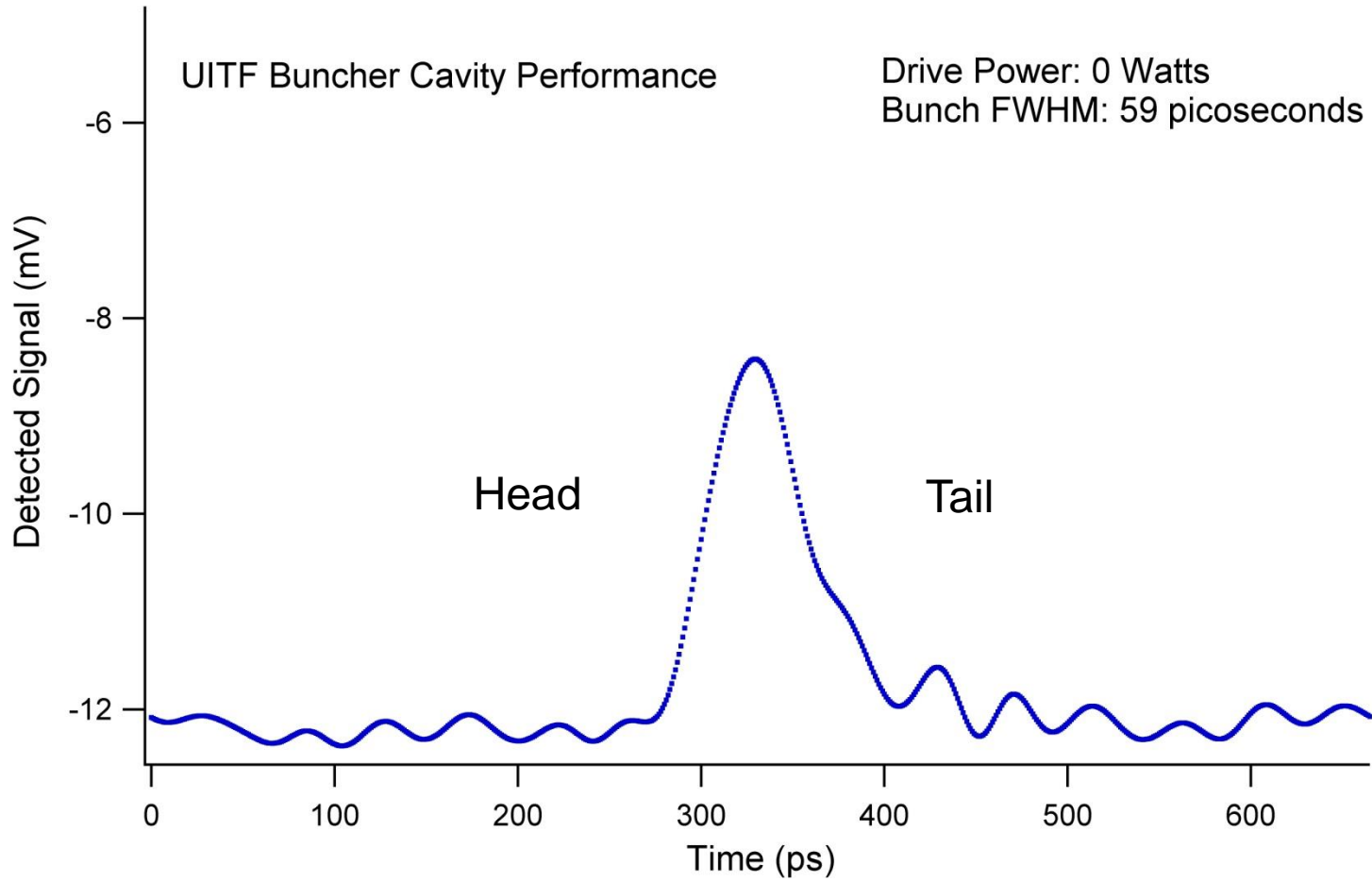
Electrodynamic : 4909 Paseo Del Norte suite D,
Albuquerque, NM 87113 (505)-225-9279
Brock.electro@outlook.com

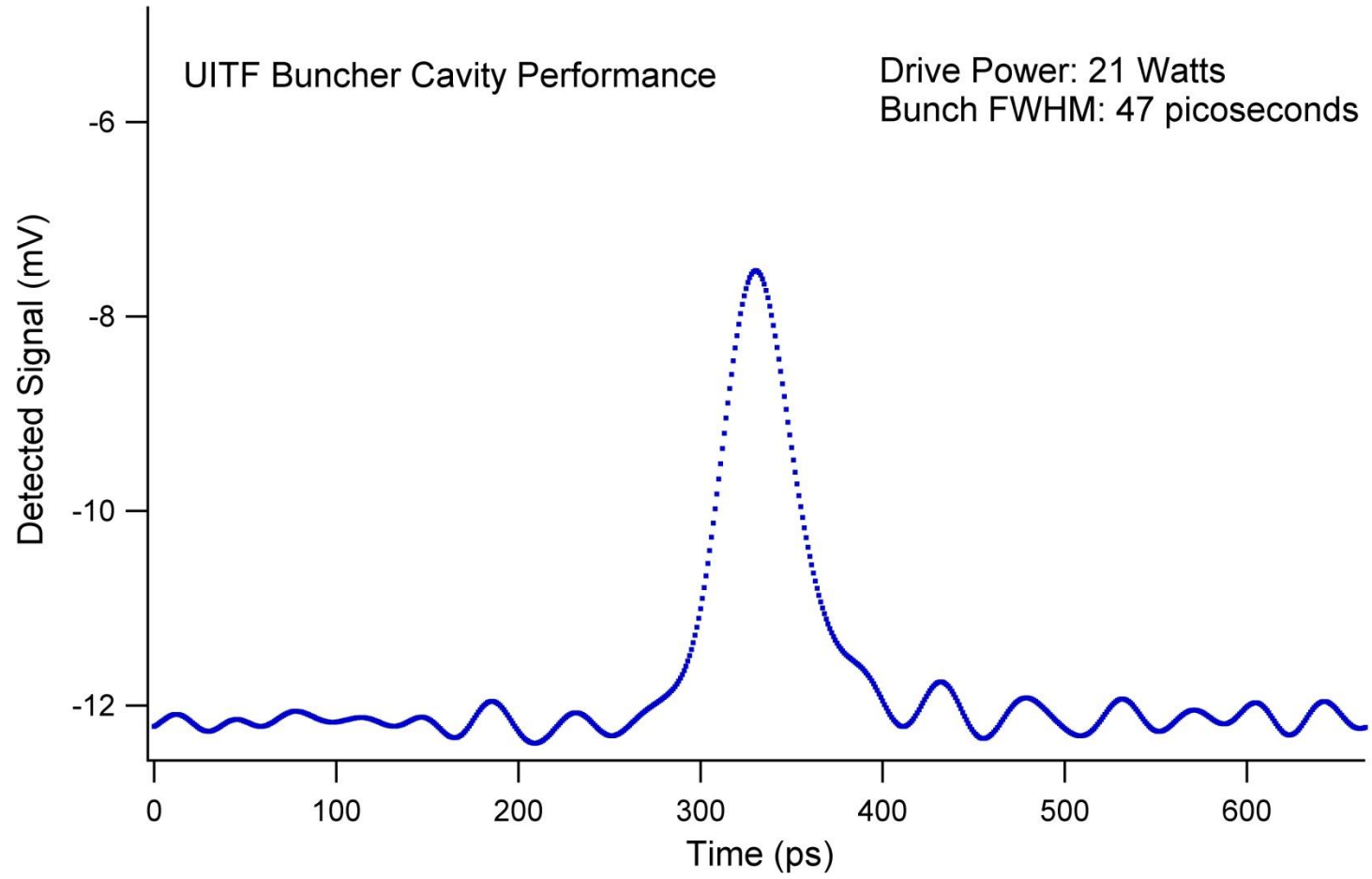


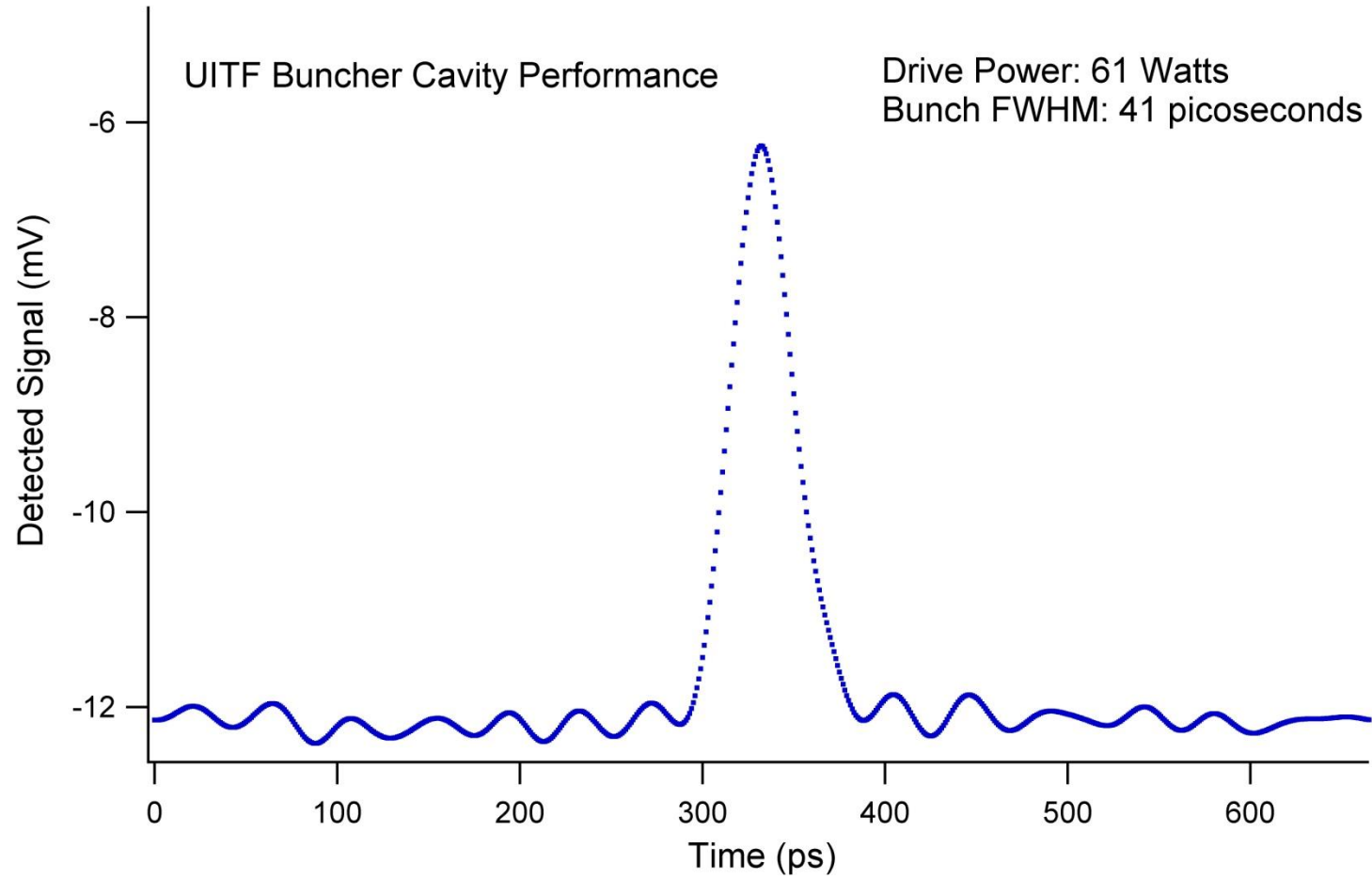
Electrodynamics

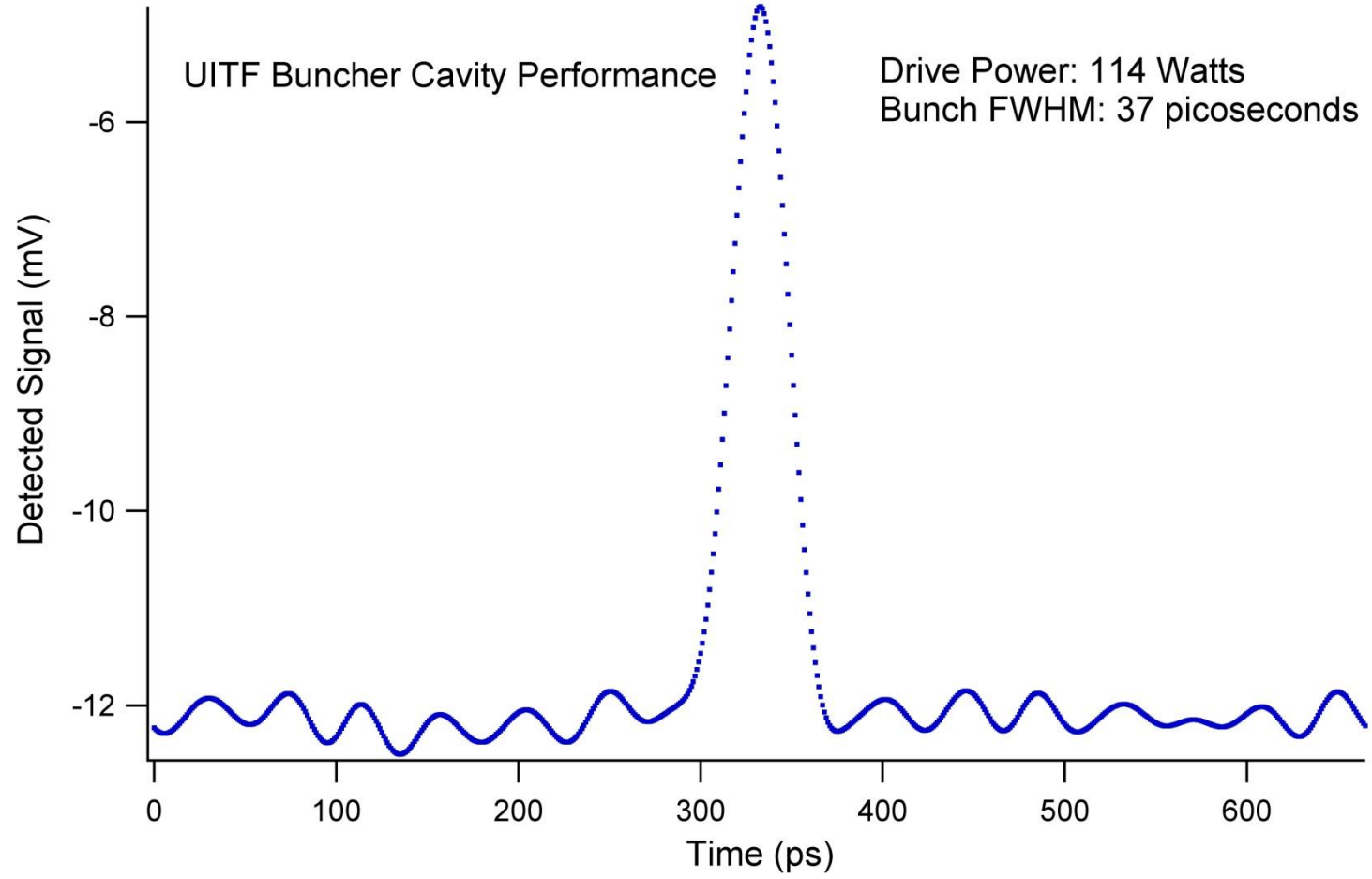
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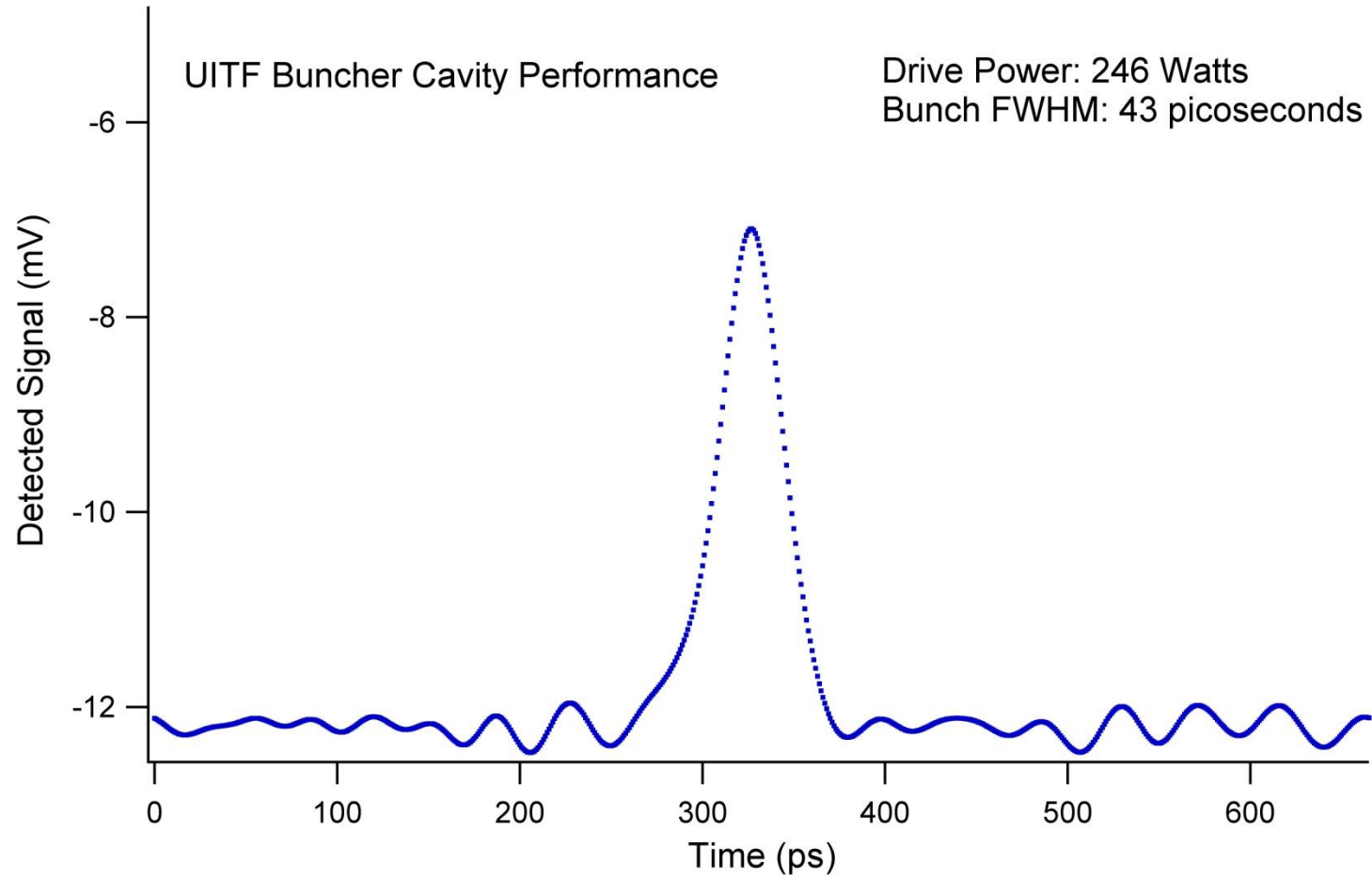


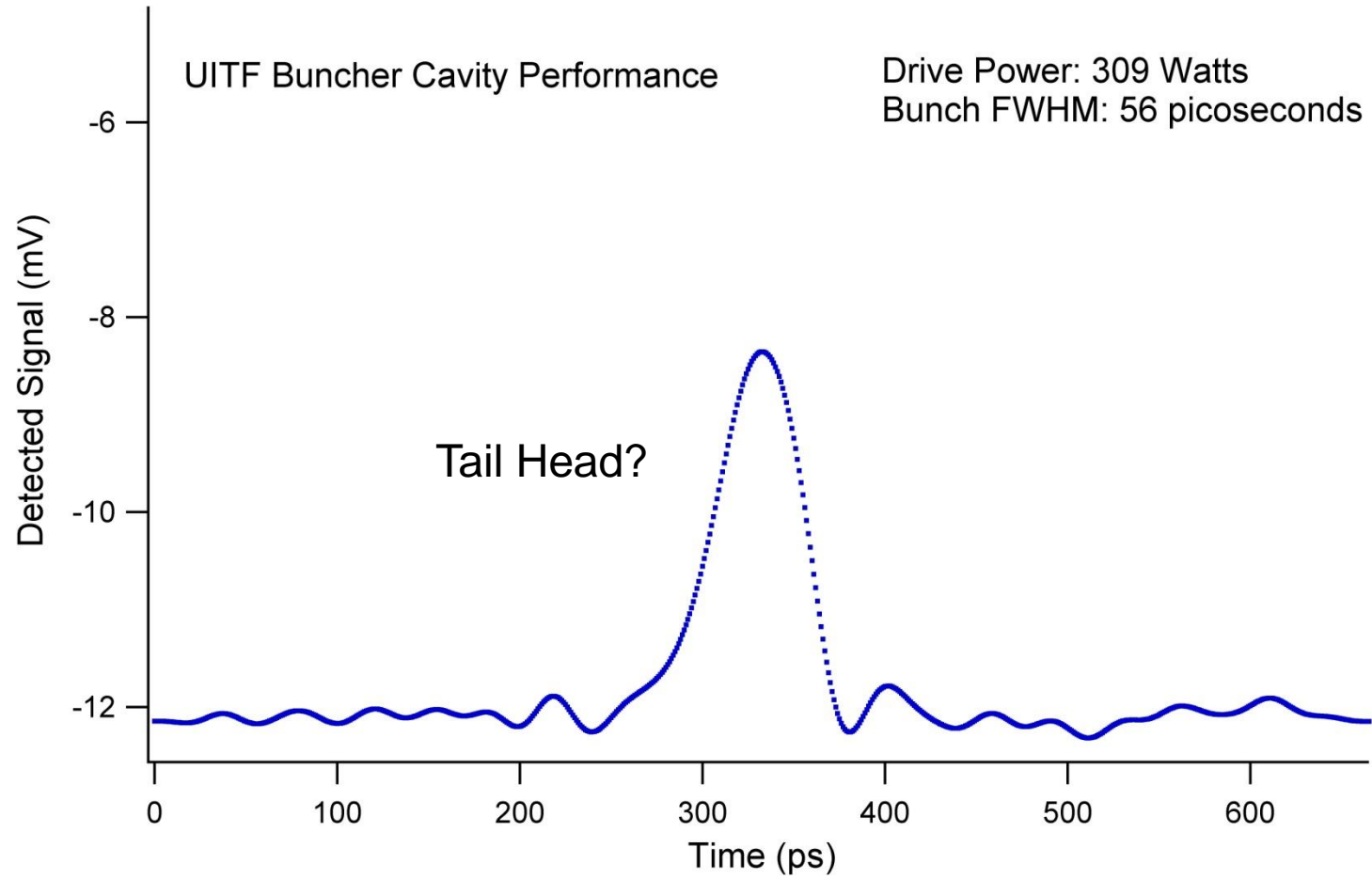










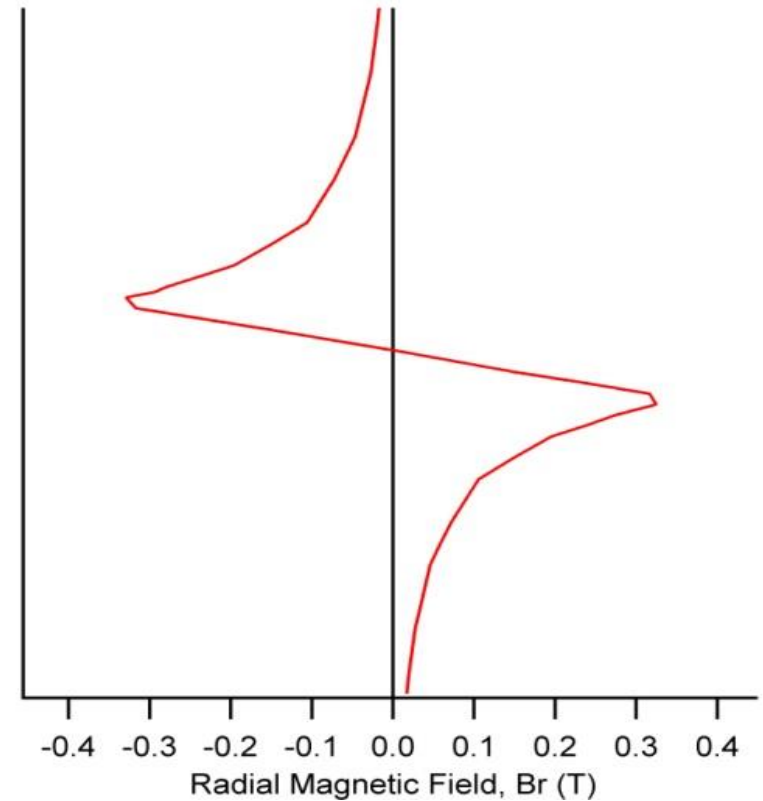
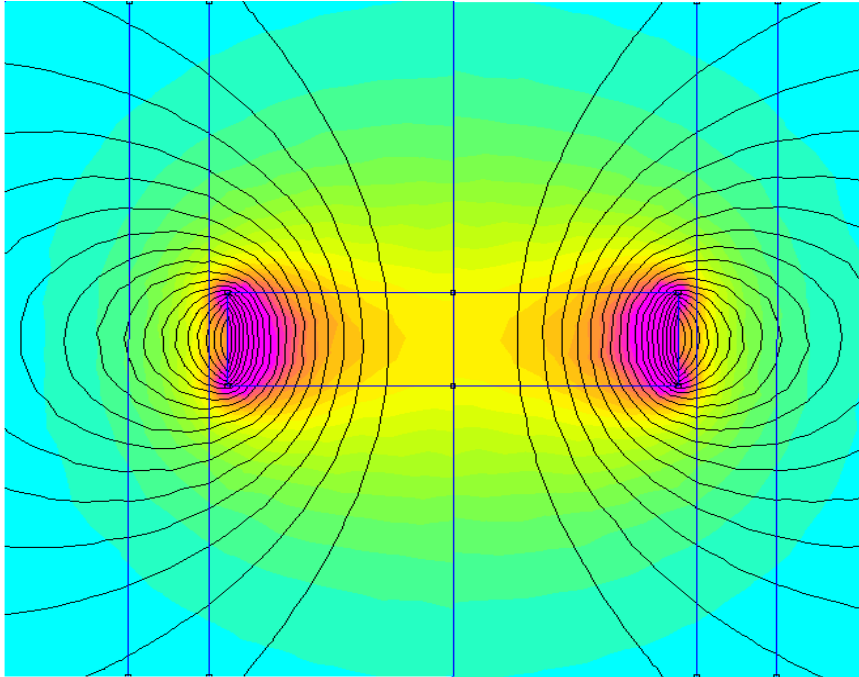




Resonant Polarimetry and Magnetometry

- To non-invasively measure bunch magnetization or spin magnetization, energy must be exclusively extracted from its component of the of the passing beam's magnetic field.
- Longitudinally spin polarized and longitudinally magnetized bunches have a magnetic field orientation that is orthogonal to the beams 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 magnetic field orientation as longitudinally spin polarized beams.

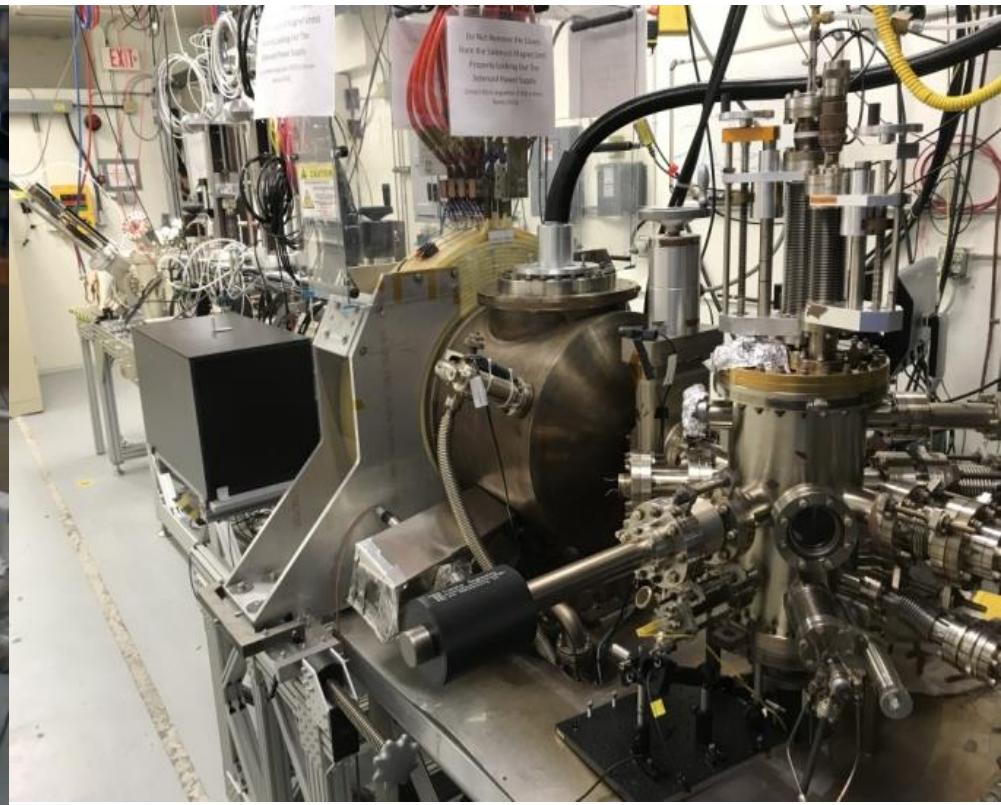
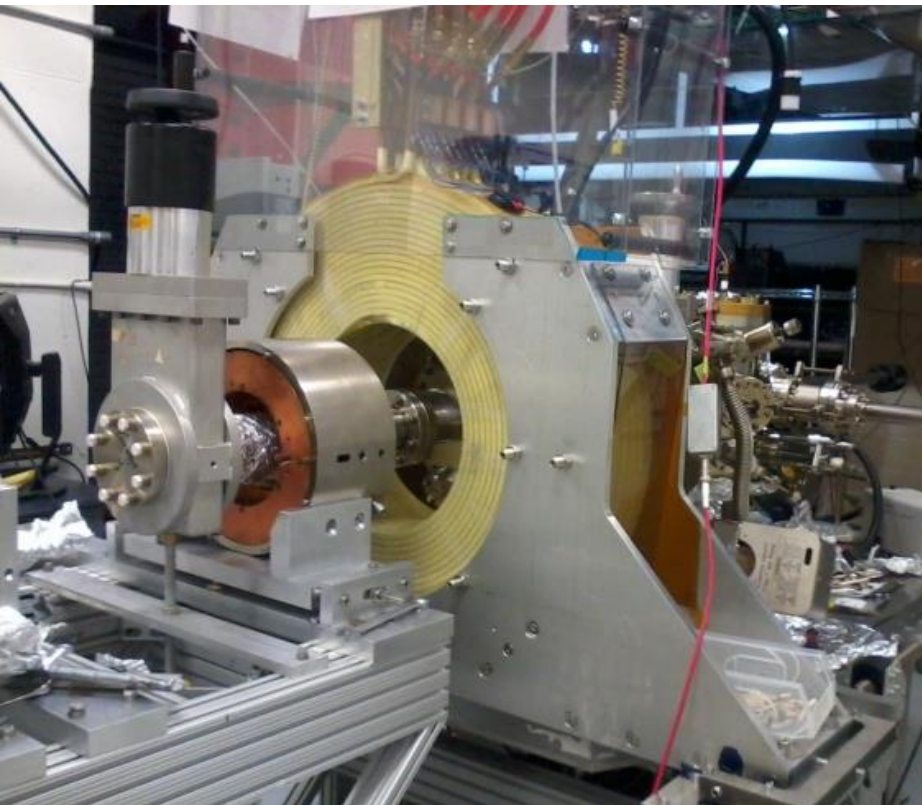
The Classic Magnet in Tube Drop Experiment



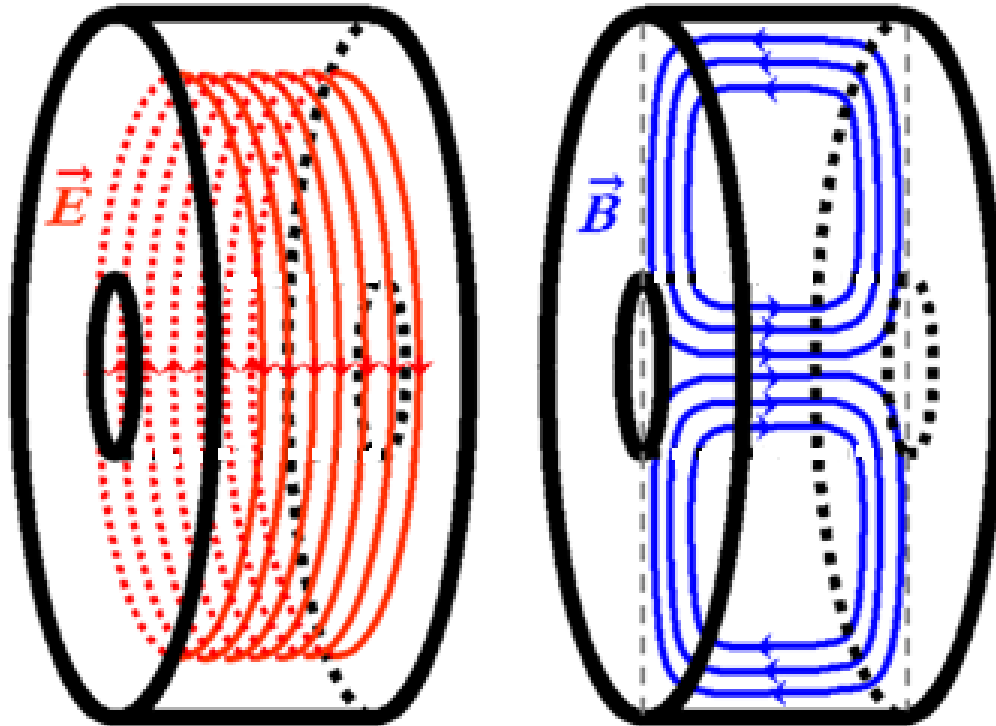
$$F = mg = I_{ind}(B_r 2\pi r_{tube}),$$

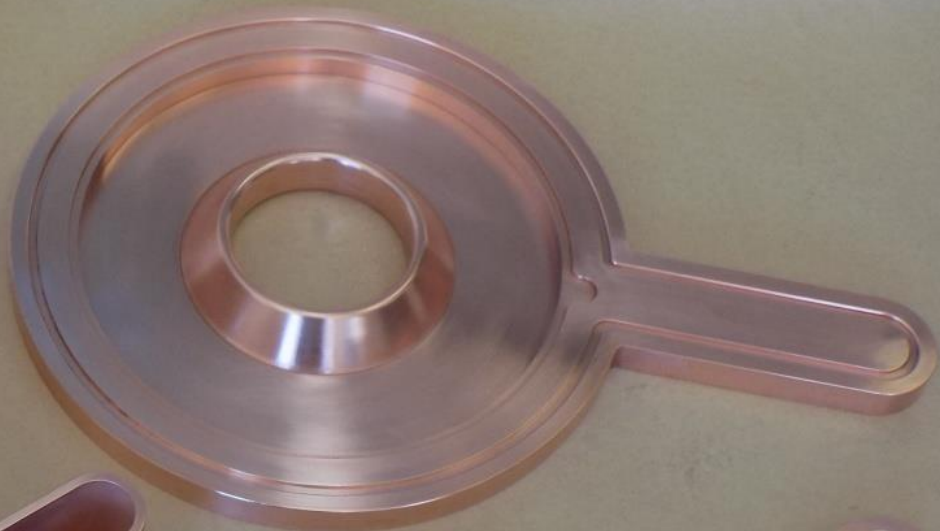
$$V_{ind} = v(B_r 2\pi r_{tube})$$

Resonant Magnetometry on the GTS at Jlab

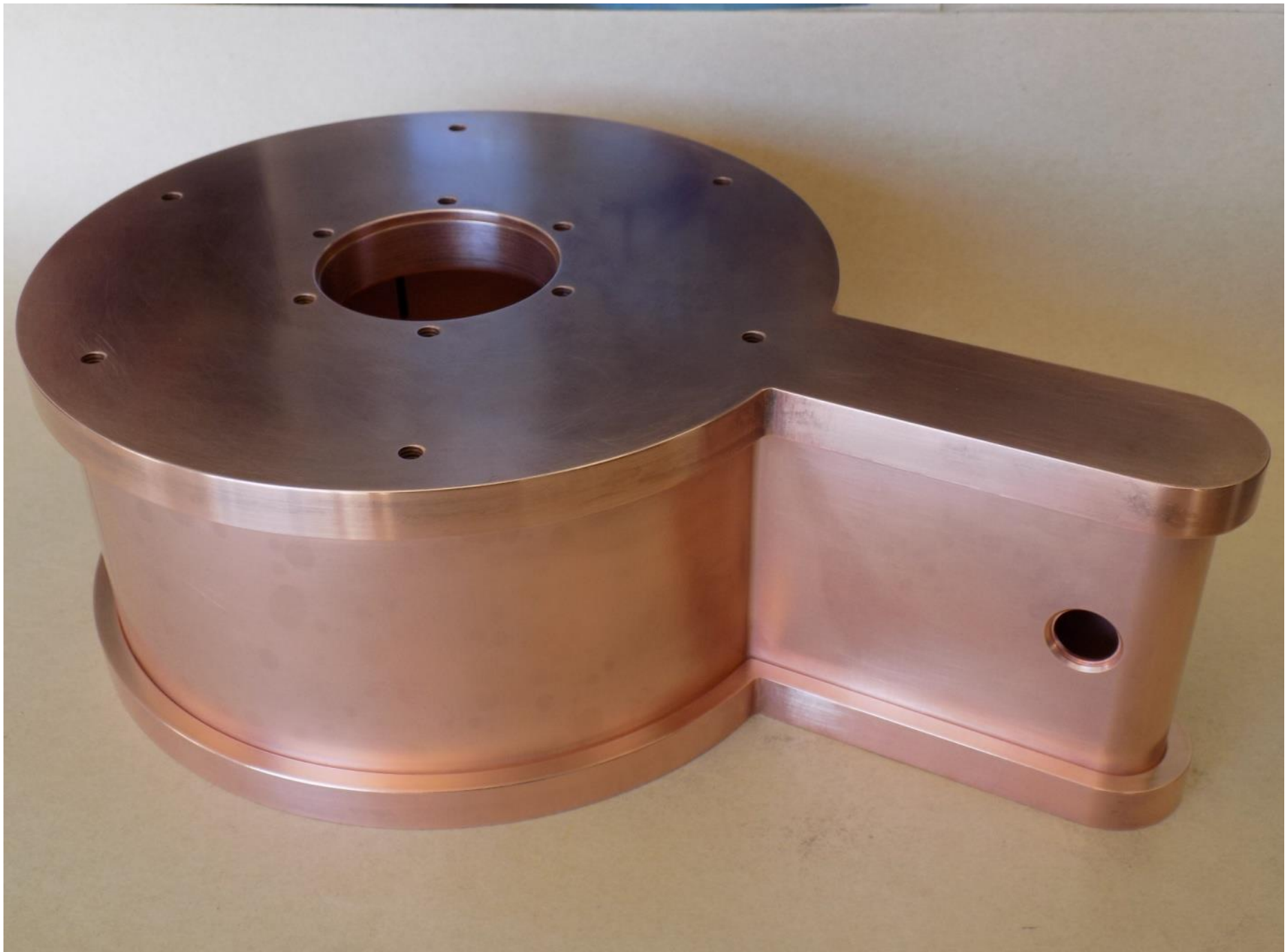


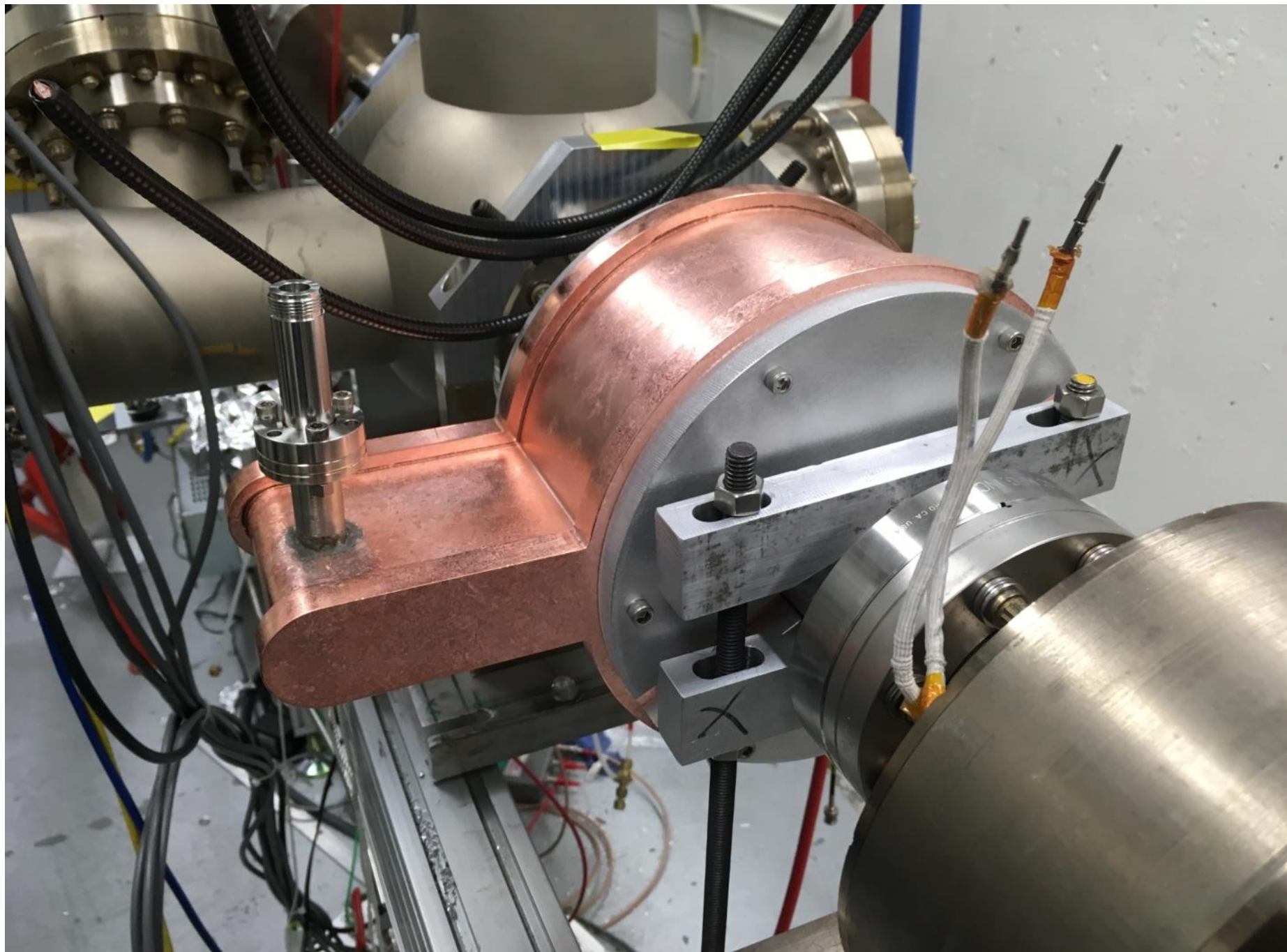
TE₀₁₁ Resonant Mode

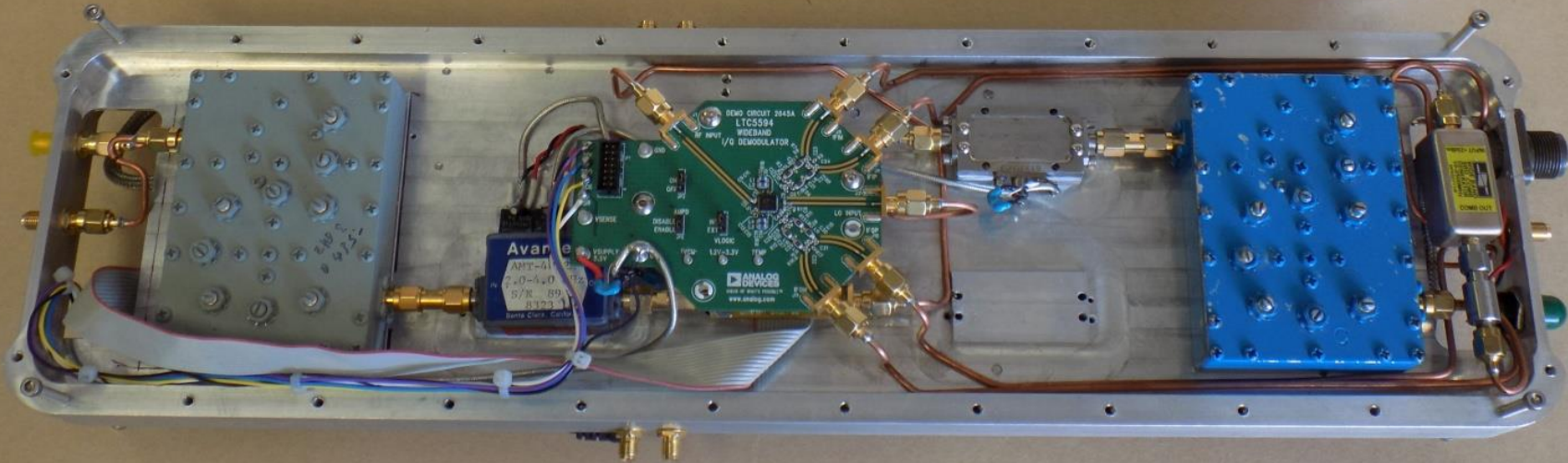
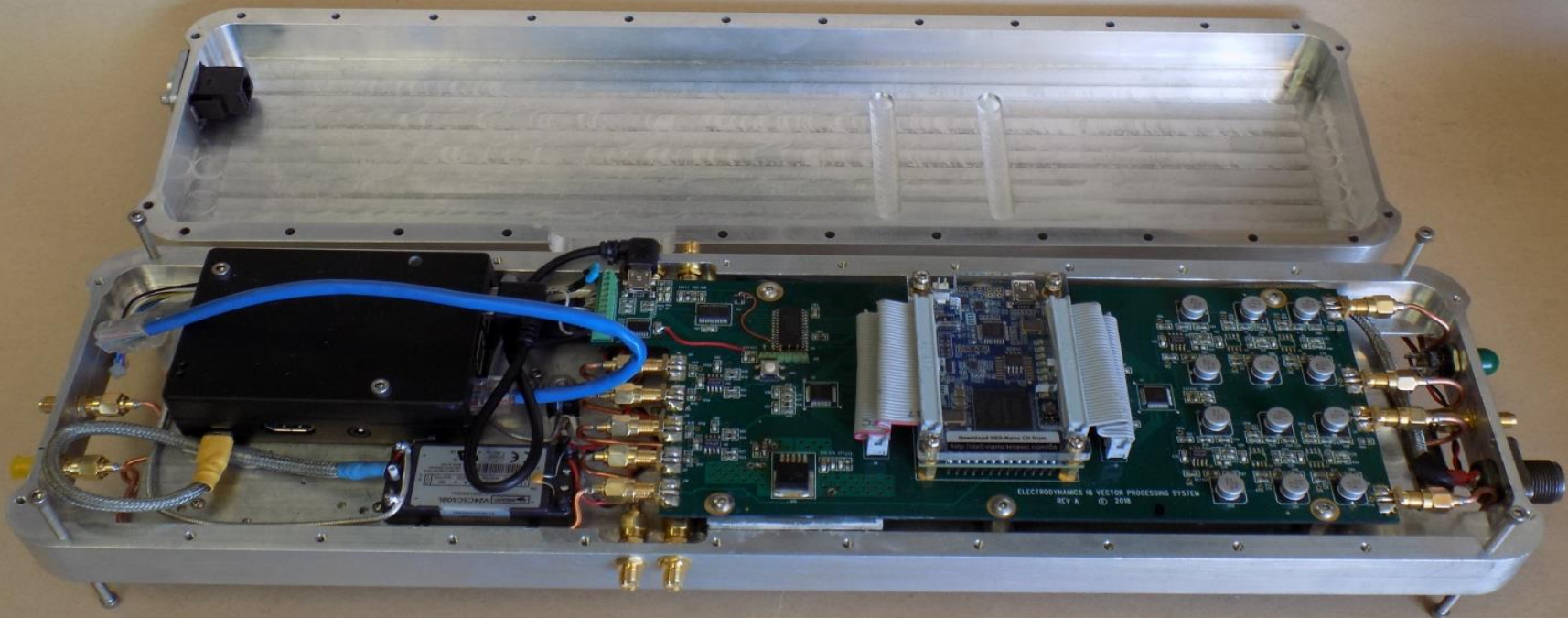




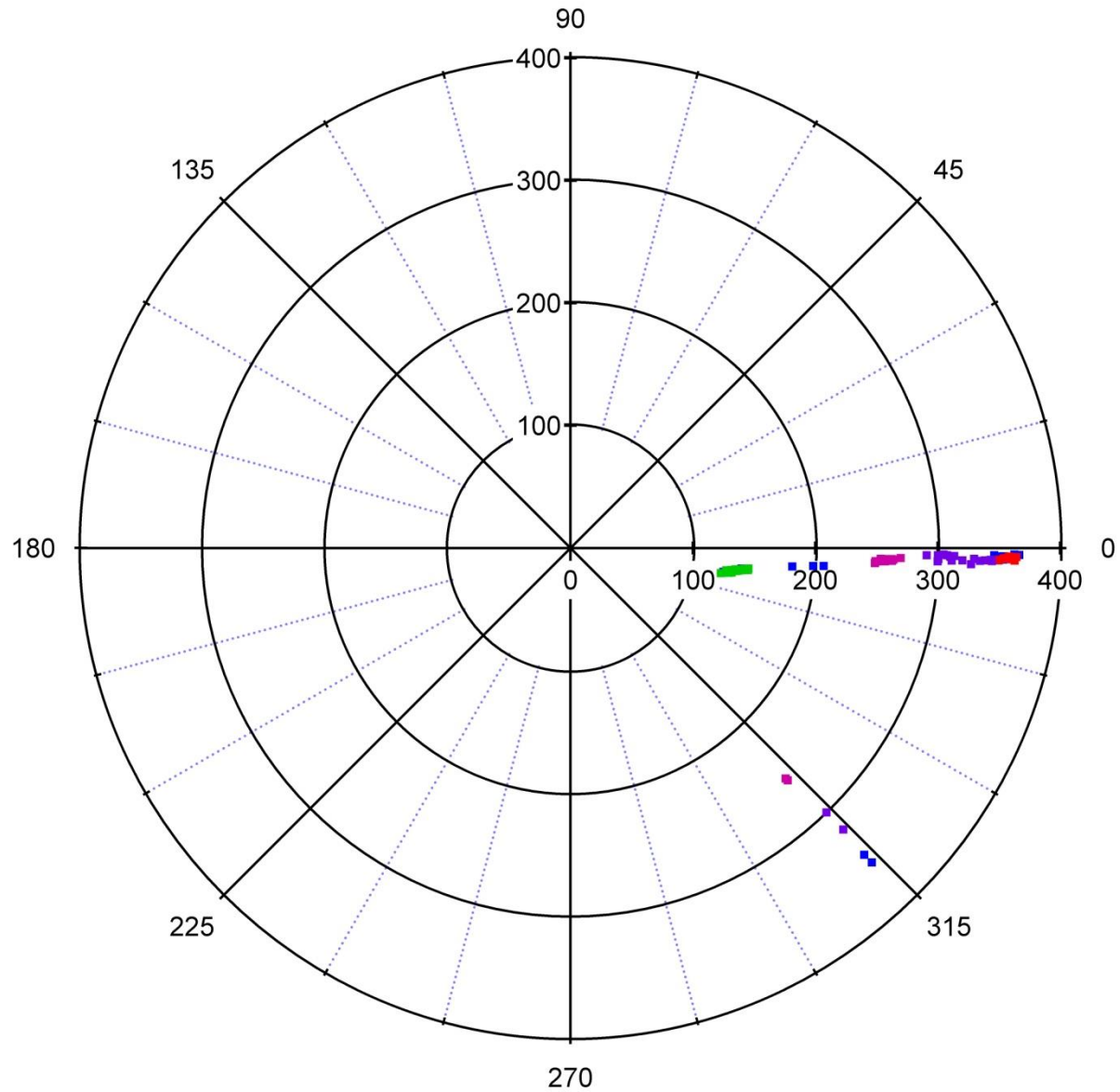




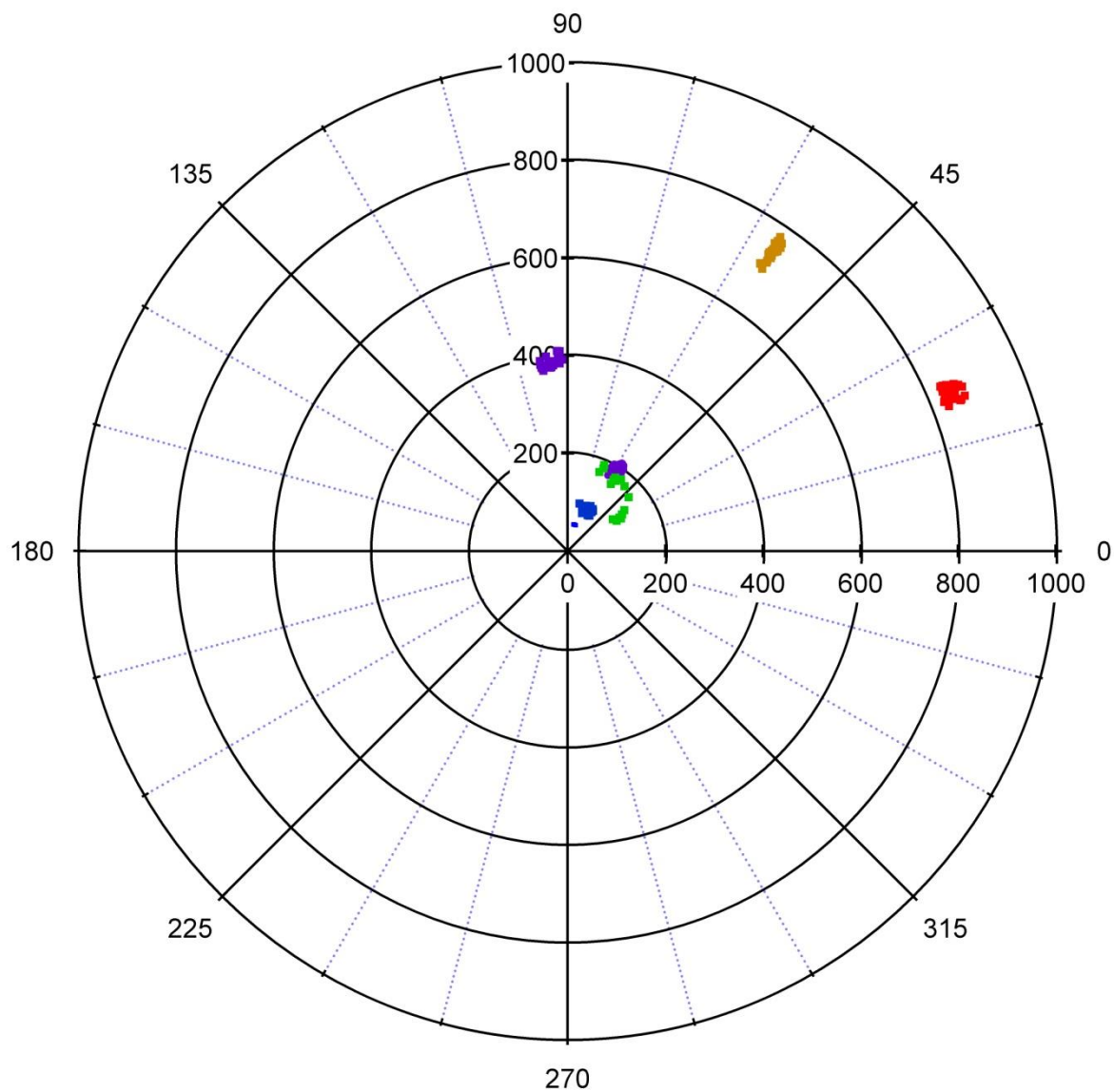




Measurement of an Unmagnetized Beam



Measurement of a Magnetized Beam



Magnetometry Observations:

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

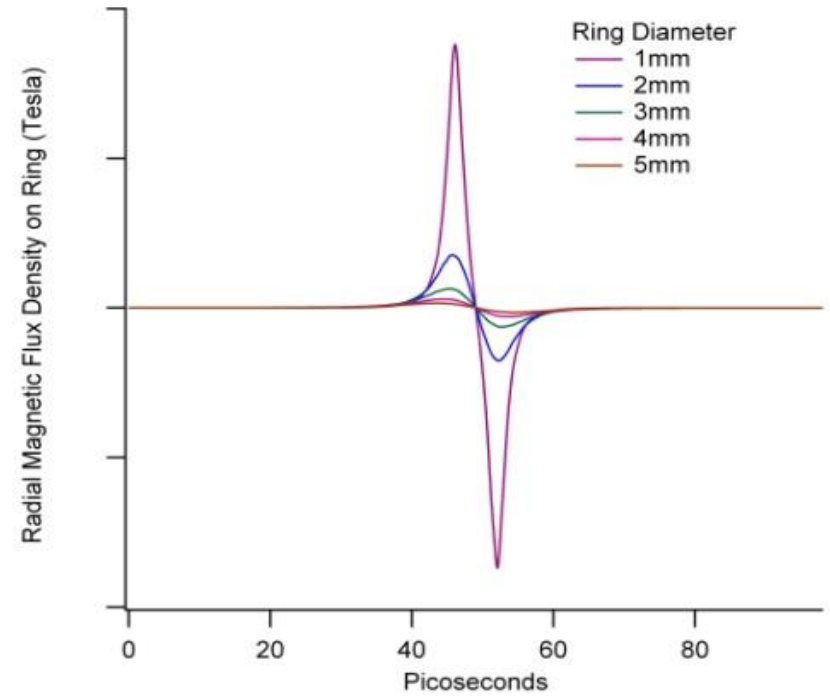
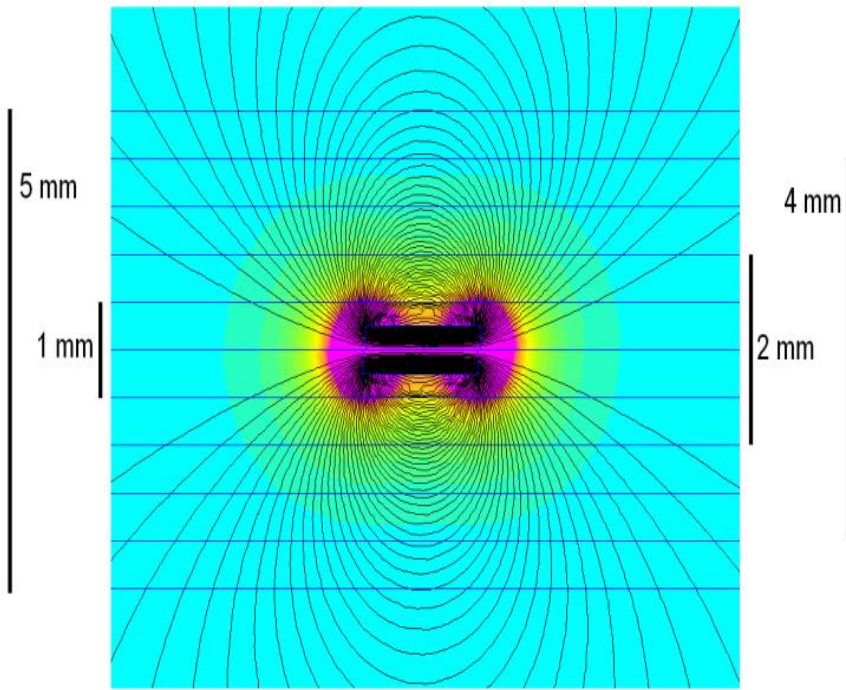
A magnetized and centered beam produces a signal many orders of magnitude above the noise floor.

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

An off-axis magnetized beam creates a strong signal with phase shift that changes with beam position.

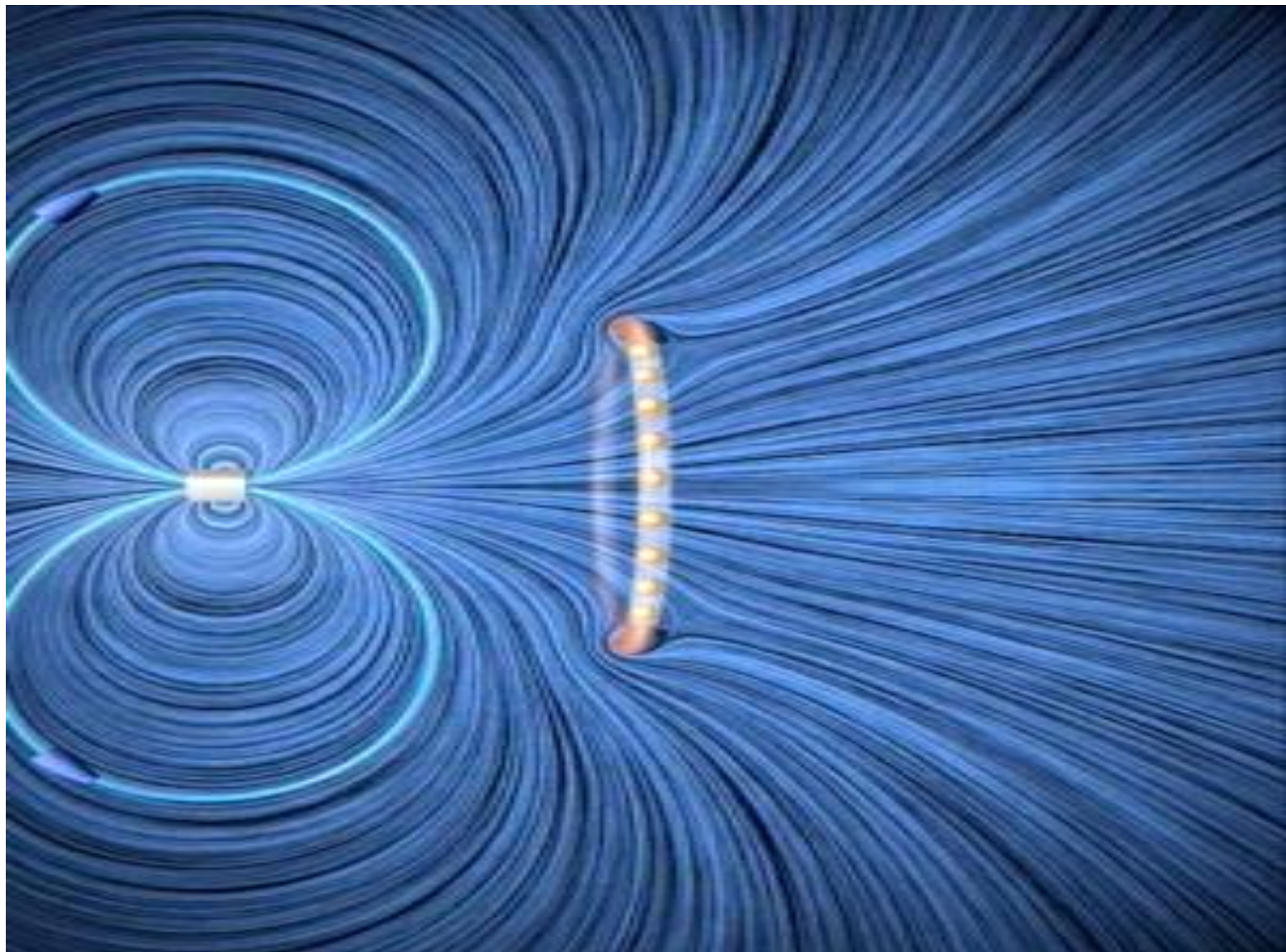
It is believed that the phase shift is due to the nature of the cavity's excitation, synchronous vs. asynchronous, and can be used to distinguish electric from magnetic excitation.

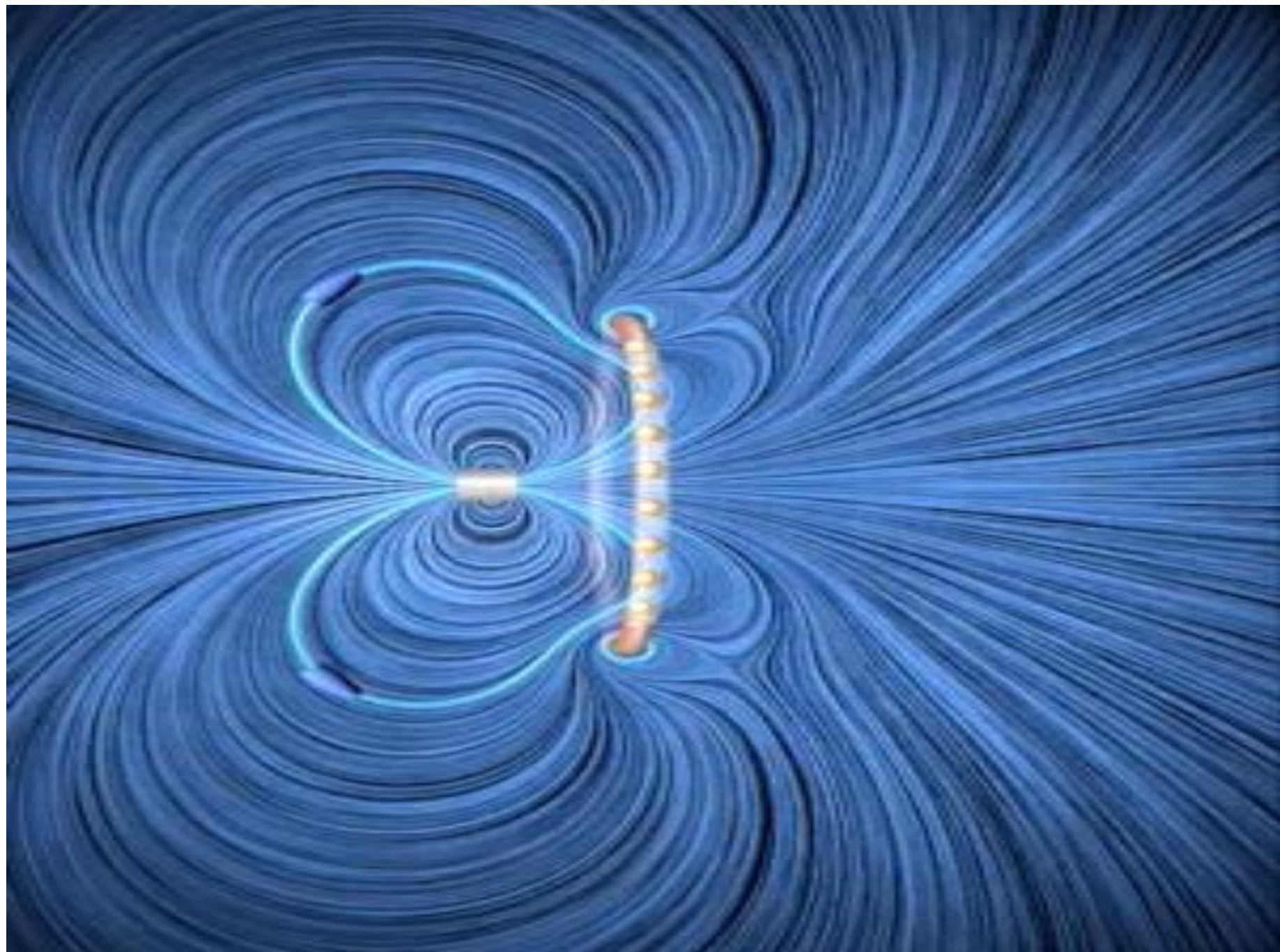


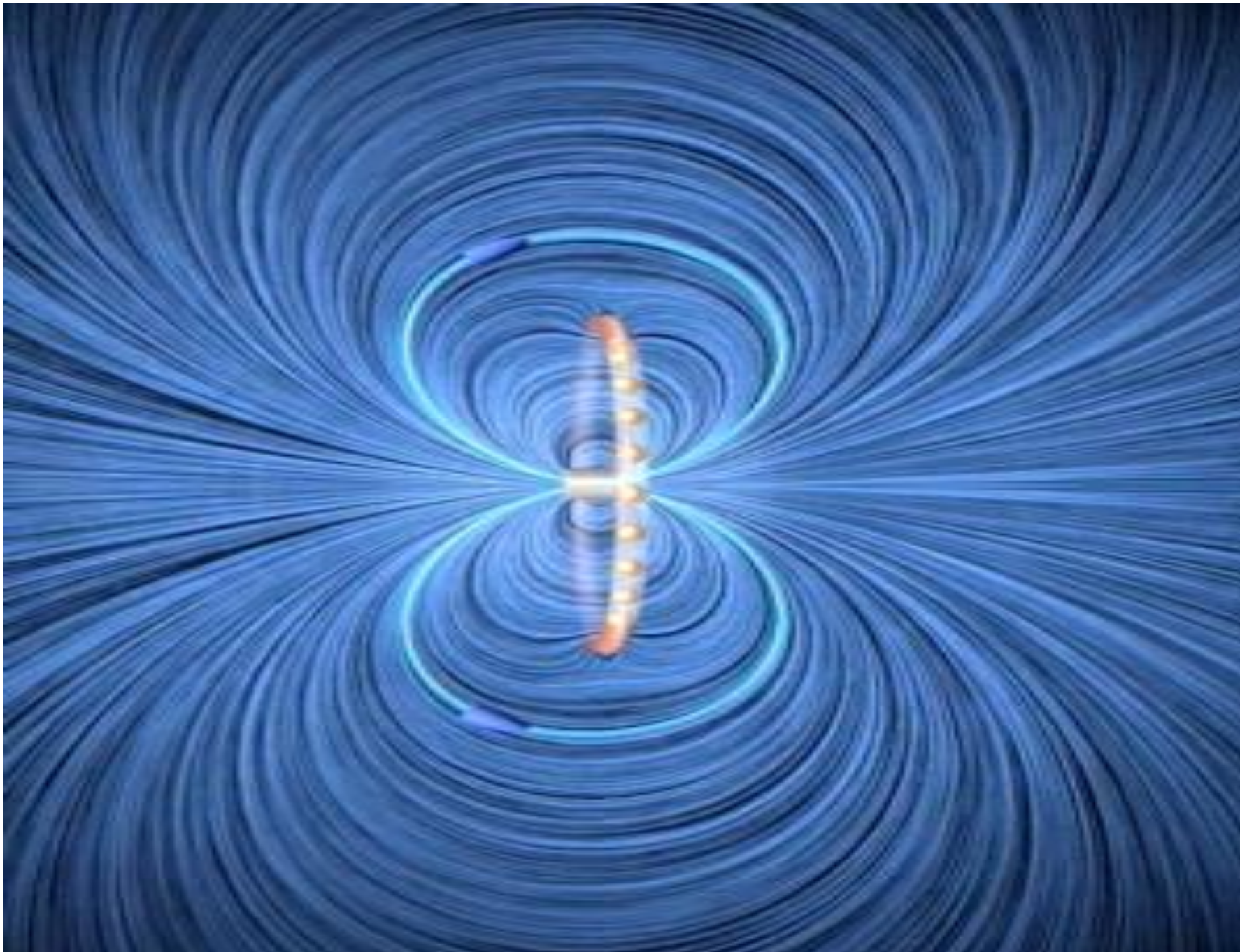


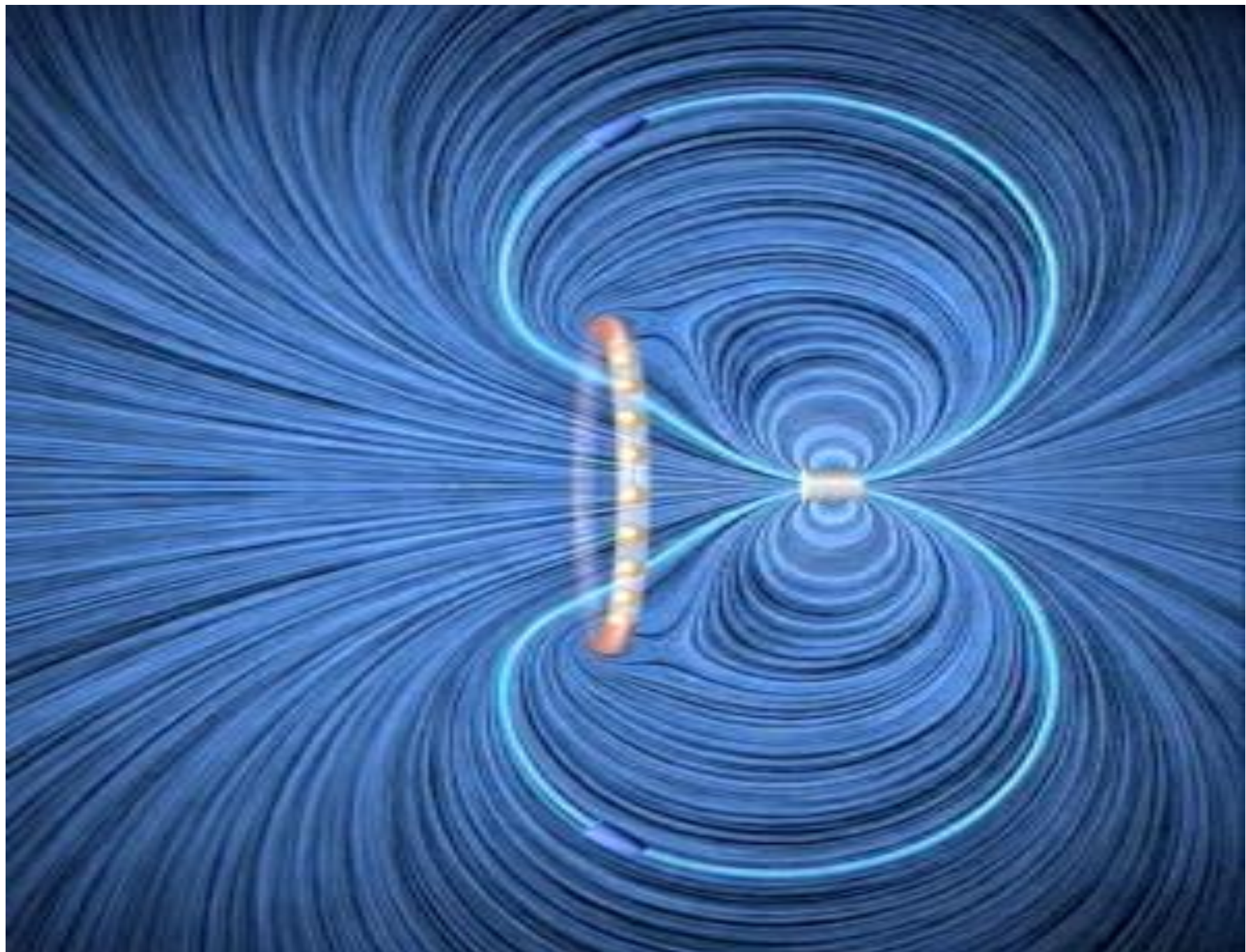
$$F = I_{ind}(B_r 2\pi r_{tube}),$$

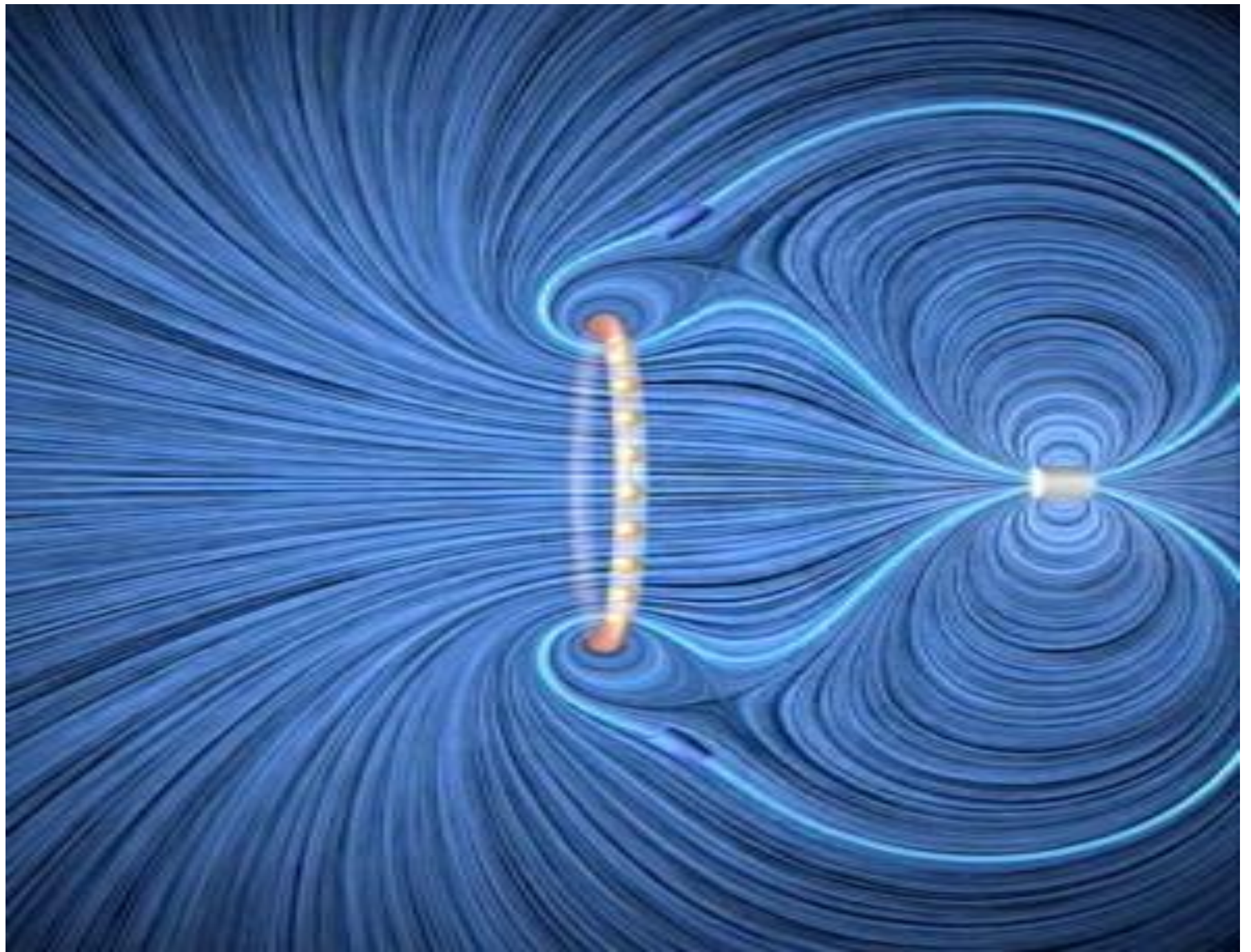
$$V_{ind} = v(B_r 2\pi r_{tube})$$

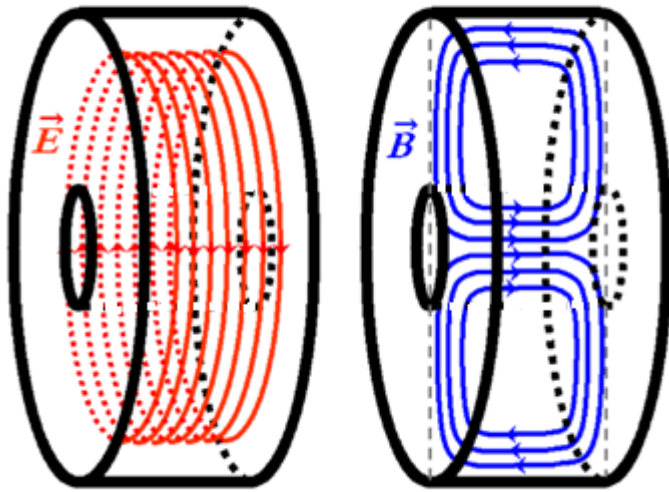




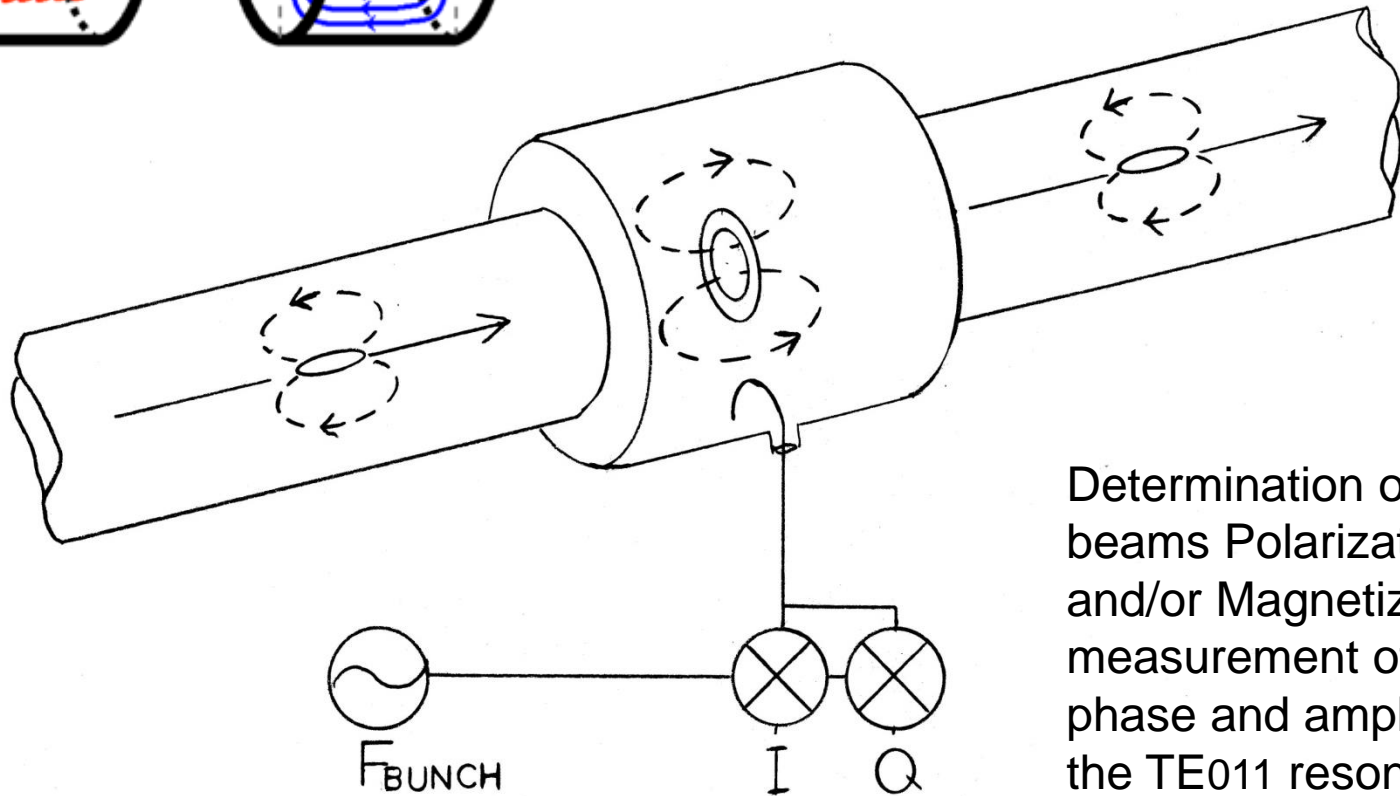




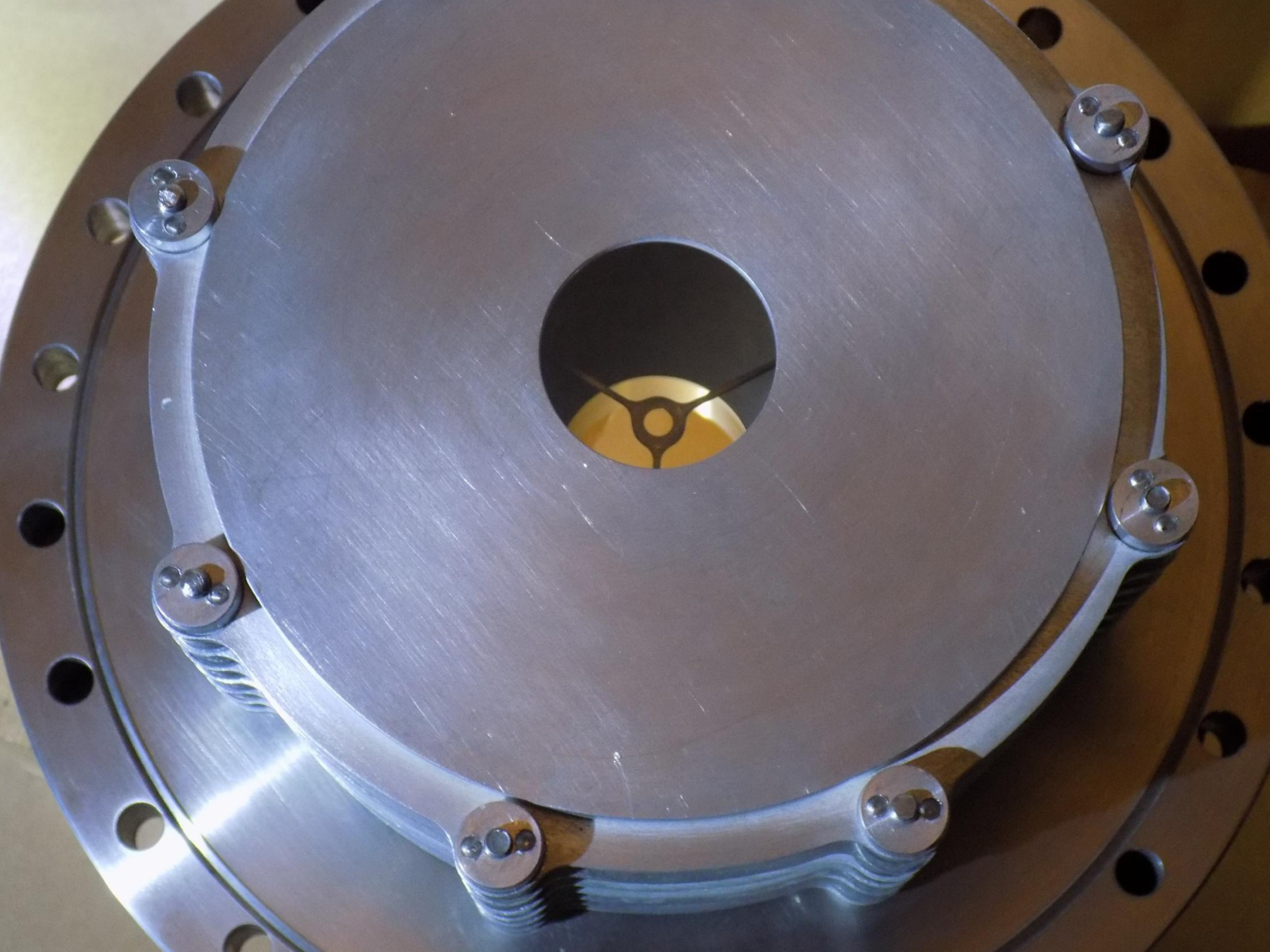


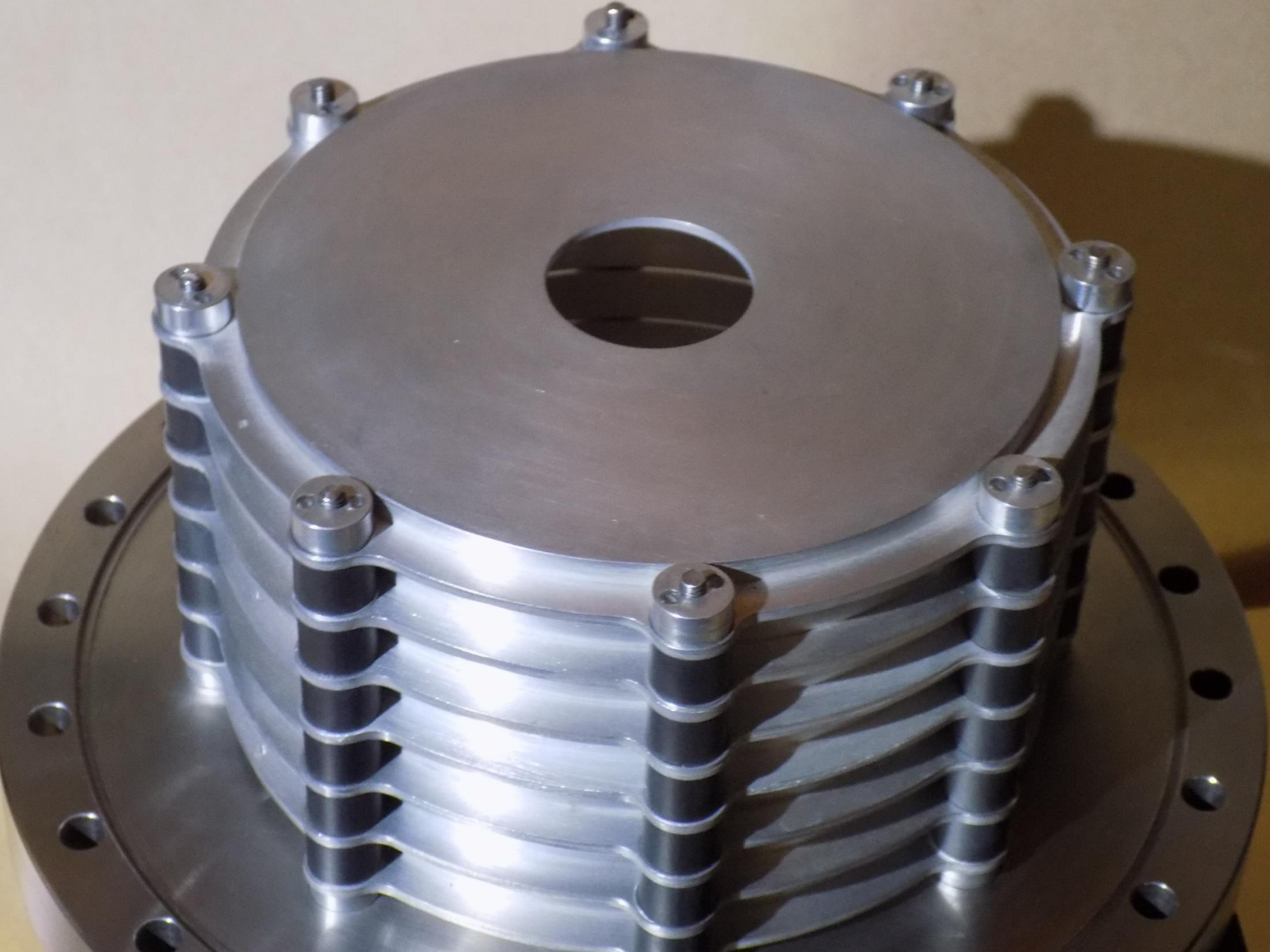


TE₀₁₁ Cavity Resonance

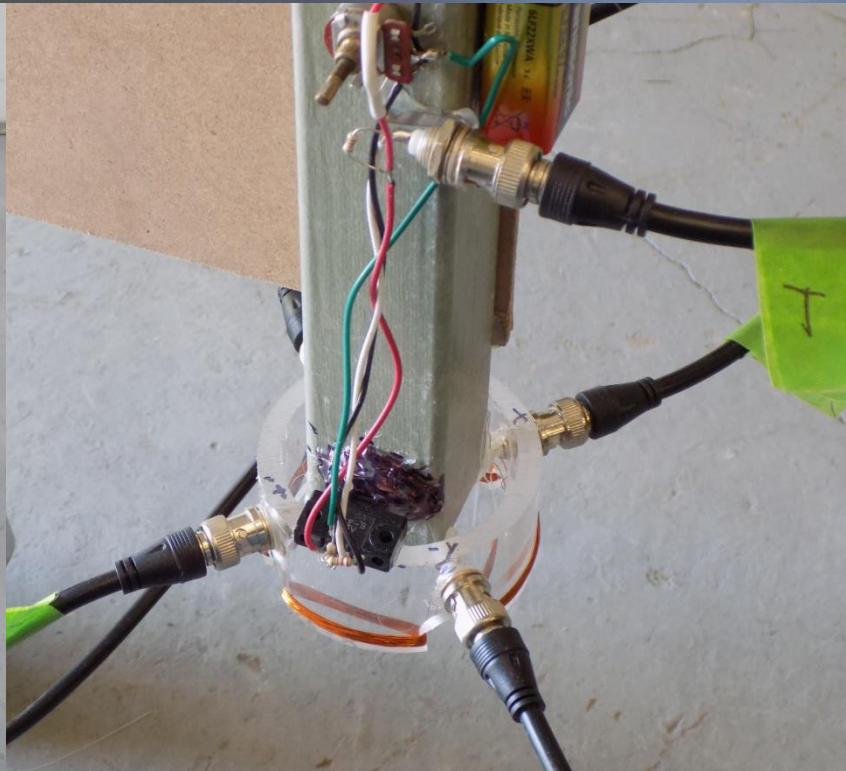
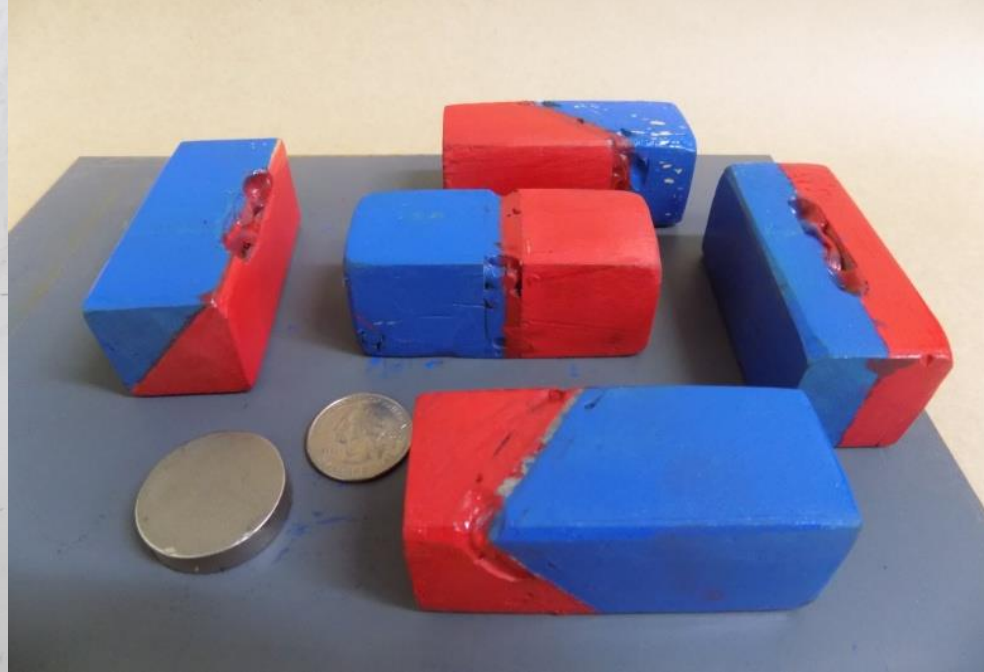
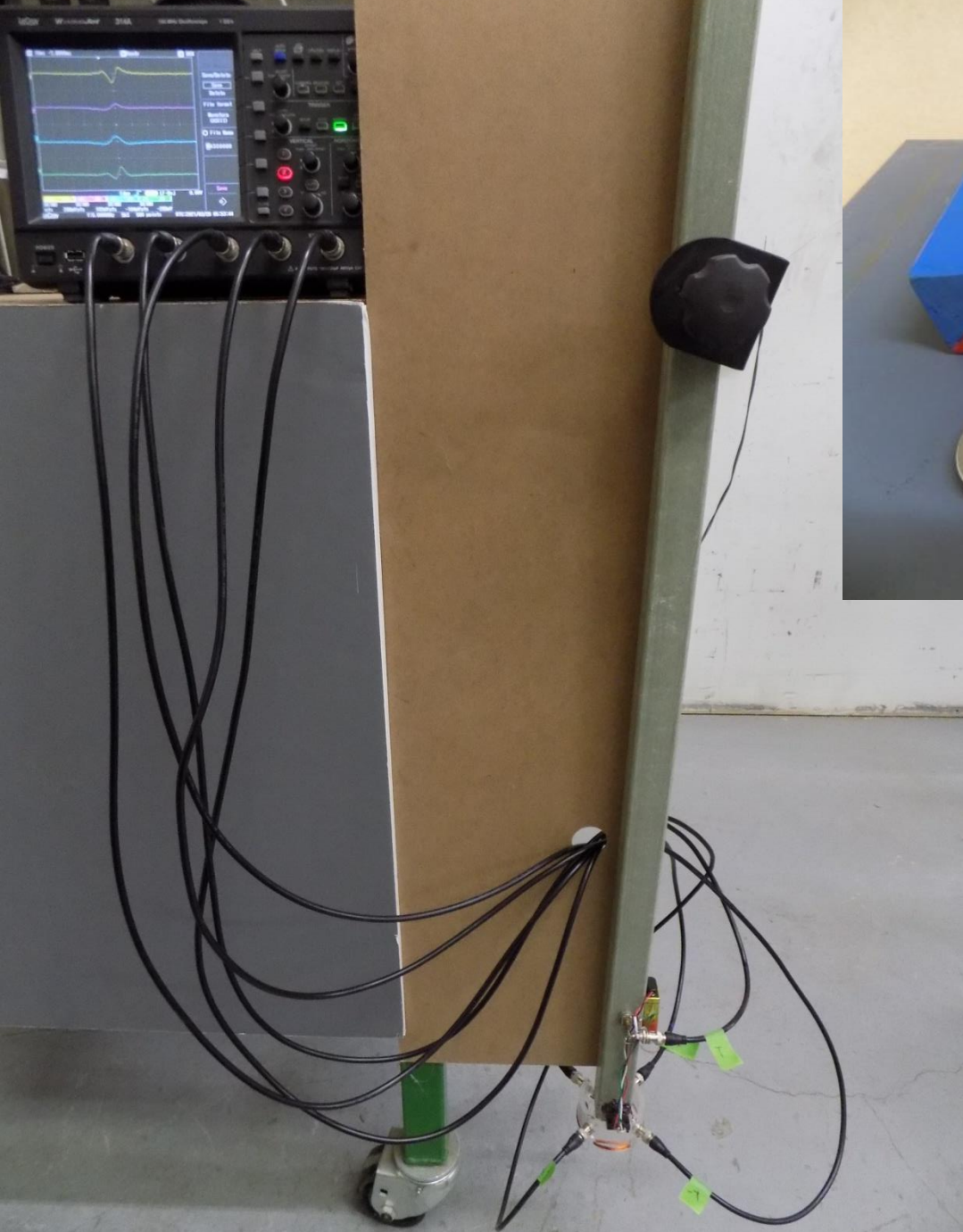


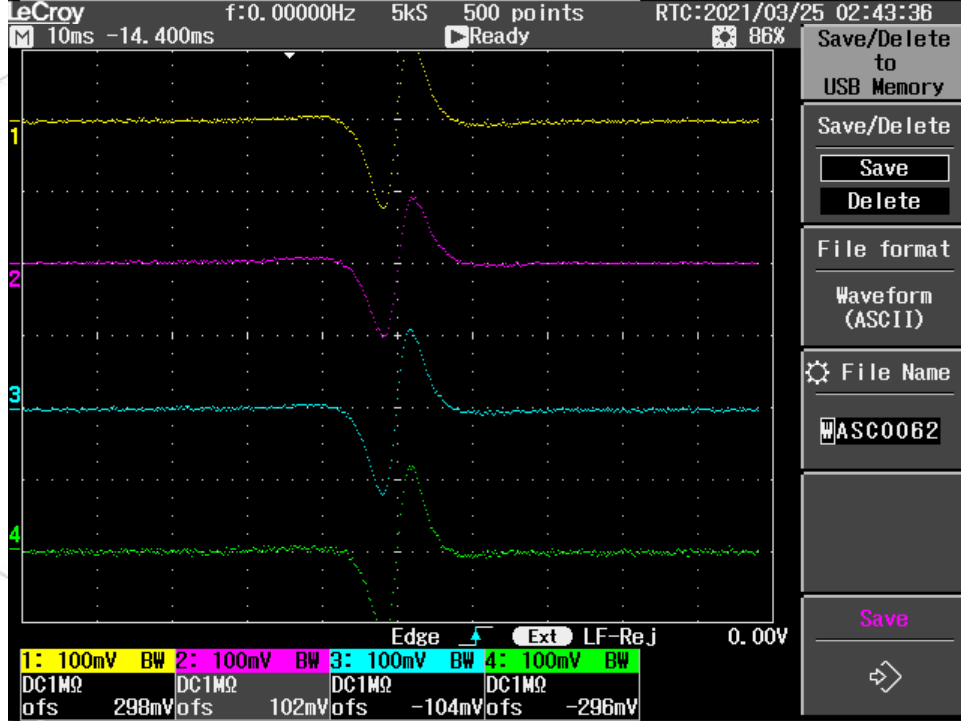
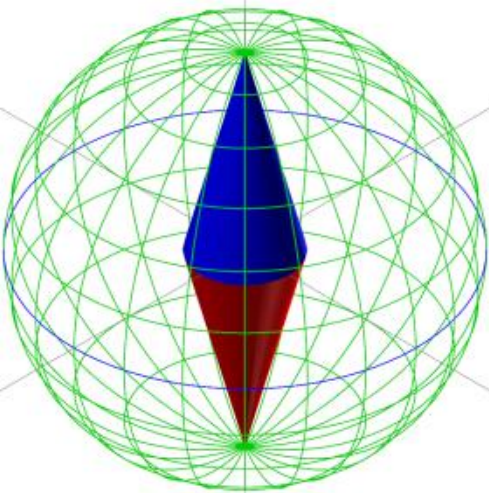
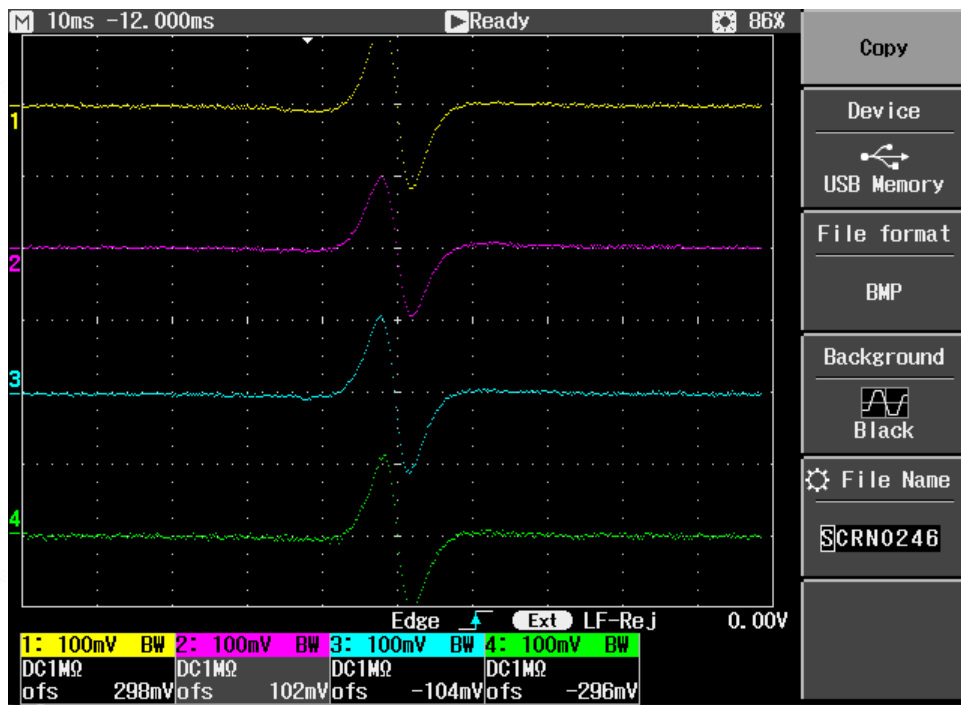
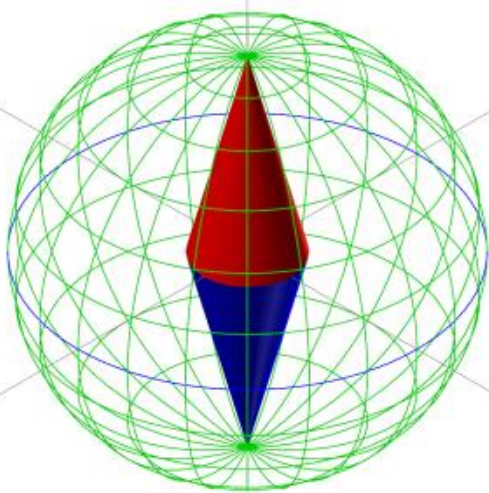
Determination of the beams Polarization and/or Magnetization by measurement of the phase and amplitude of the TE₀₁₁ resonance induced.











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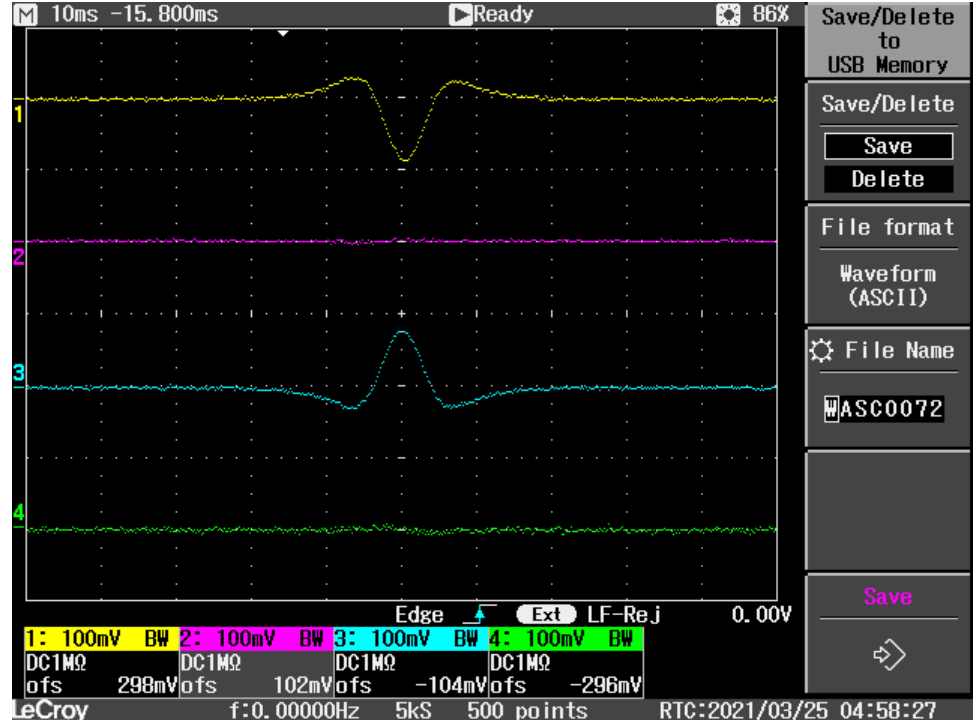
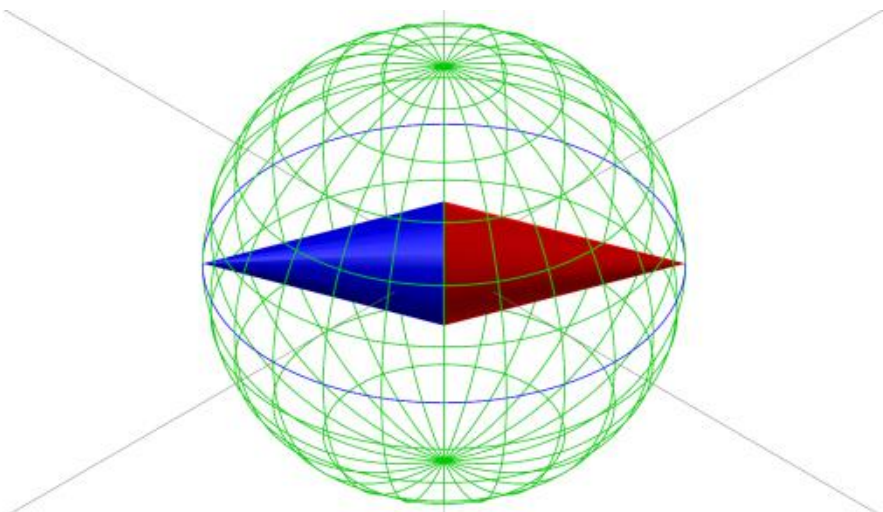
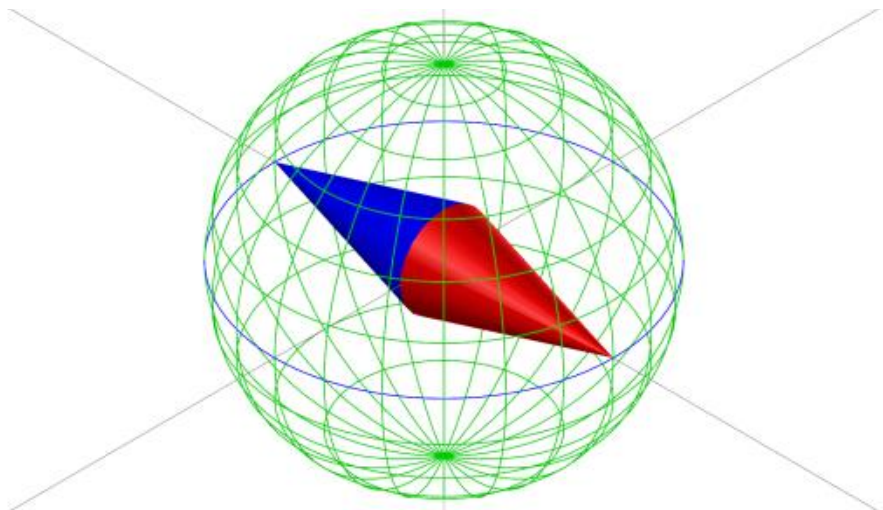
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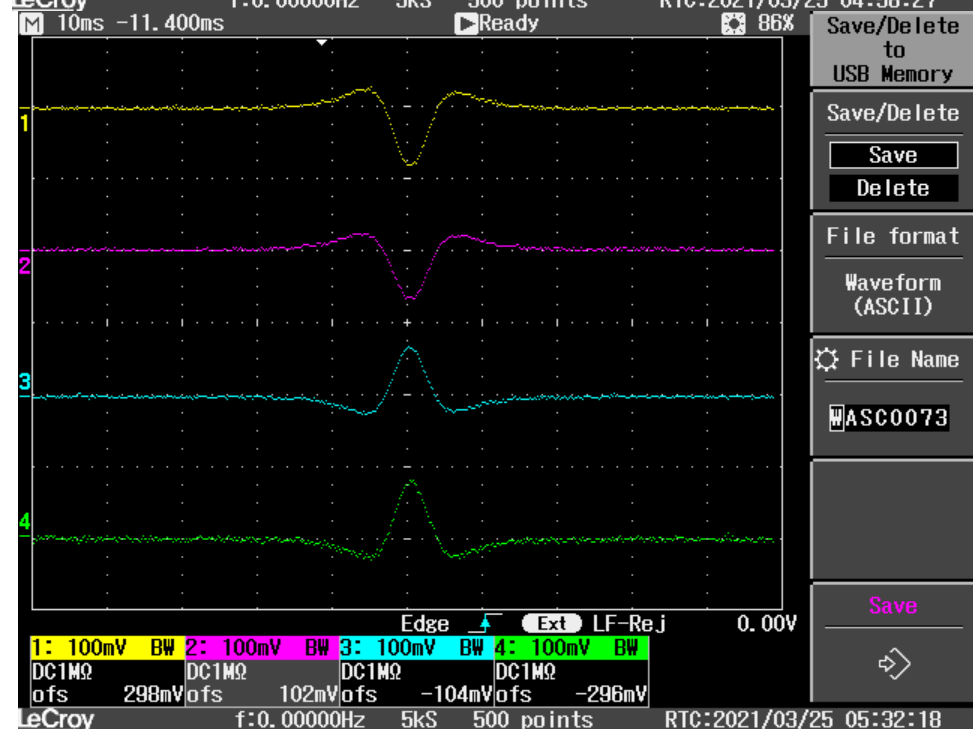
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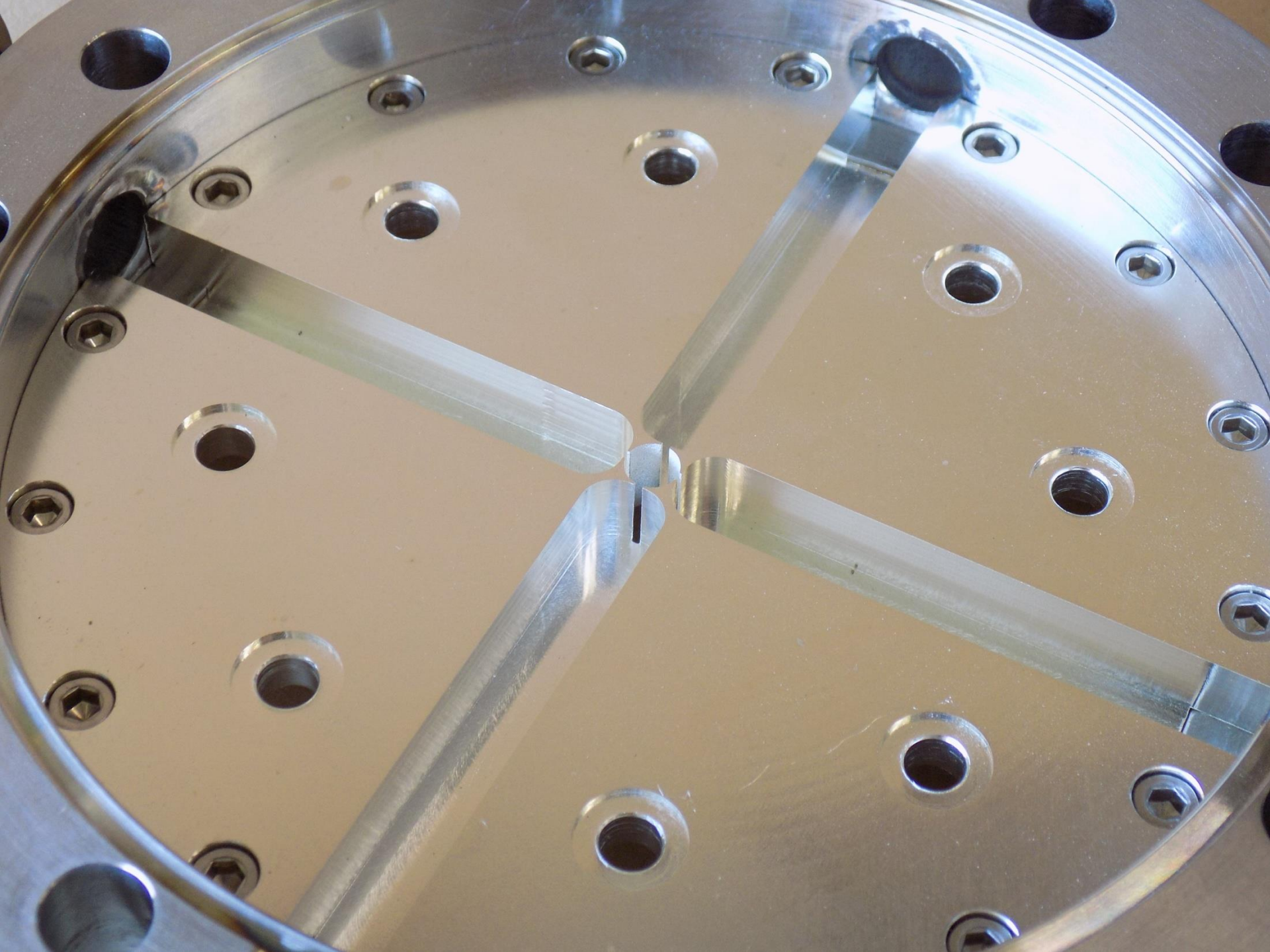
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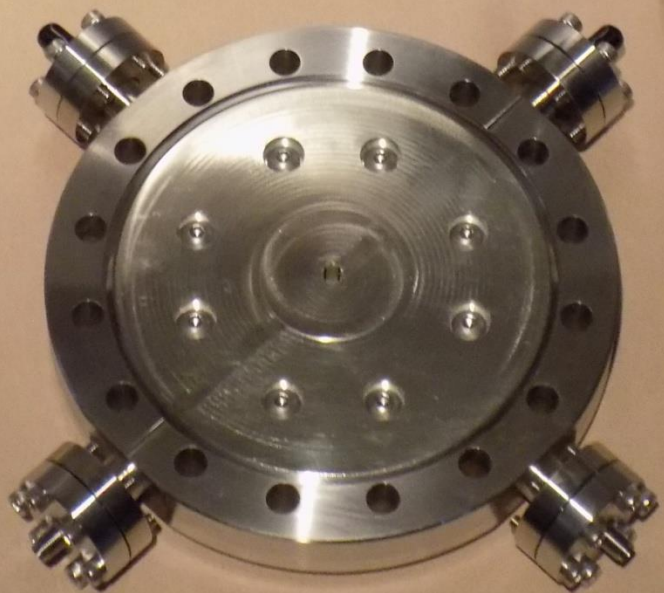
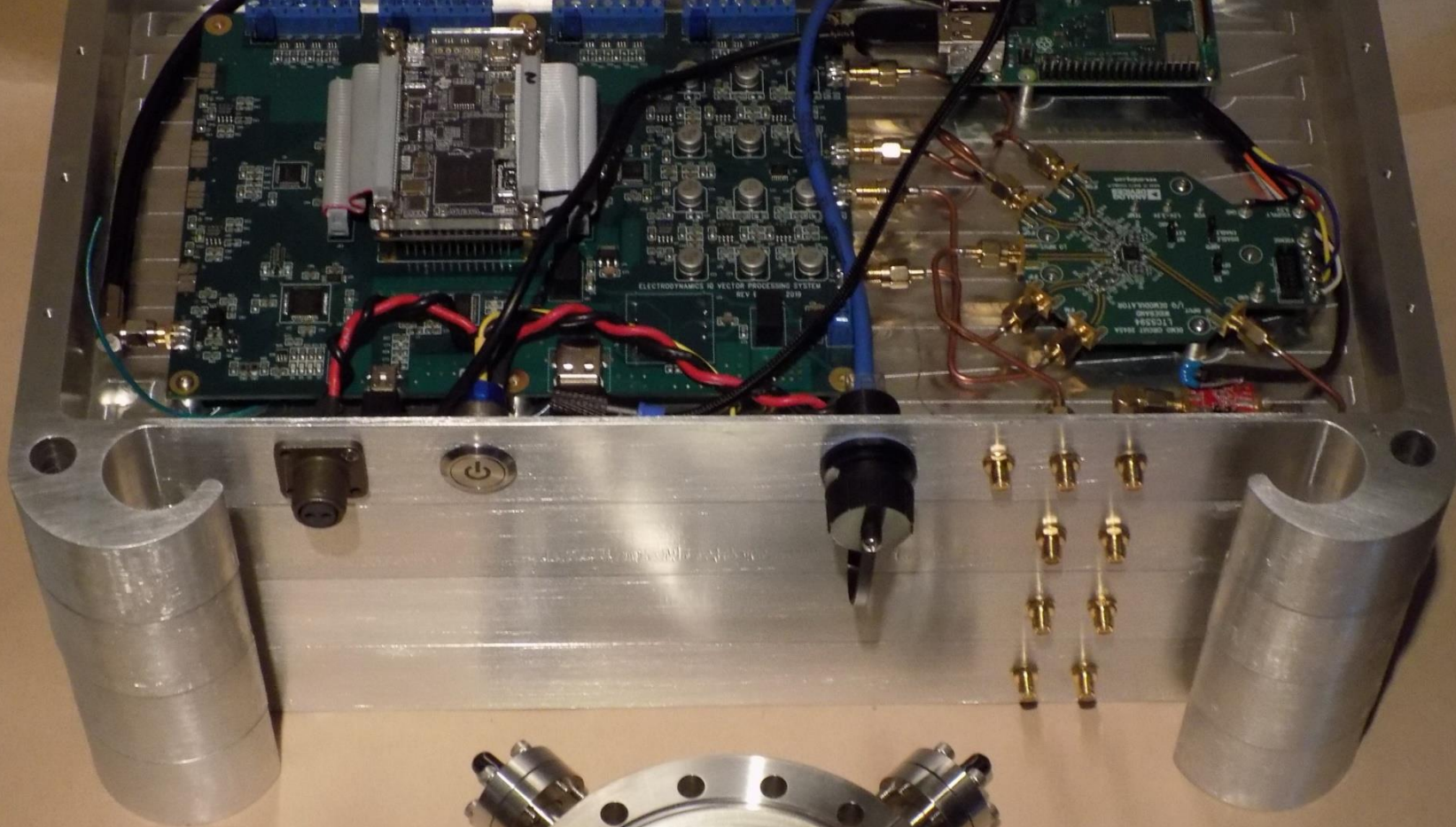
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Thank you for supporting the SBIR Program

- Two polarimetry experiments are being prepared for installed on the UITF.
- Magnetometry will soon resume on the GTS.
- Beam monitors? We would like to provide BNL with a non-invasive bunch length monitors etc. Please send me an e-mail, Brock.electro@outlook.com or give me a call: 505-225-9279.