

Resonant Polarimetry and Magnetometry

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

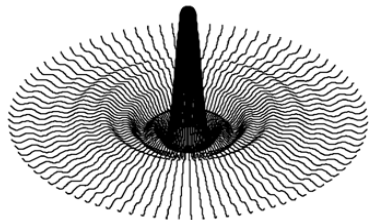
PI: Brock F. Roberts

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).

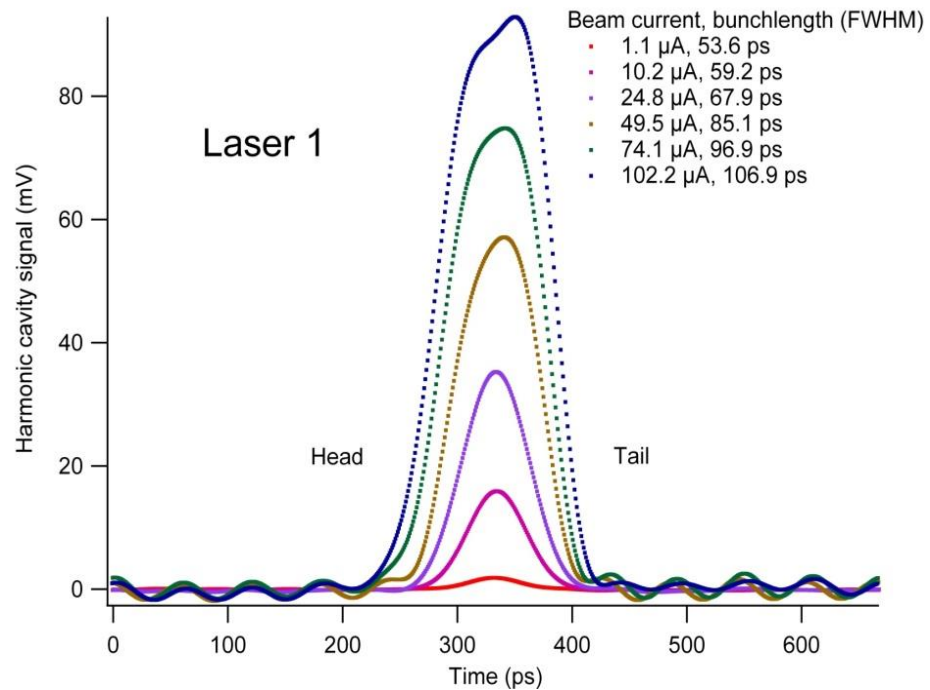
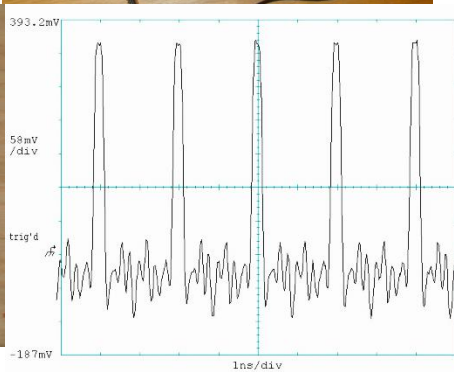
Subcontractor: Thomas Jefferson National Laboratory's (JLAB) Center for Injectors and Sources (CIS).

Electrodynamic : 4909 Paseo Del Norte suite D, Albuquerque, NM 87113 (505)-225-9279

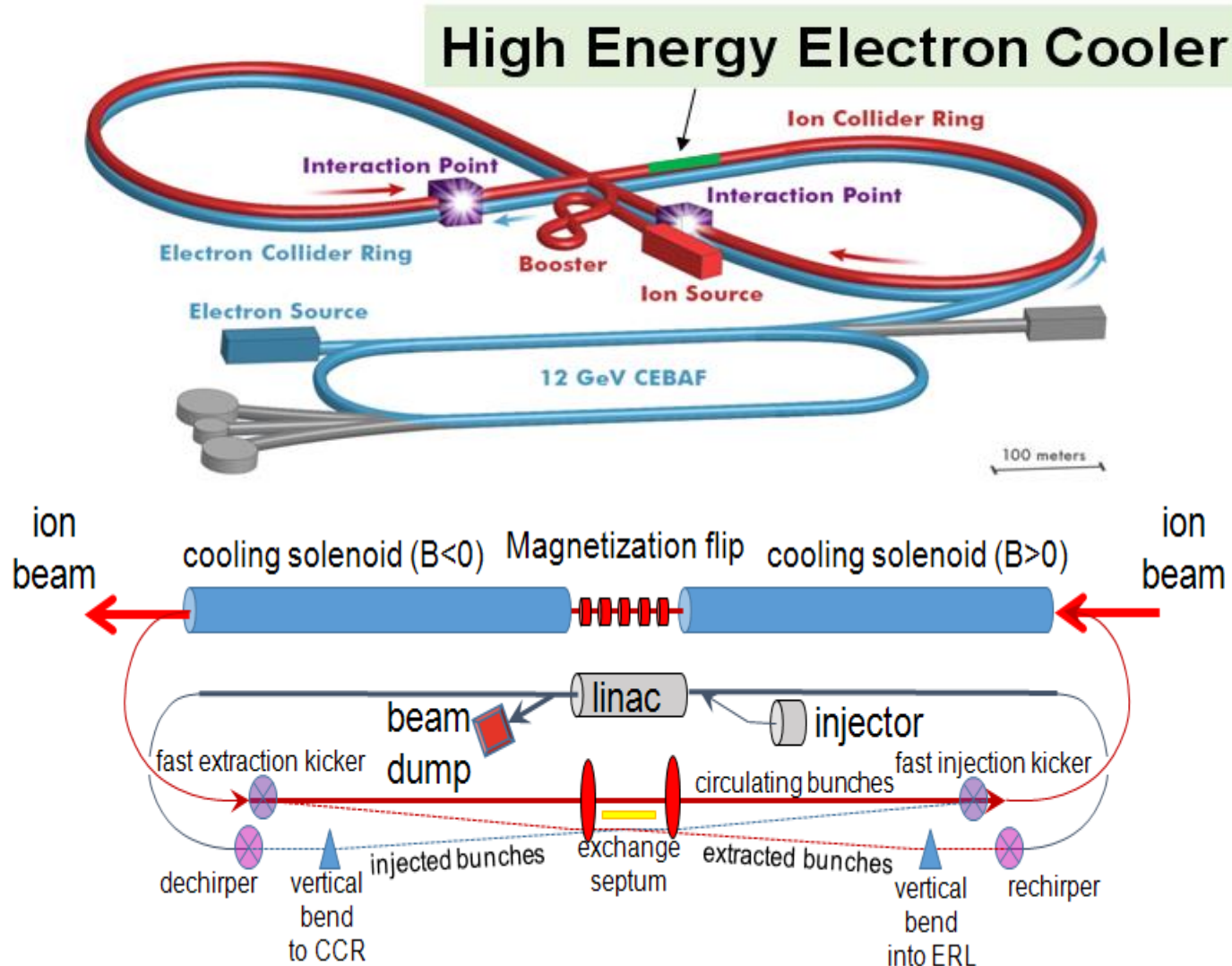


Electrodynamics

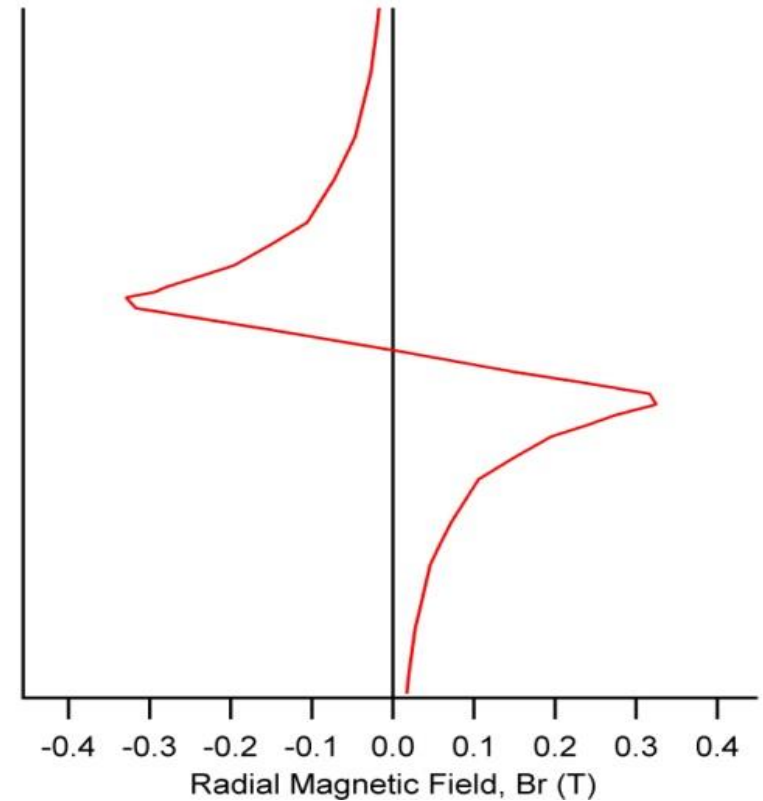
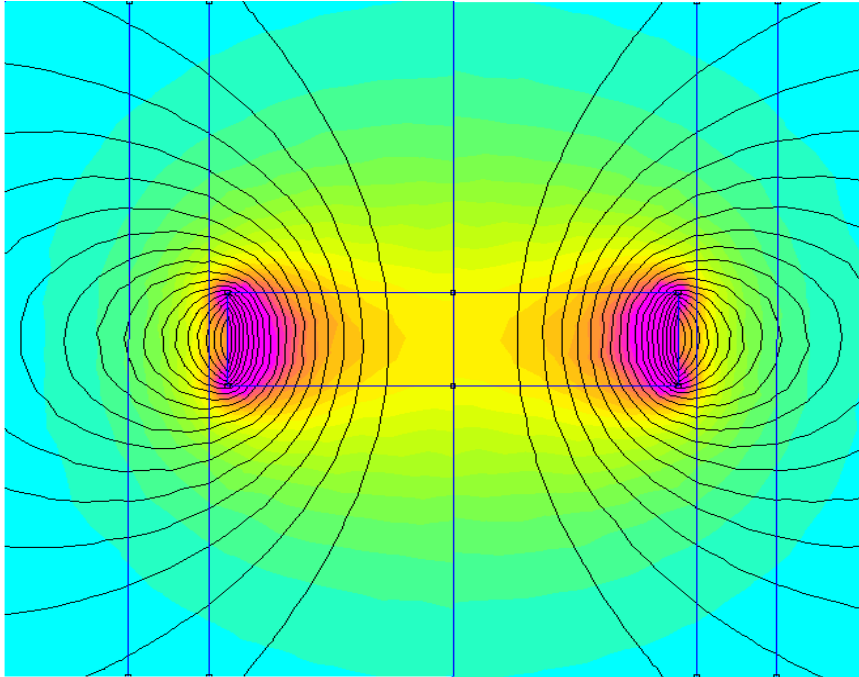
4909 Paseo Del Norte Suite D
Albuquerque, NM 87113
(505) 225-9279



Why? The EIC needs them.

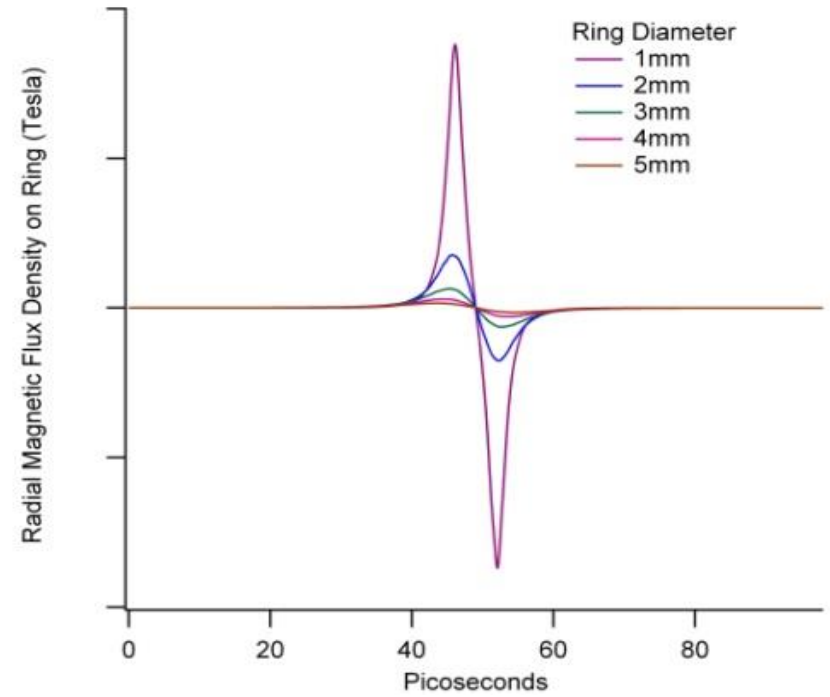
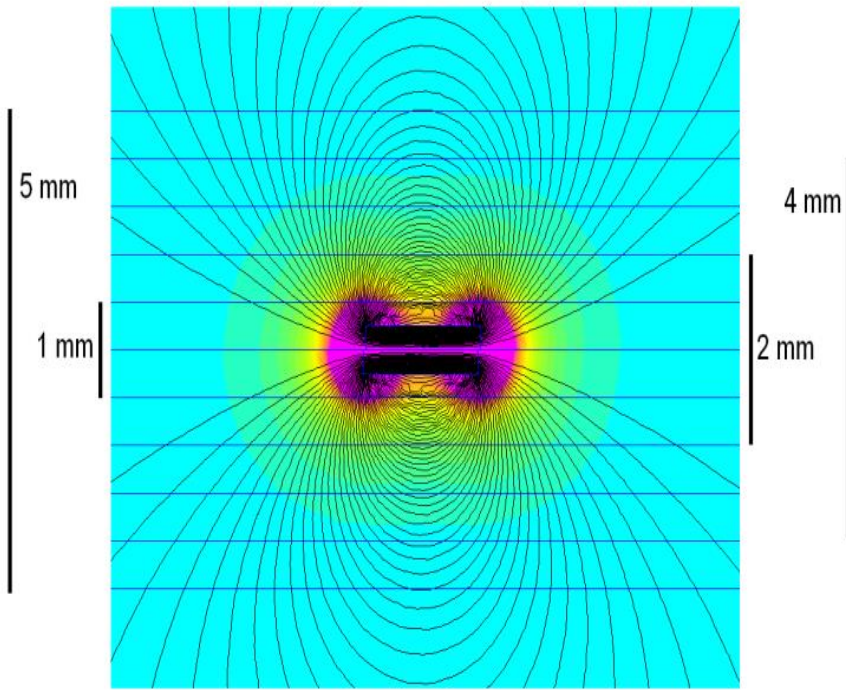


The Classic Magnet in Tube Drop Experiment



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

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

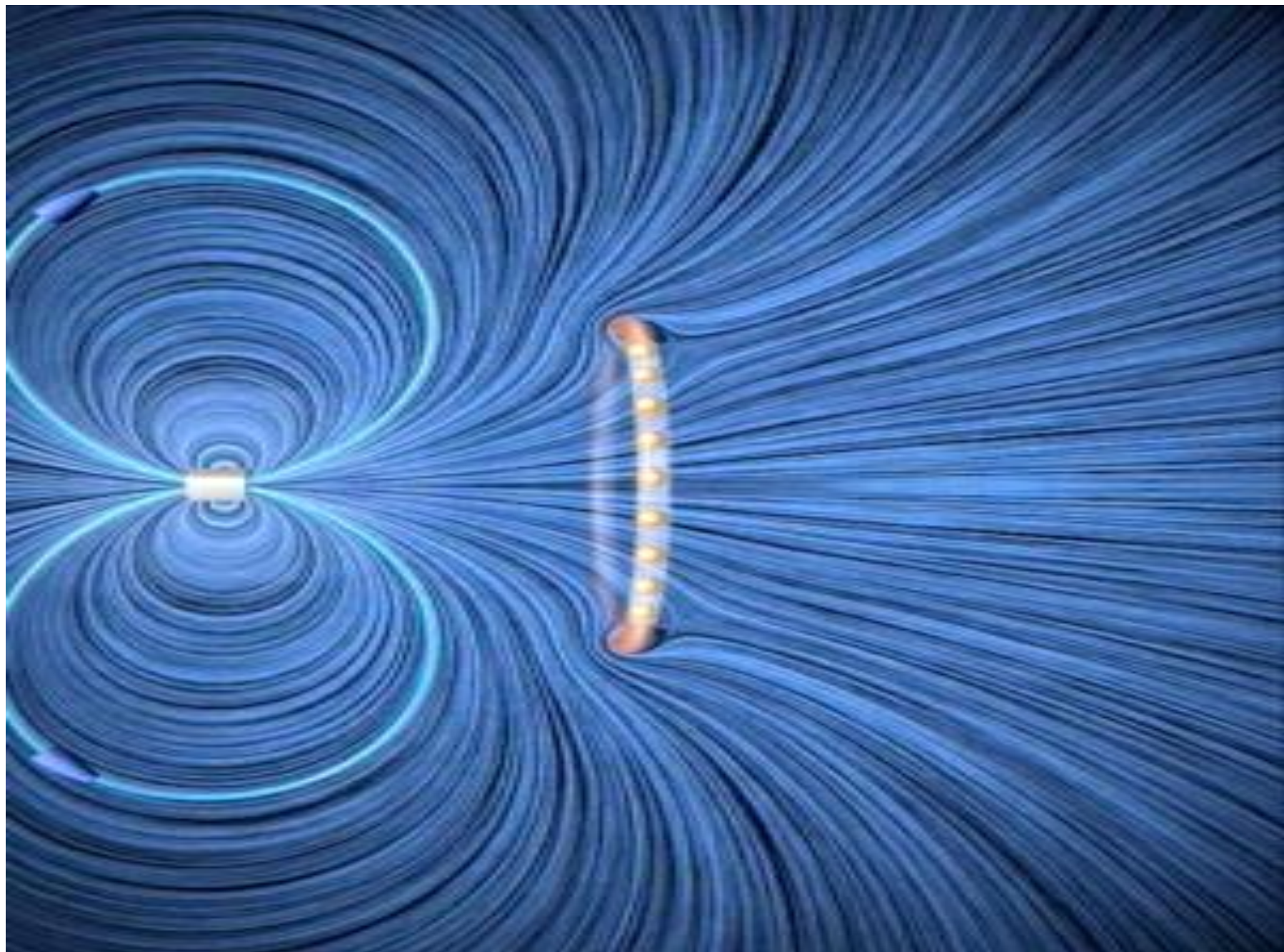


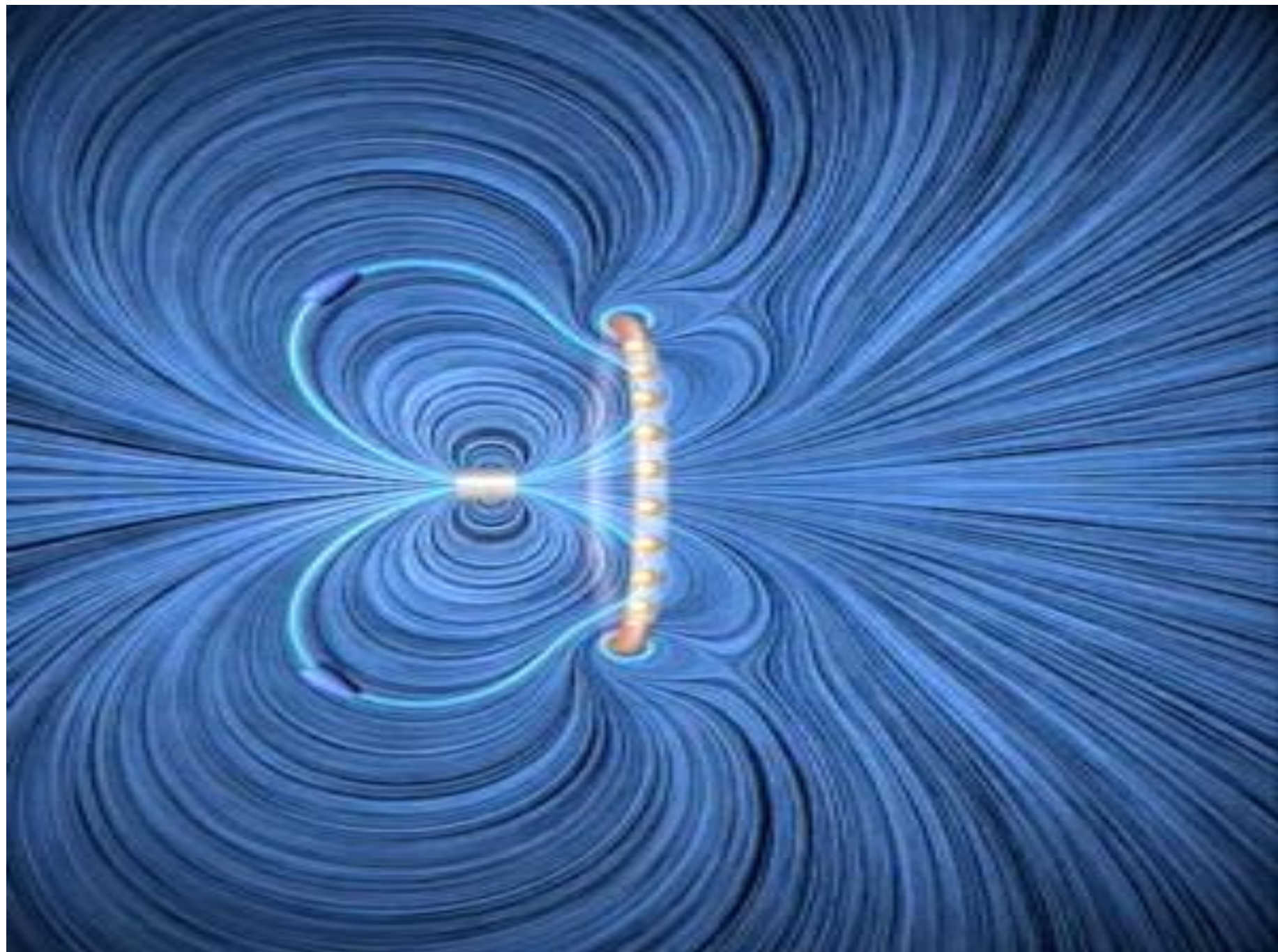
$$F = mg = I_{ind}(B_r 2\pi r_{tube}),$$

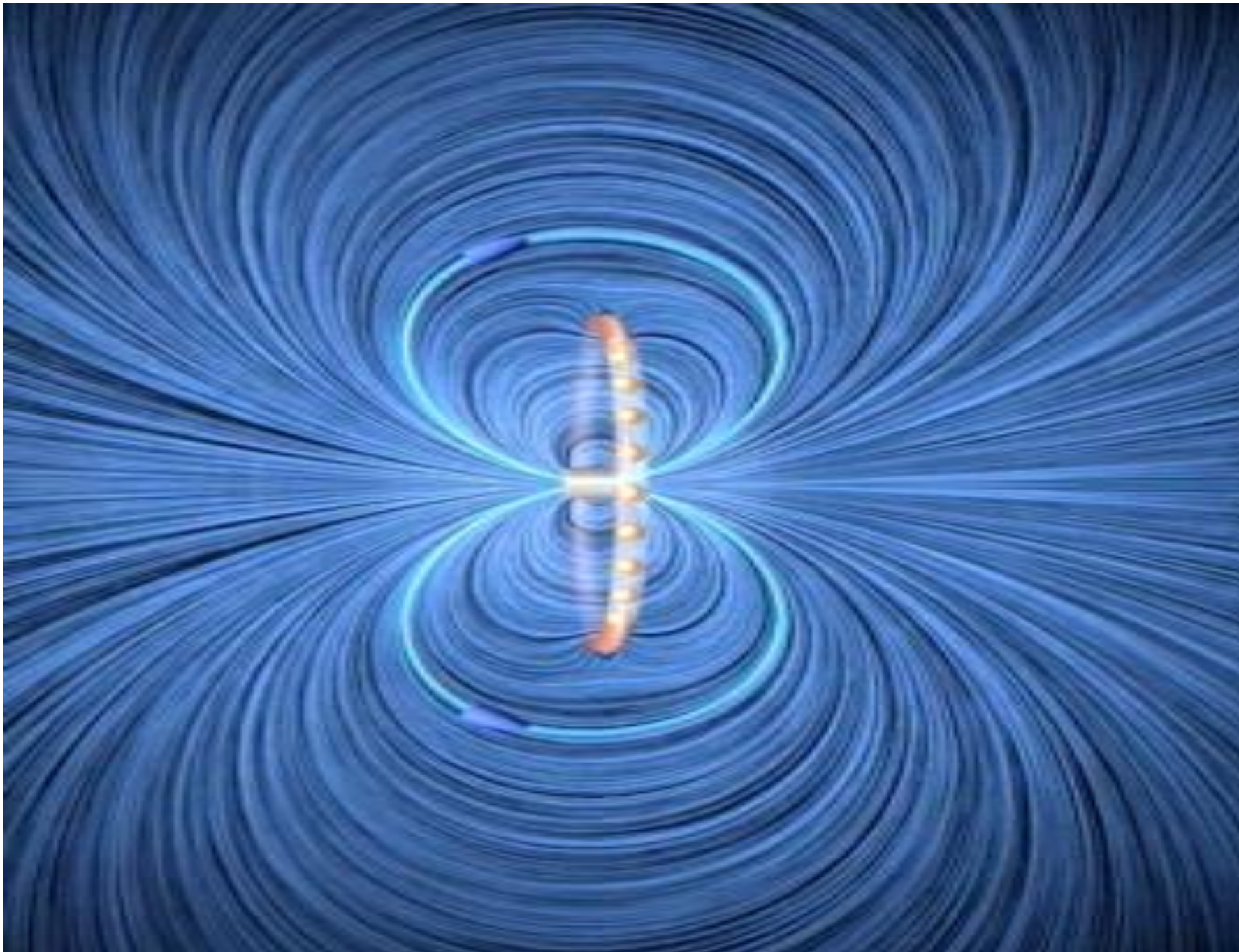
$$V_{ind} = v(B_r 2\pi r_{tube})$$

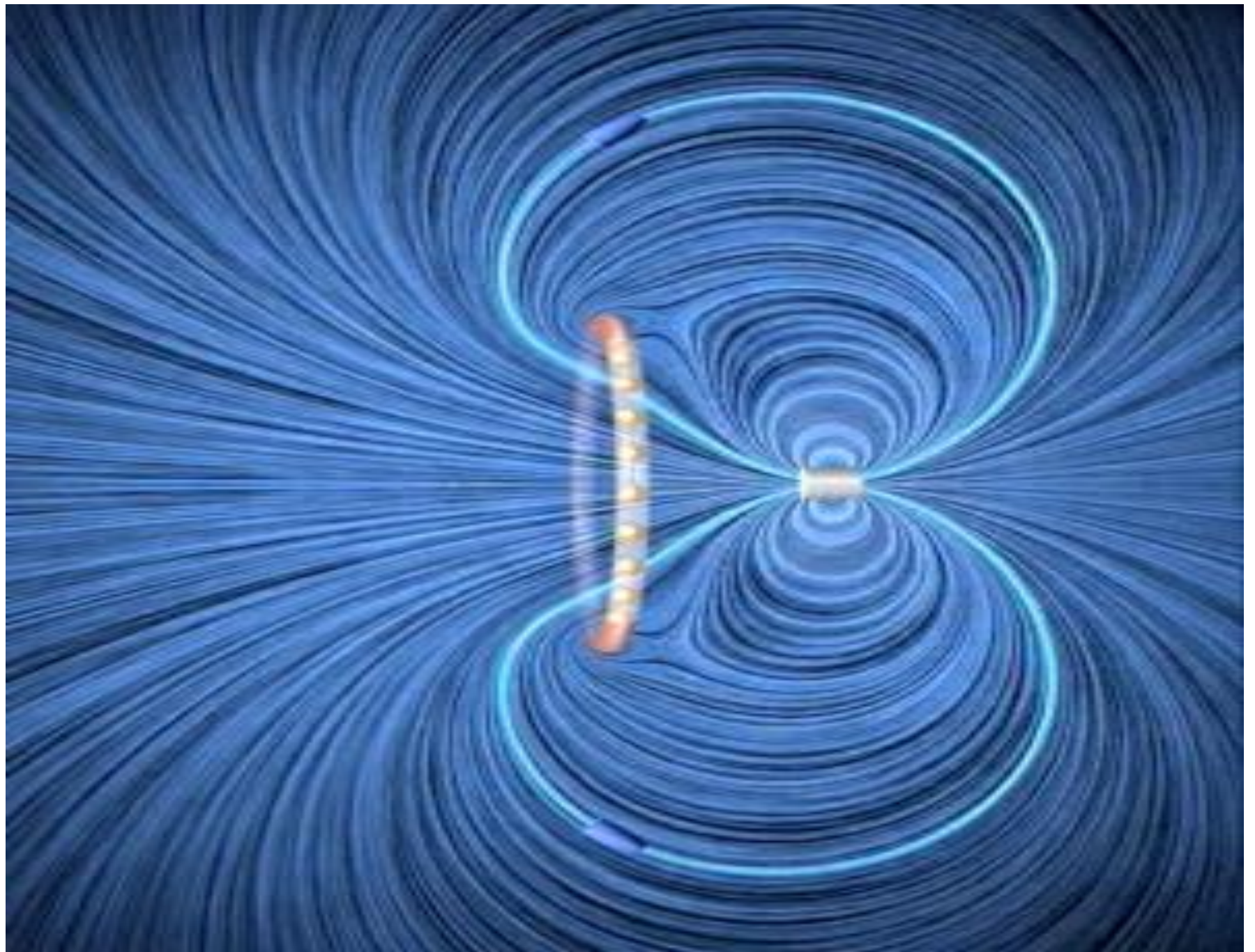
A Starting Point:

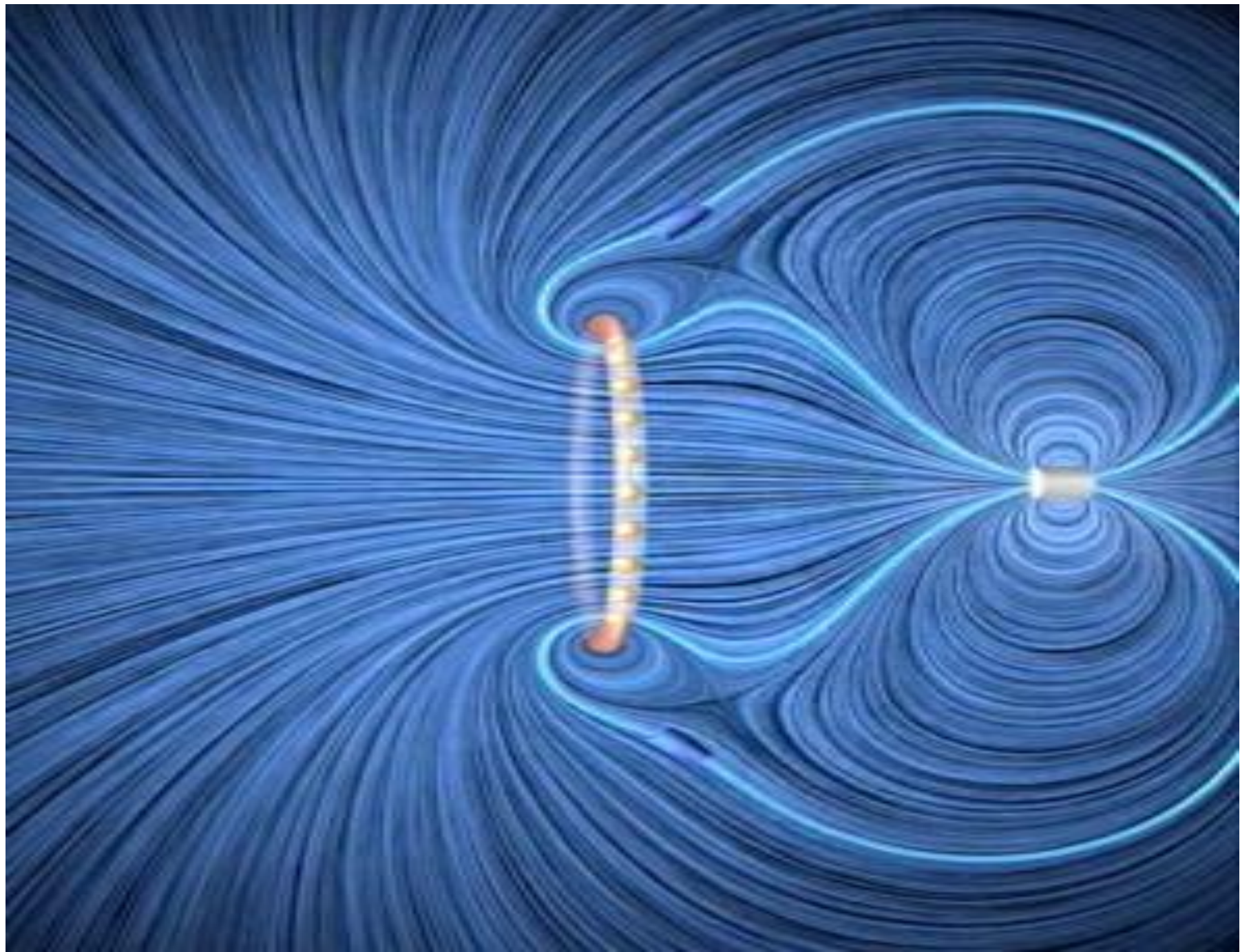
- To measure spin, energy must be exclusively extracted from the spin's component of the of the passing beam's magnetic field.
- Longitudinally polarized bunches have a magnetic field orientation that is orthogonal to the beams current's magnetic field and is similar to a dipole magnet traveling North/South or S/N down a beam tube.
- Magnetized beams have the same field magnetic orientation as longitudinally spin polarized beams.

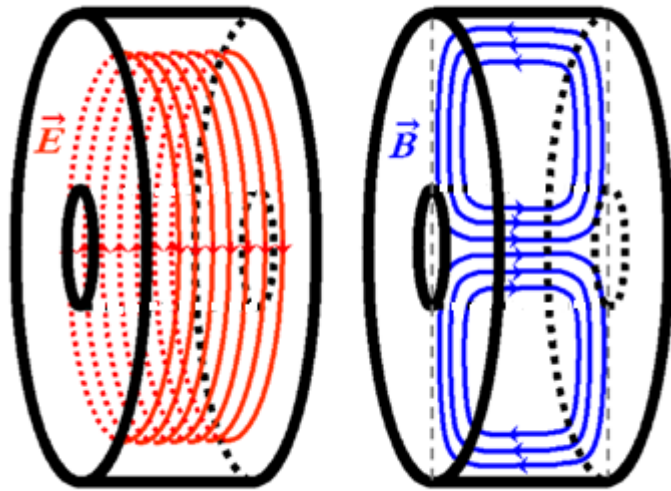




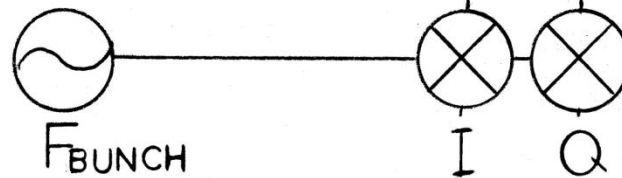
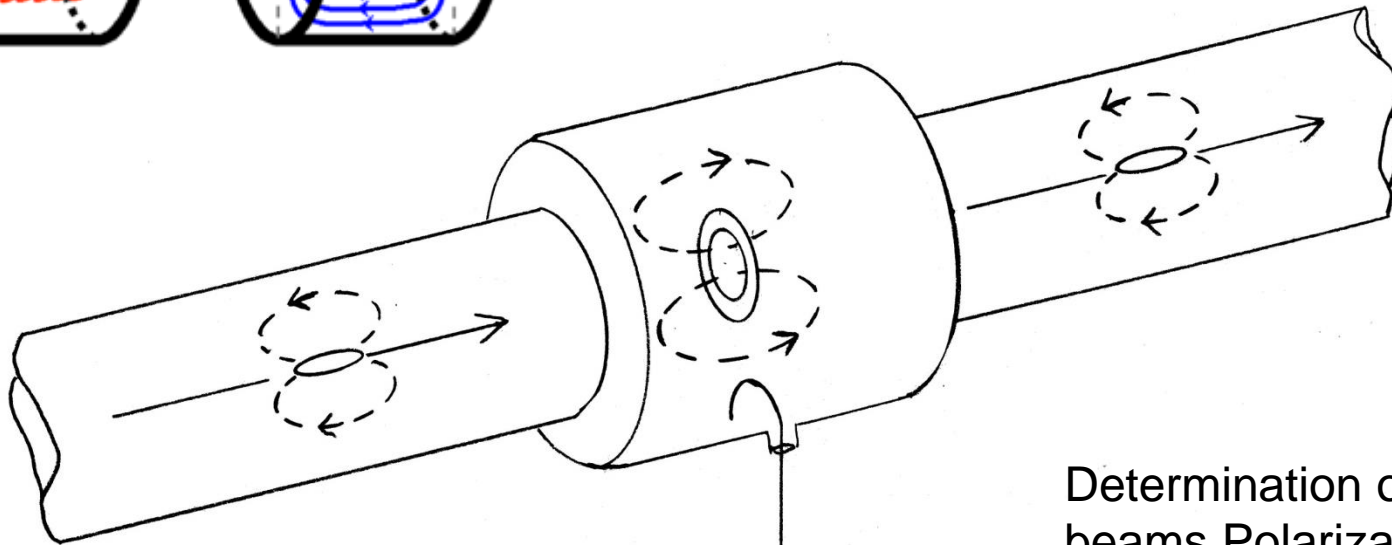




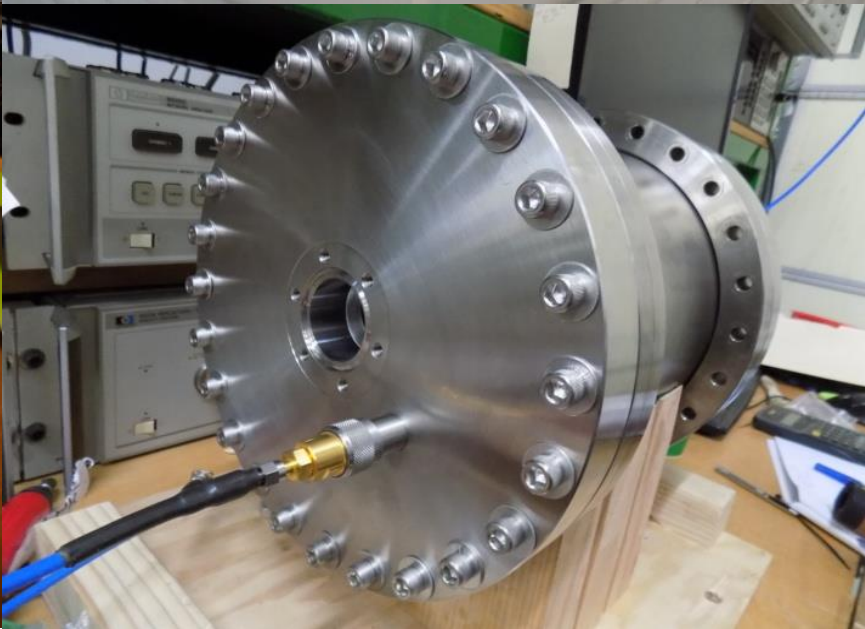
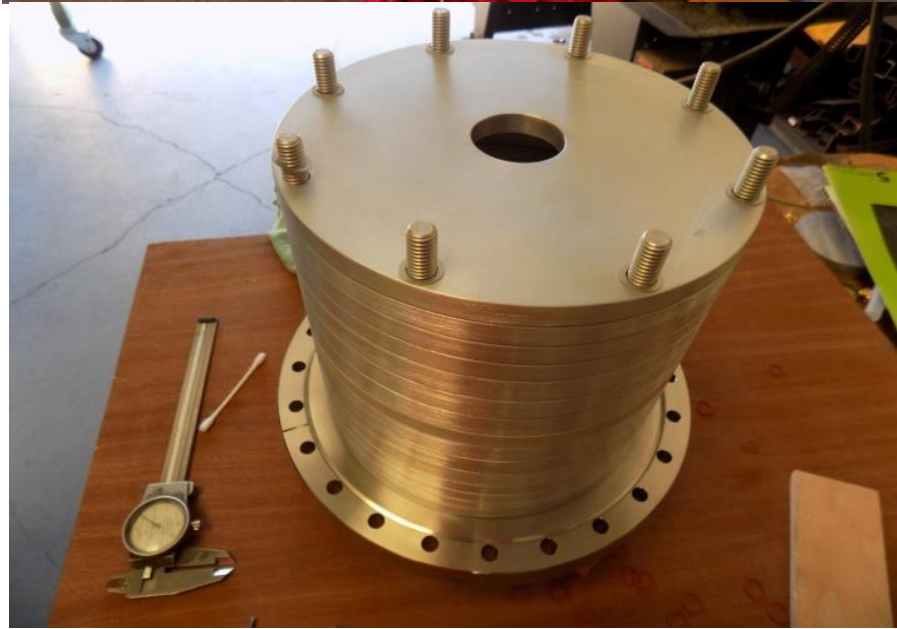
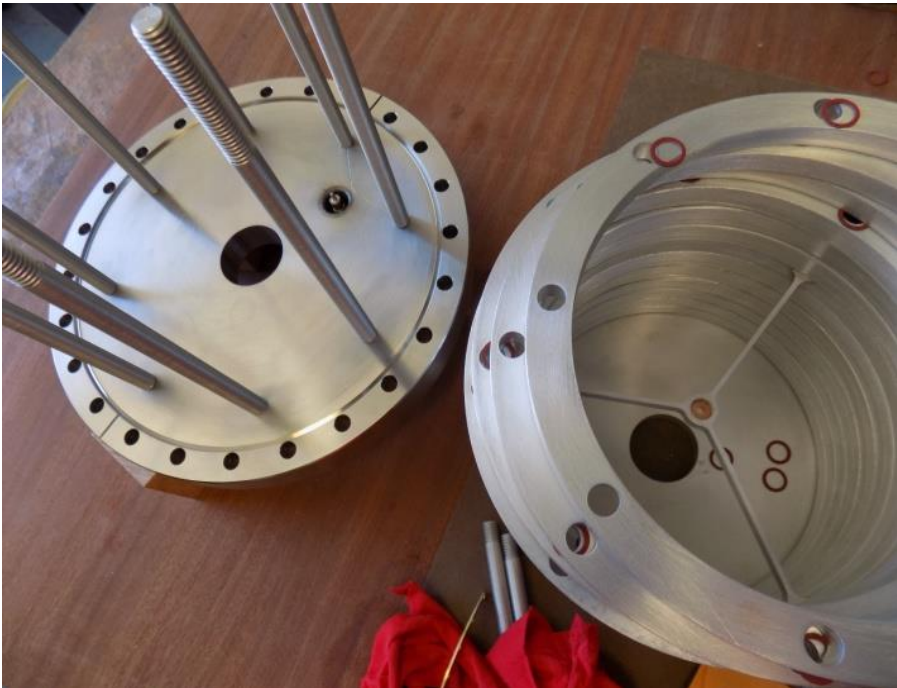


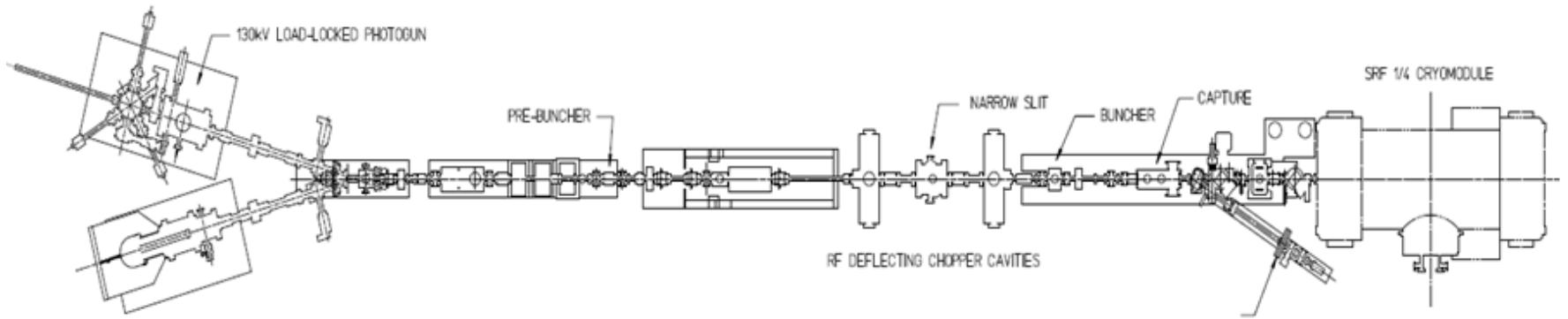
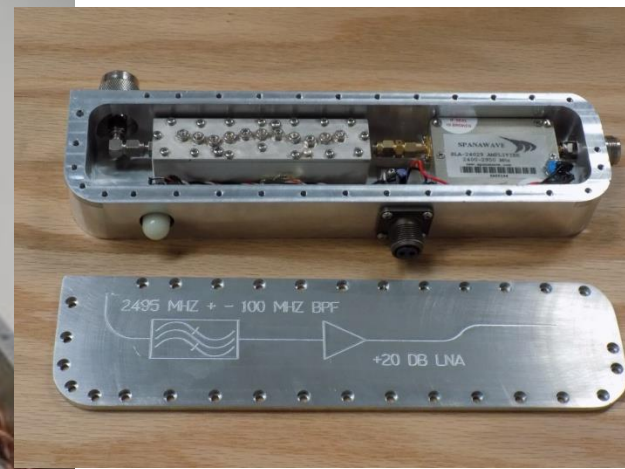
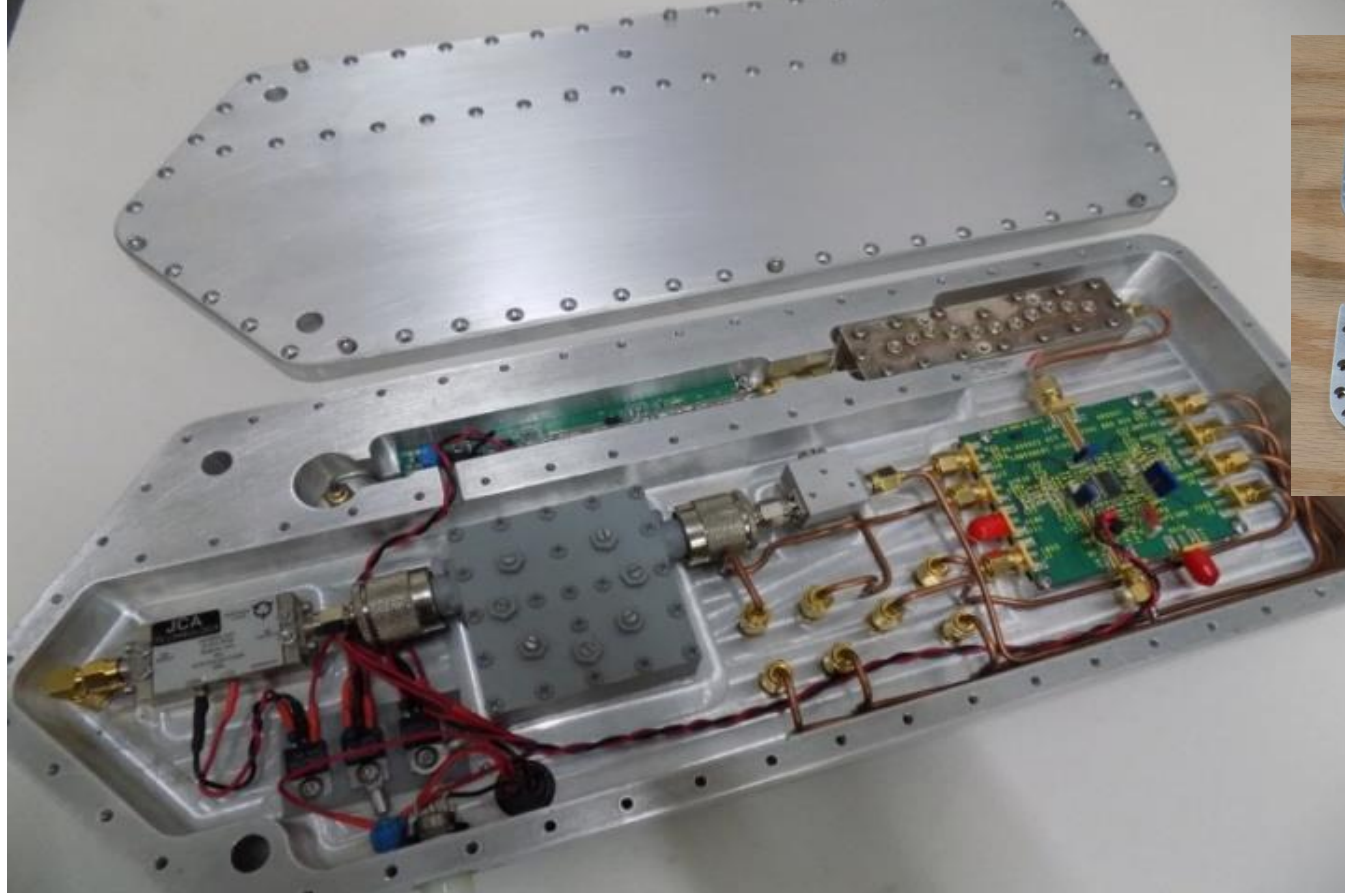


TE₀₁₁ Cavity Resonance

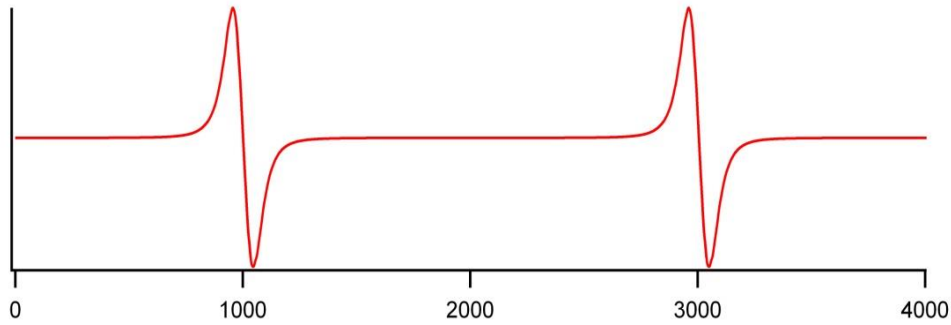


Determination of the beams Polarization and/or Magnetization by measurement of the phase and amplitude of the TE₀₁₁ resonance induced.

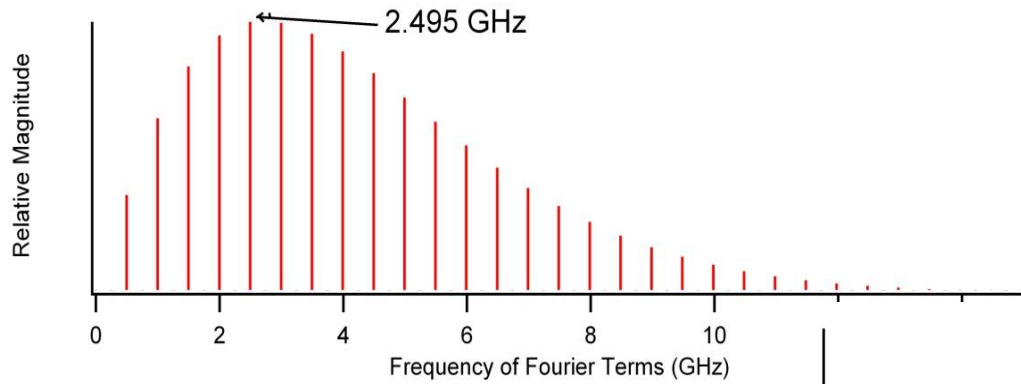




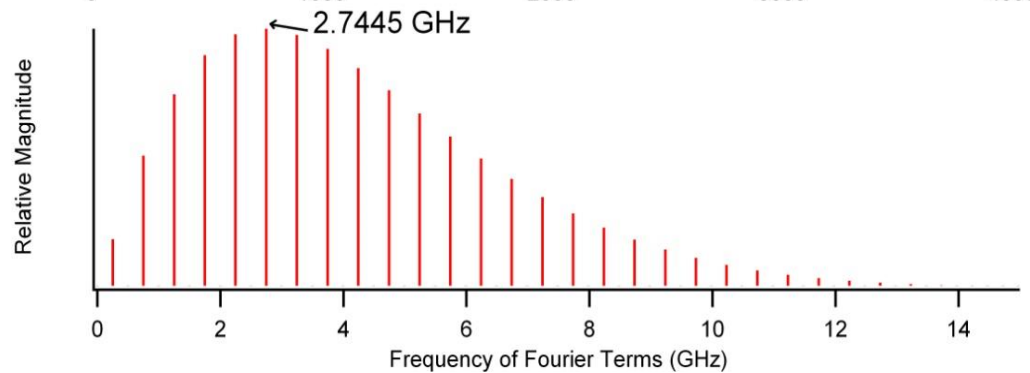
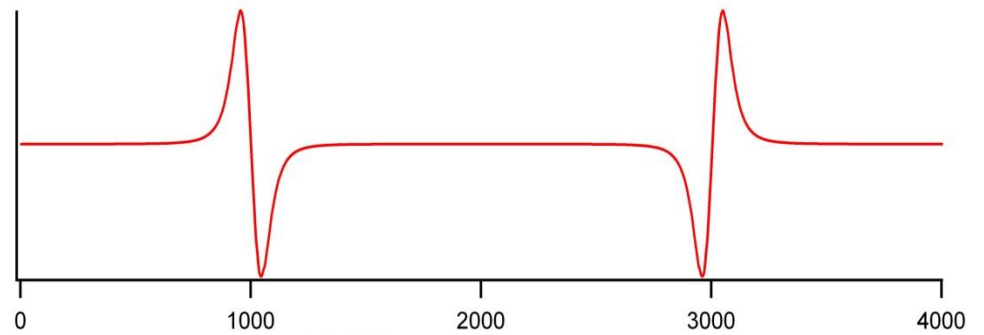
TE₀₁₁ Cavity

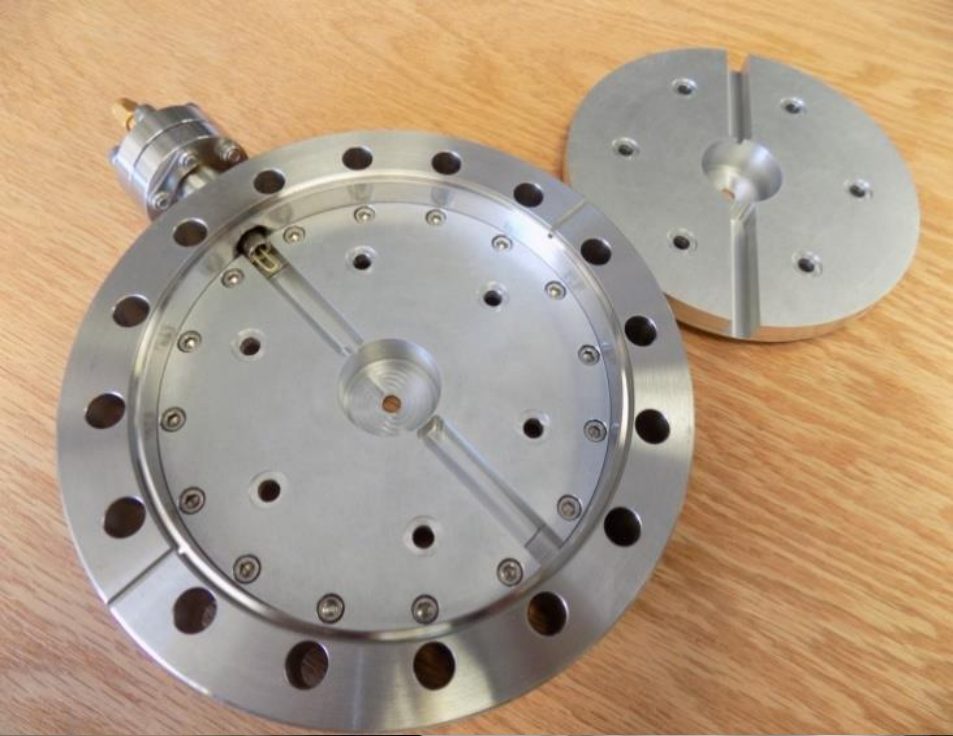
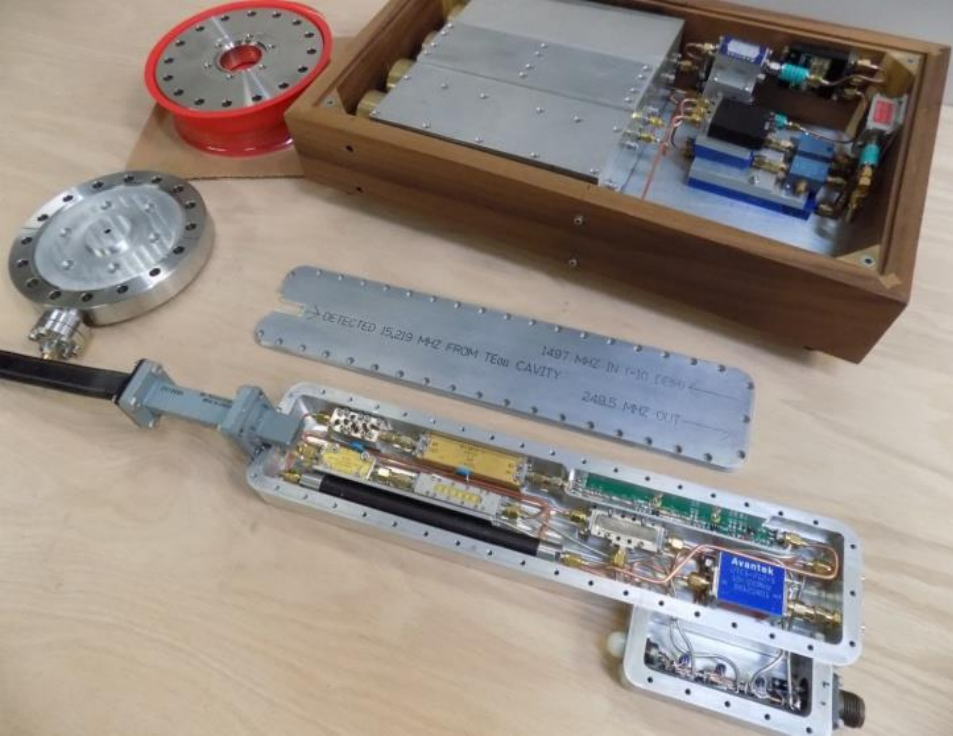


N/S, N/S Beam



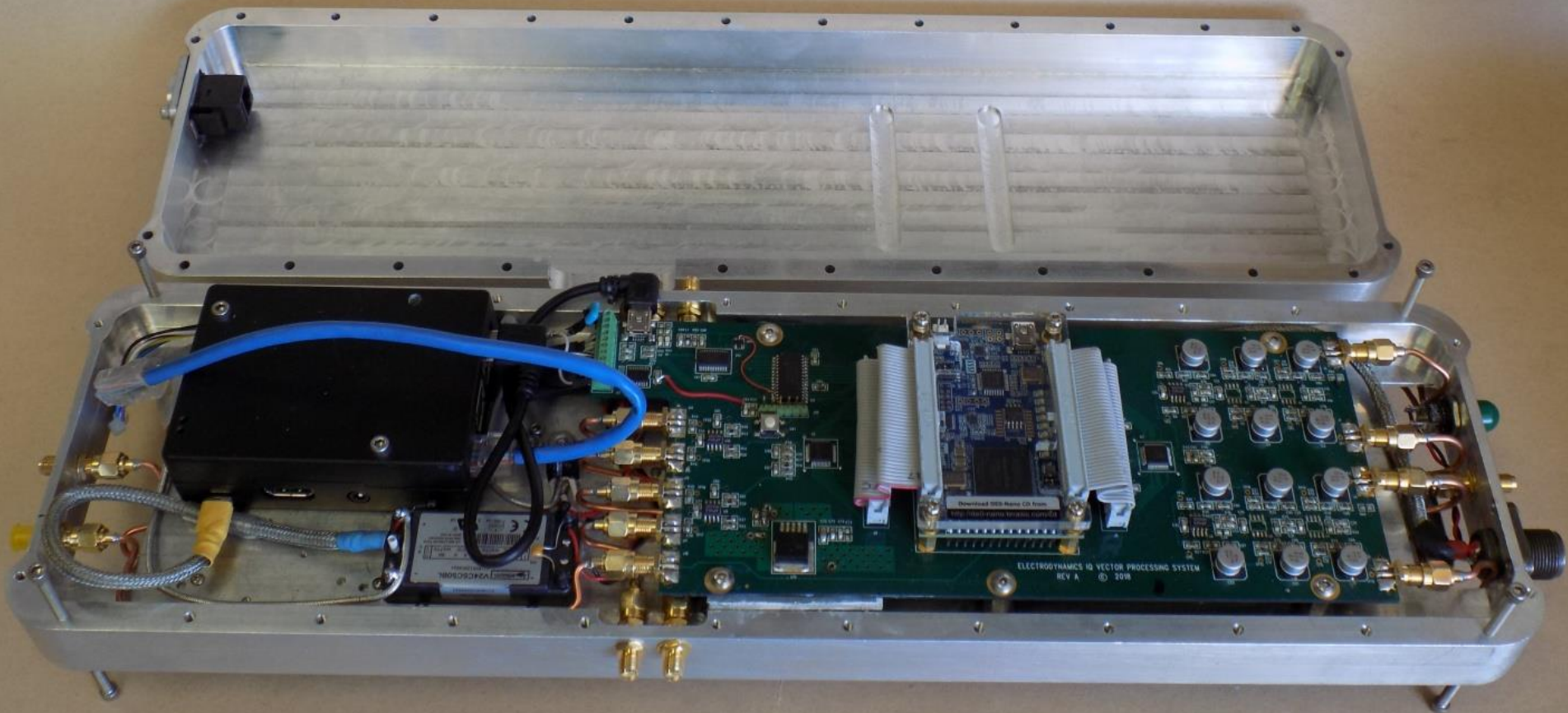
N/S, S/N Beam



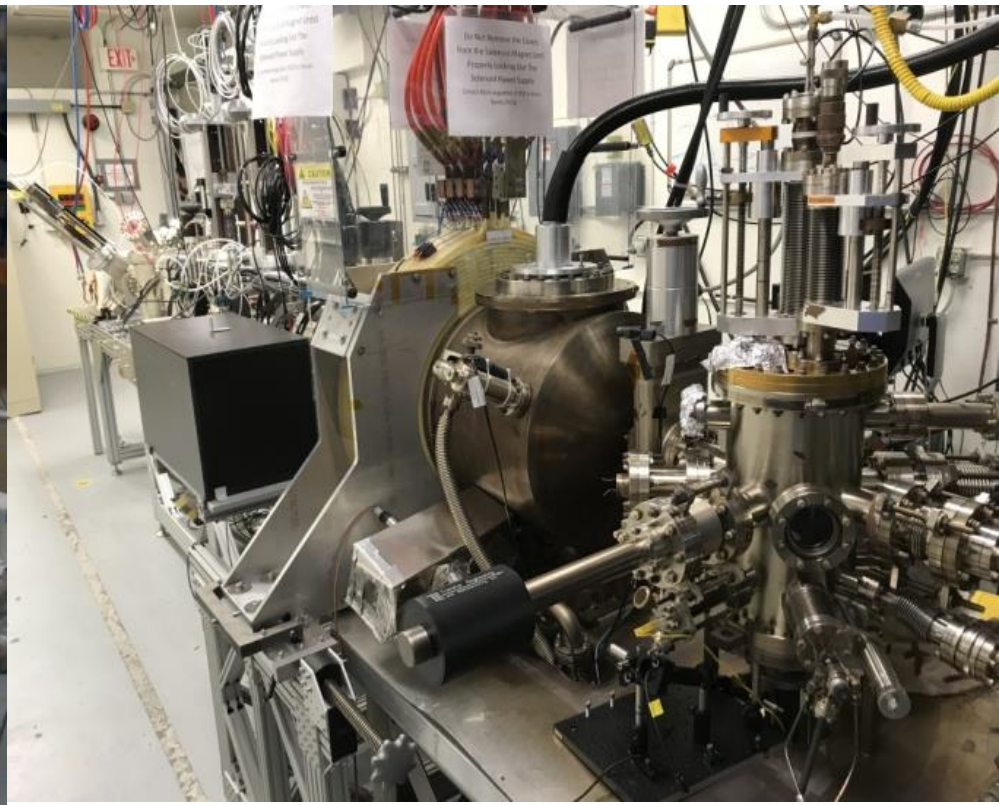
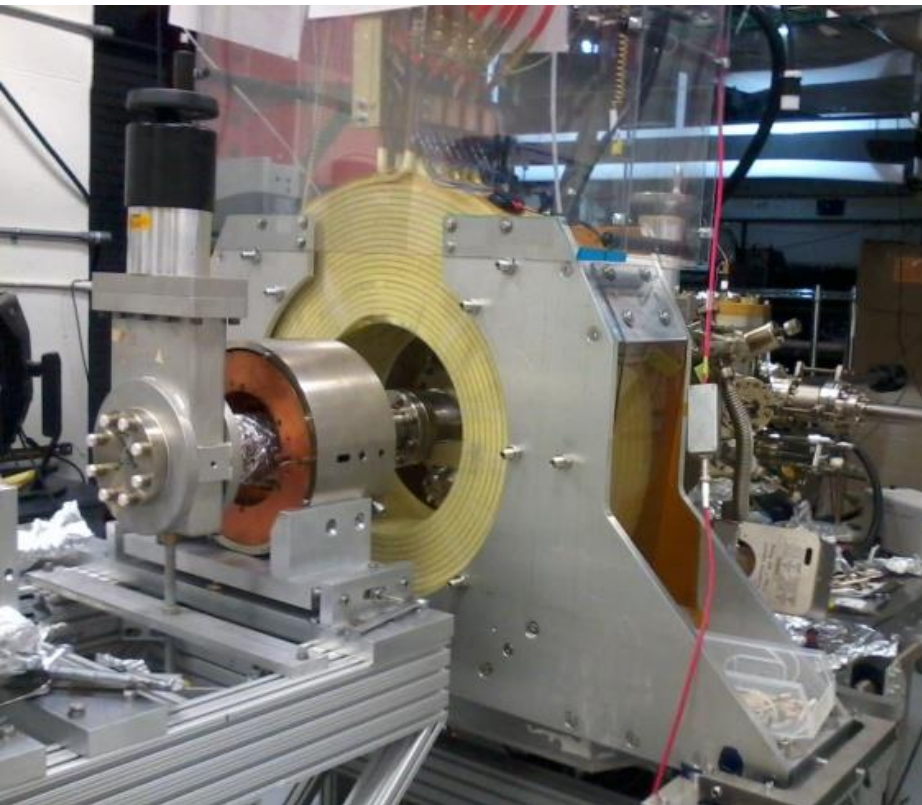




New Polarimetry/Magnetometry Vector Processor!

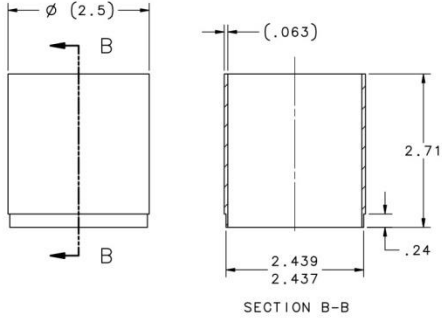
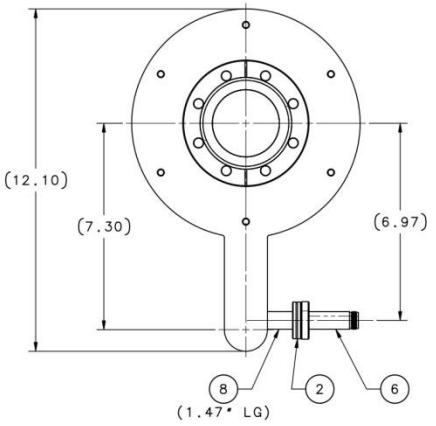
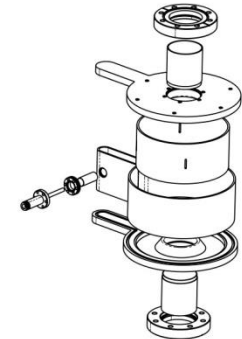


Resonant Magnetometry on the GTS at Jlab

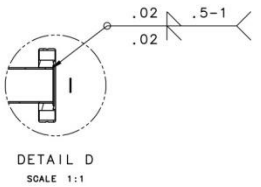
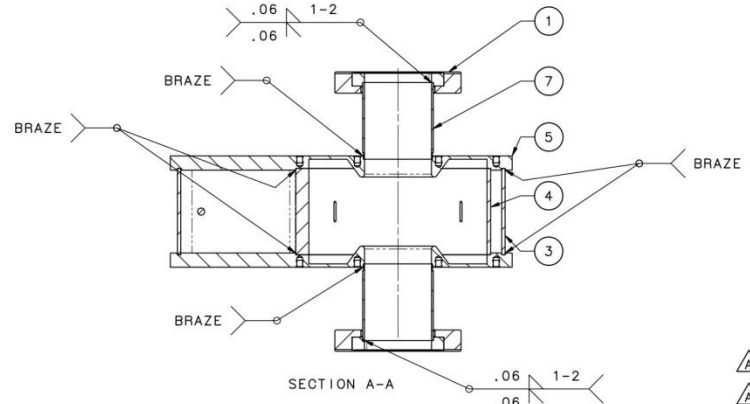
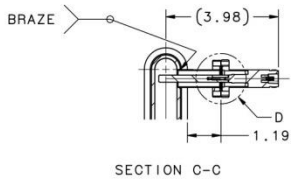
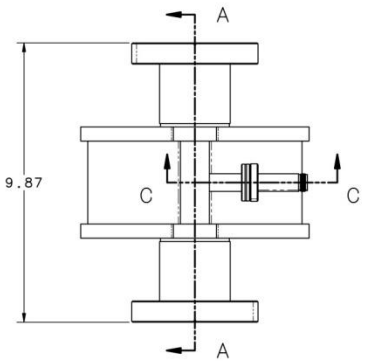


8 7 6 5 4 3 2 1

REVISION HISTORY			
ZONE	REV	DESCRIPTION	DATE/REVISOR
A3	A	STEP REMOVED FROM ITEMS 3-5 FOR MACHINING PURPOSES	12JUN18/JH



ITEM 7
SCALE 1:1




QTY	ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION OR DESIGNATION	MATERIAL SPECIFICATION	NOTES
1	8	-	TUBE .625 OD X .576 ID X 1.47" LONG	304 STAINLESS STEEL	
2	7	-	TUBE 2.5 OD X .063 WALL	304 STAINLESS STEEL	
1	6	JL0068861	FEED THRU ASSY		
2	5	JL0060736	TE011 2994MHZ BASE PLATE		
1	4	JL0060744	TE011 2994MHZ INNER SLEEVE		
1	3	JL0060749	TE011 2994MHZ OUTER SLEEVE		
1	2	LESKER F0133X062N	DN16CF (1.33" OD) 304L SS Standard ConFlat's (CF) Flange		
2	1	MDC 1112241	CF ROTATABLE FLANGE 4.50 OD X 2-1/2 TUBE 316LN		



<p>FOR JLAB INTERNAL USE ONLY</p> <p>SEE ESM4 MANUAL CHAPTER 6151 FOR PRESSURE AND VACUUM SYSTEMS SAFETY SUPPLEMENT AND WELDING AND BRAZING SUPPLEMENT</p>		<p>DIM & TOL PER ASME Y14.5 2009 UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:</p> <p>FRACTIONS DECIMAL ANGLES</p> <p>$\pm 1/8$.001 1° 30'</p> <p>$\pm .005$.001 1° 30'</p>	<p>UNITED STATES DEPARTMENT OF ENERGY</p> <p>Jefferson Lab</p> <p>Thomas Jefferson National Accelerator Facility</p> <p>Report News Virginia</p>
<p>WELD CLASS</p> <p>PRESSURE/VACUUM CLASS</p> <p>N/A</p>	<p>THIRD ANGLE PROJECTION</p> <p>FINISH MACHINED SURFACES UNLESS OTHERWISE NOTED</p> <p>DEBURR & BREAK ALL SHARP EDGES</p>	<p>SEE PARTS LIST</p> <p>SRF JLEIC</p> <p>MAGNETIZED BUNCHED BEAM</p> <p>TE011 2994 MHZ CAVITY</p>	<p>SCALE 1:2</p> <p>DATE 07MAY18</p> <p>DRAWN J.ABSTRONG</p>
<p>WELD CODE</p> <p>PRESSURE SYSTEMS NUMBER</p> <p>N/A</p>	<p>DO NOT SCALE DRAWING</p> <p>SCALE 1:2</p>	<p>SIZE DWG. NO. JL0060735</p> <p>REV. A</p>	<p>SHEET 1 OF 1</p>

EXIT

FX10

 MITSUBISHI

CAUTION
DO NOT TOUCH
THIS PART
PLEASE
READ THE
MANUAL

CAUTION
DO NOT TOUCH
THIS PART
PLEASE
READ THE
MANUAL



KEYPAD

0	1	2	3	4	5	6	7	8	9	DEL
+	-	*	/	√	π	sin	cos	tan	1/x	OFF
←	→	↑	↓	ENTER	HOME	POOR	CL	STOP	RESET	PAUSE

POWER ON

STOP

FEED

AUTO

MACH

M3

M4

M5

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M7

M8

M9

M10

M11

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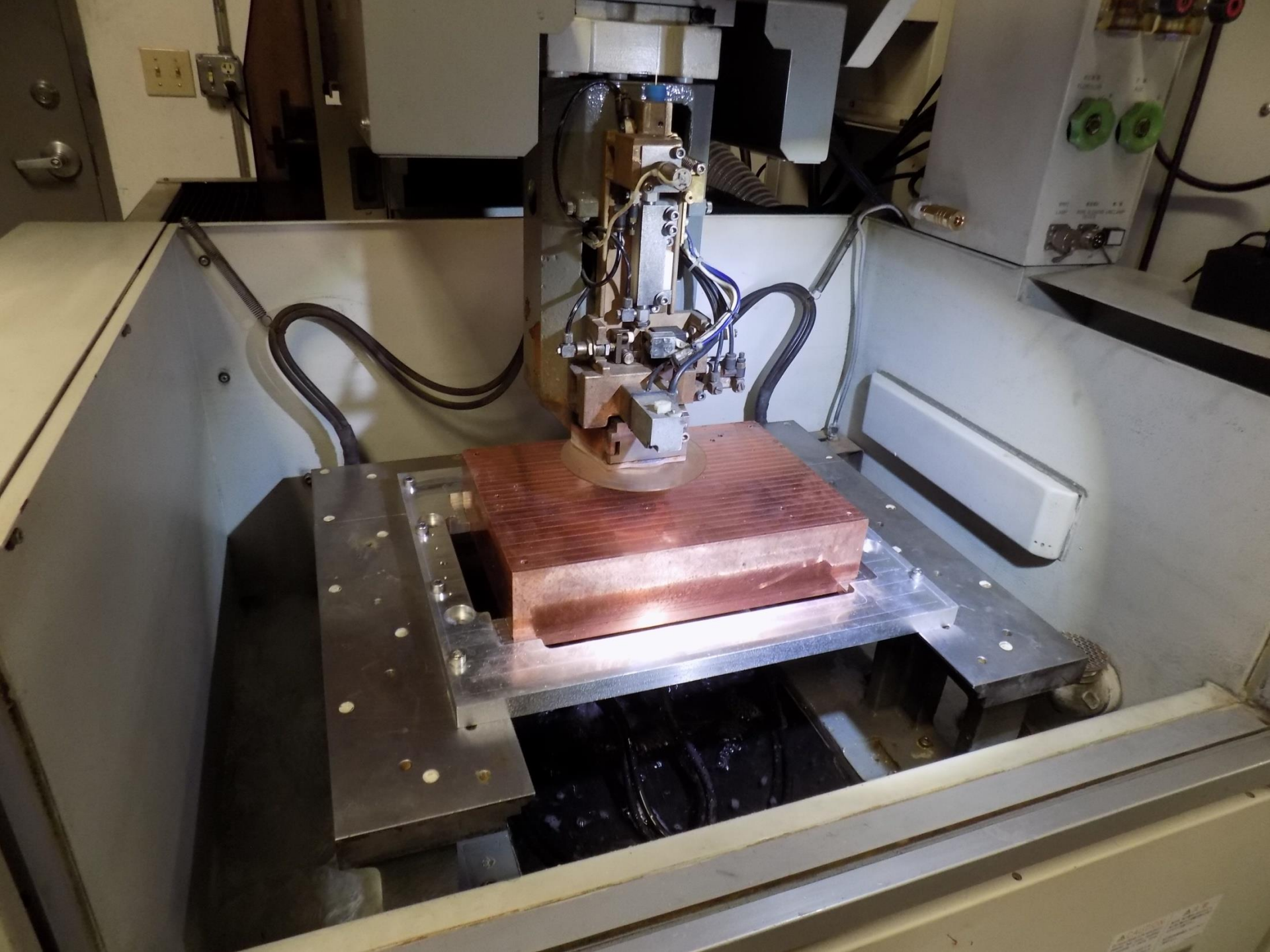
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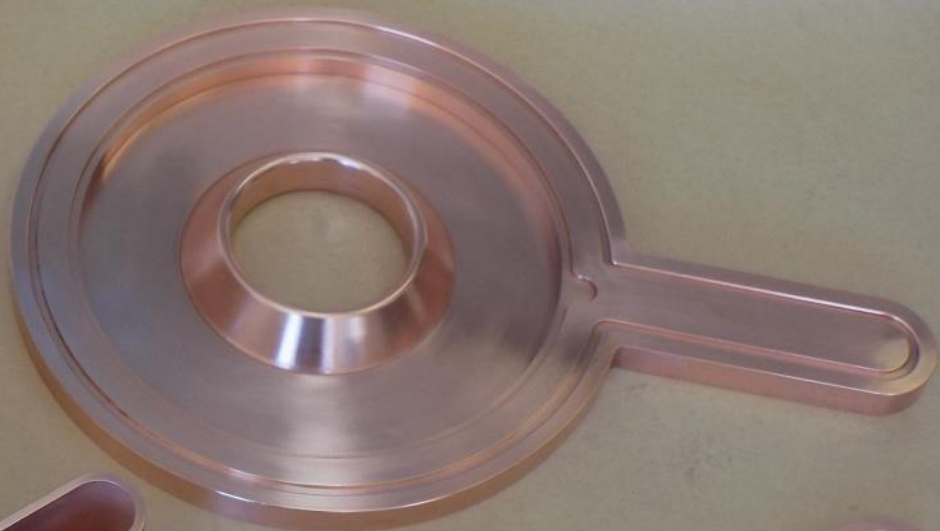
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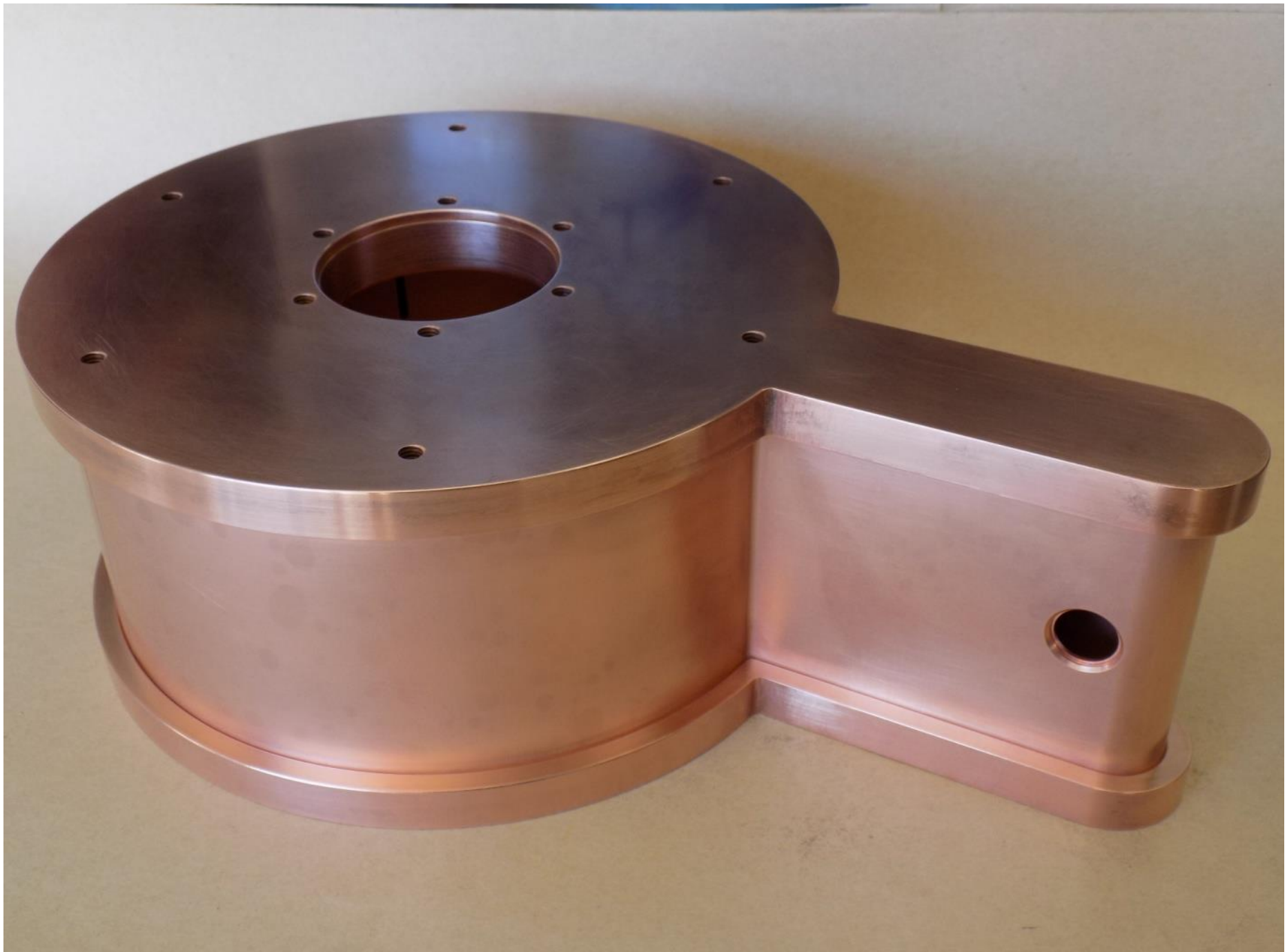
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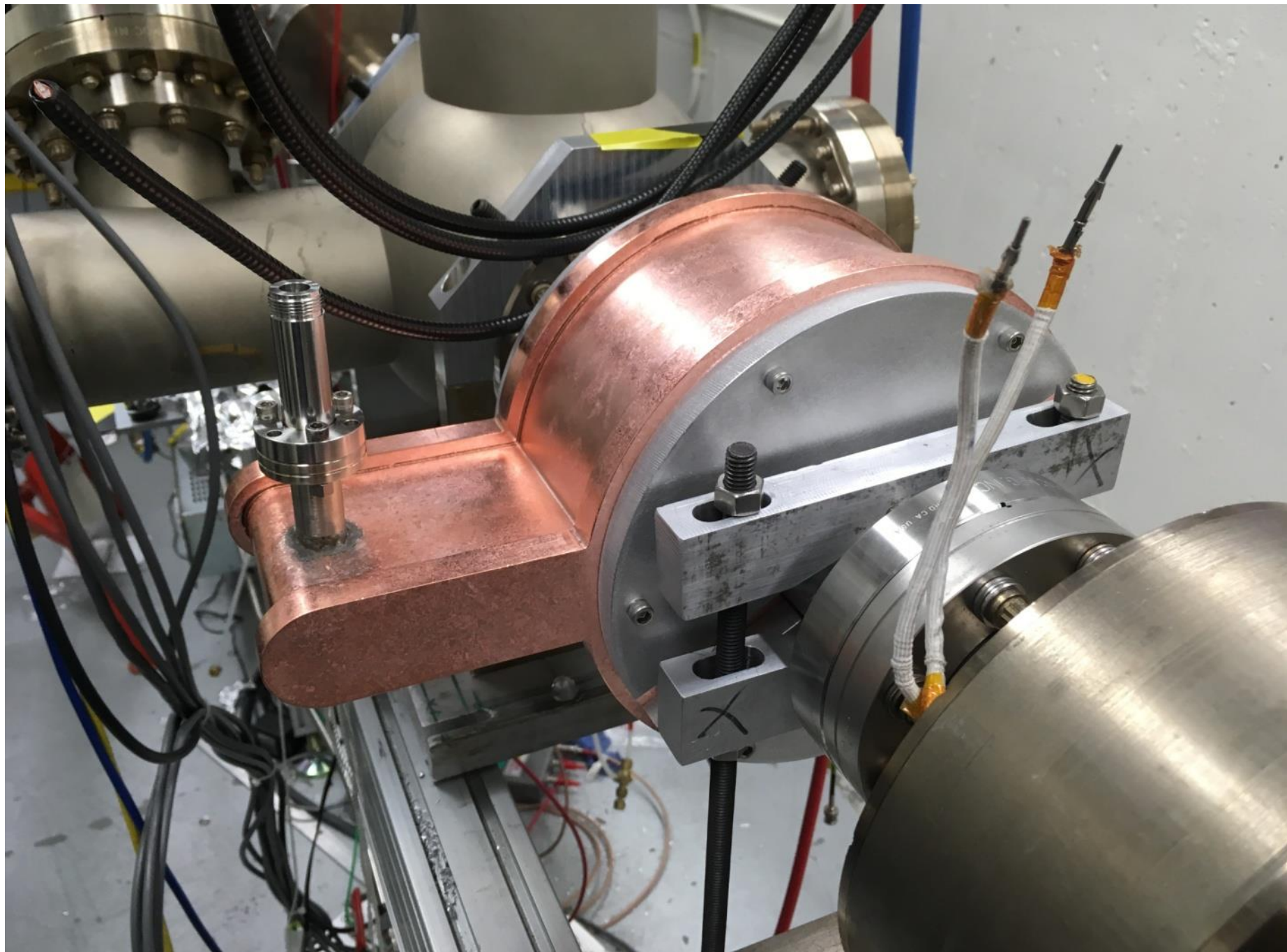
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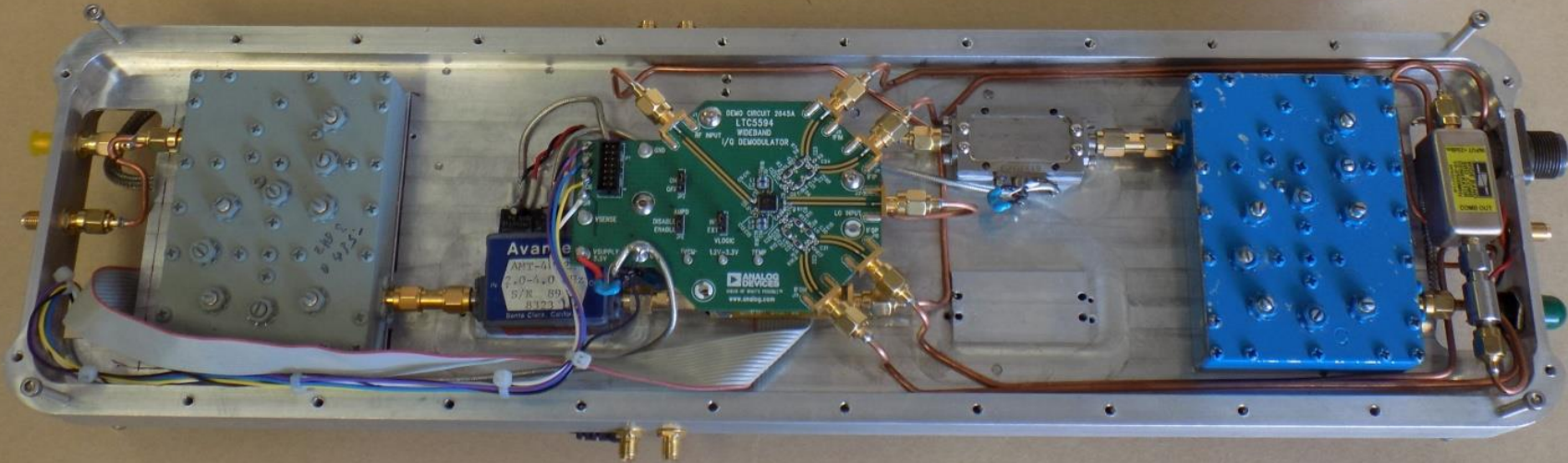




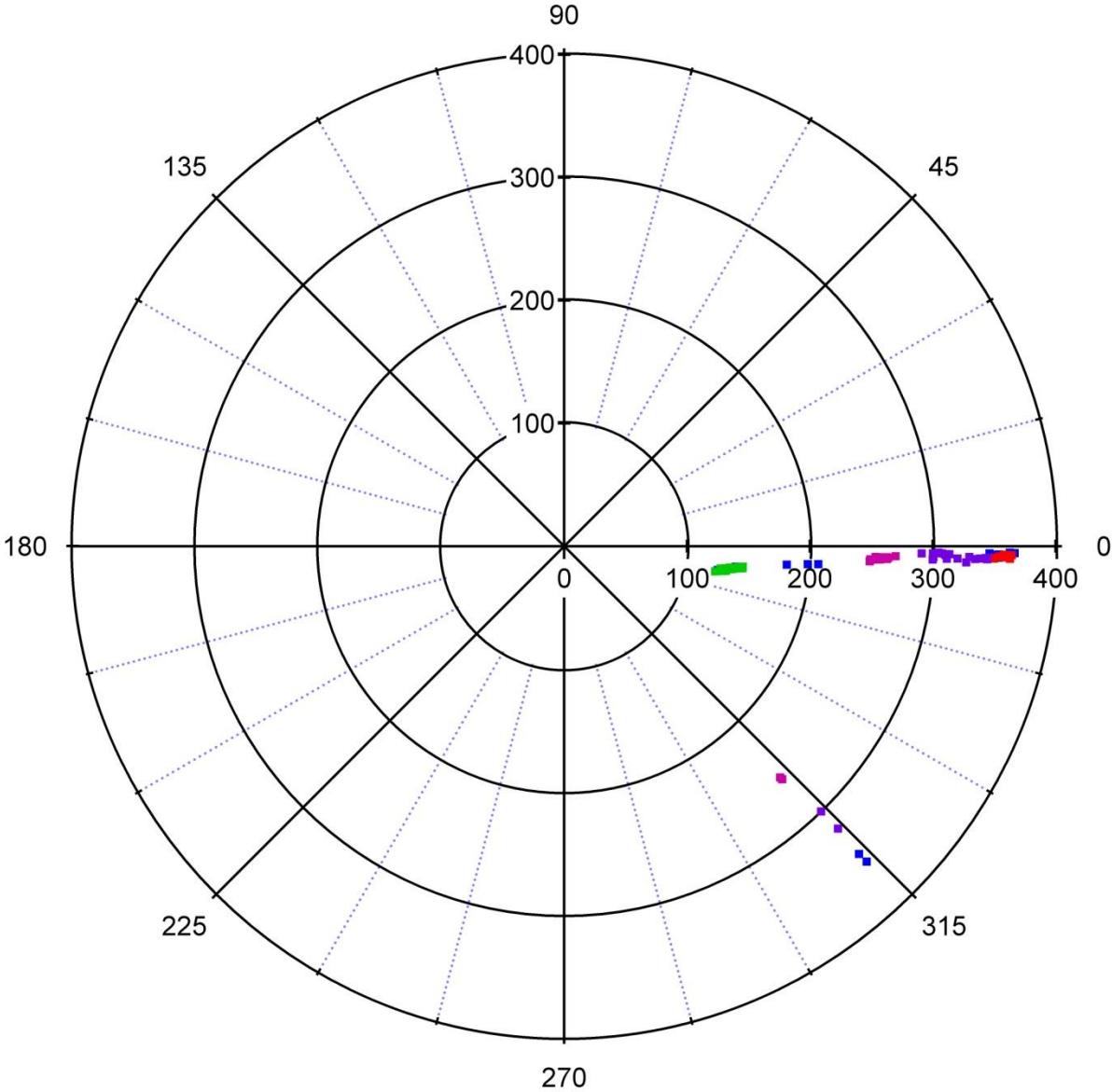




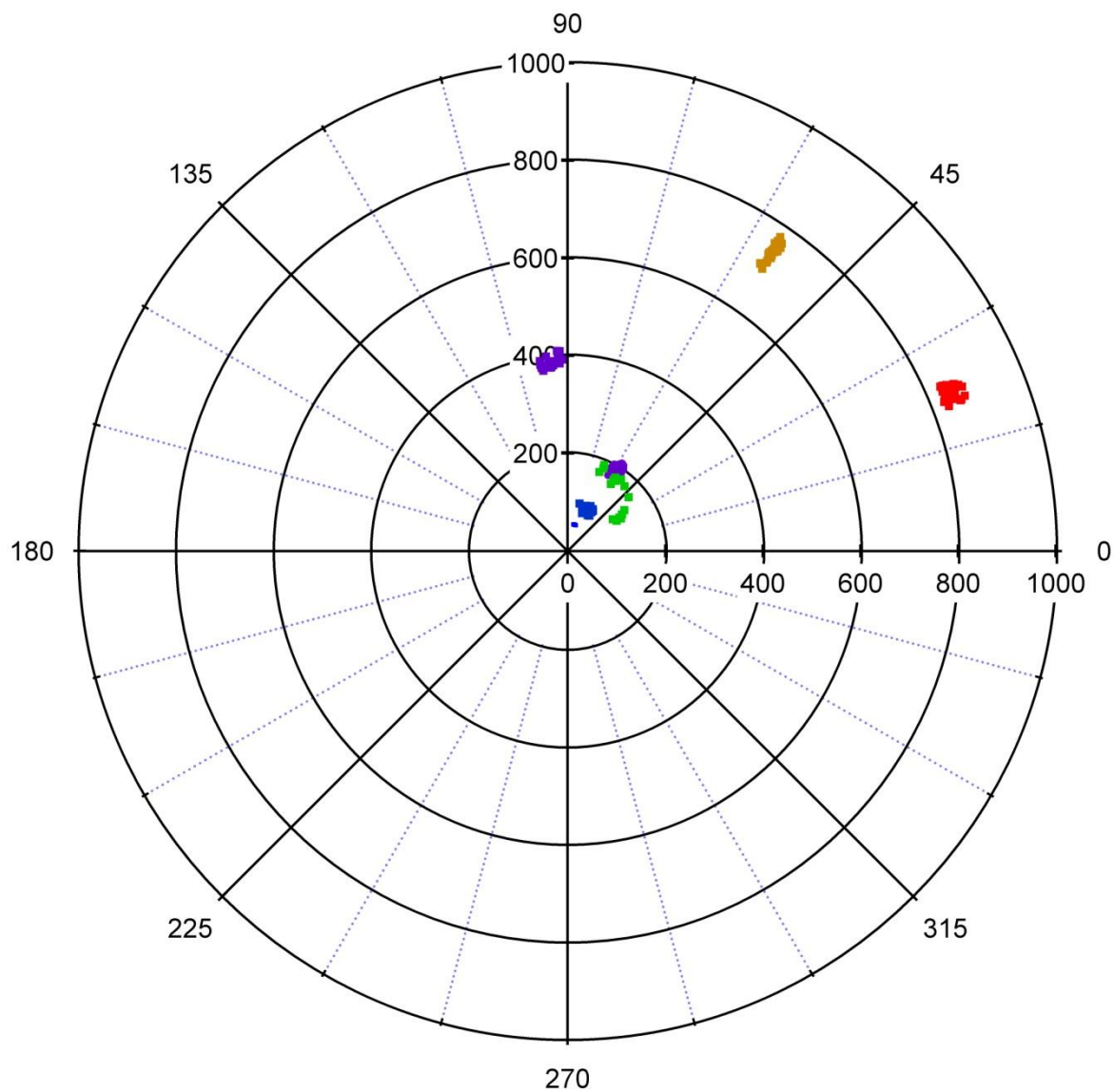




Measurement of an Unmagnetized Beam



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.

