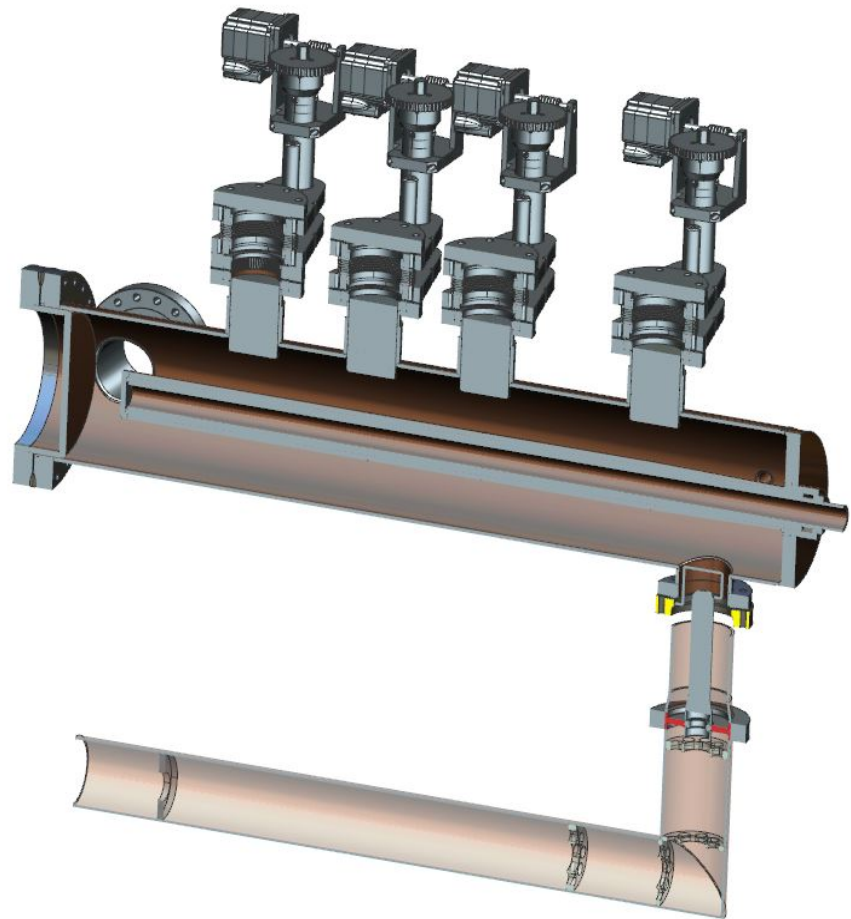


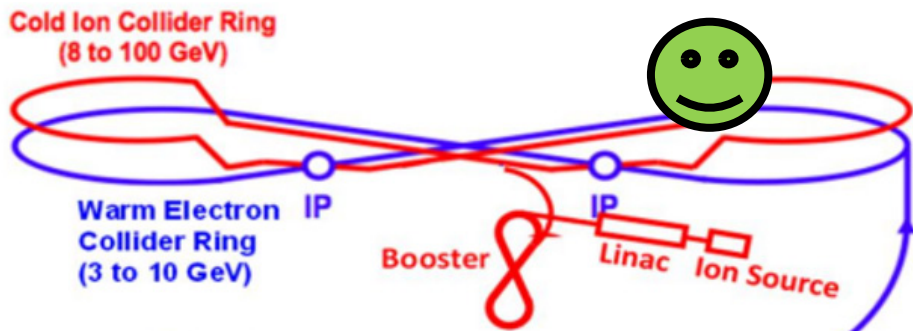
Manufacturing the Harmonic Kicker Cavity for the Electron-Ion Collider



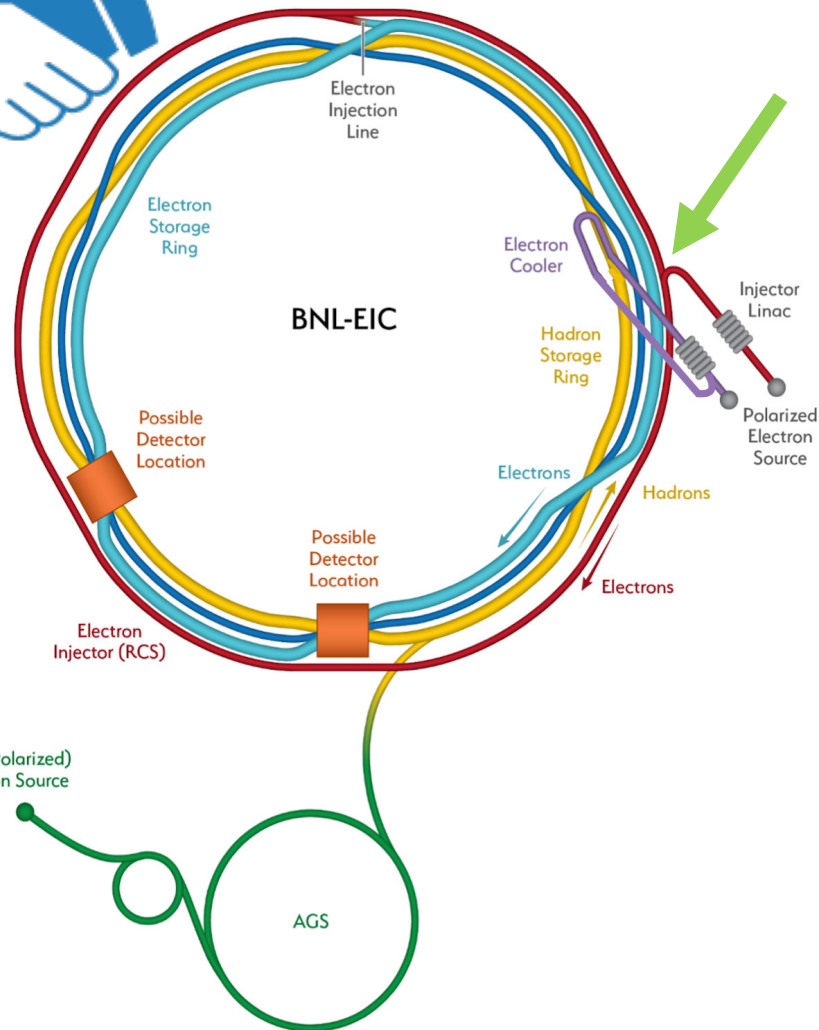
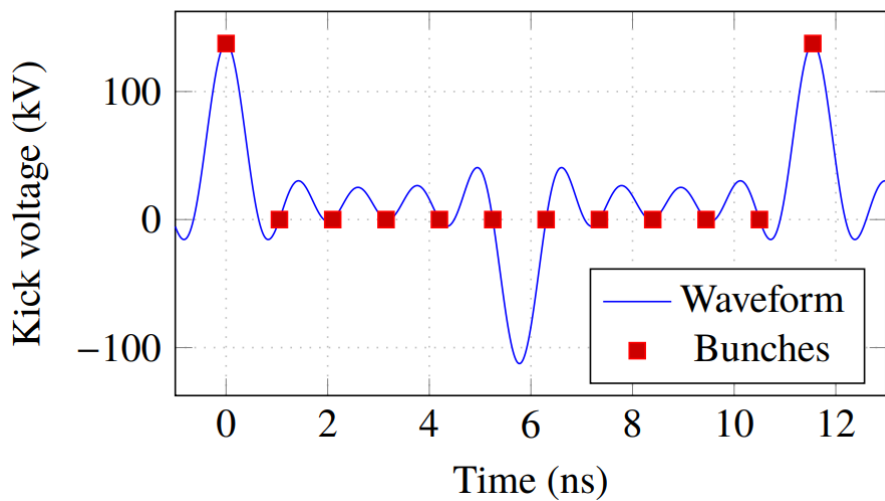
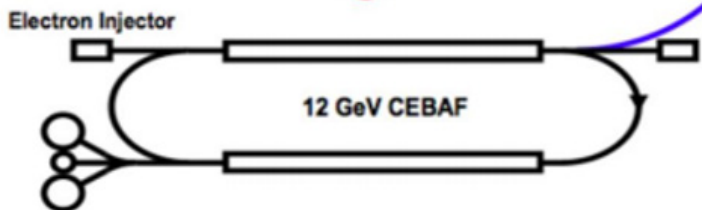
Sarah Overstreet

B.S. Math and Physics (2018)

*SRF R&D Tech./ Project
Coordinator*



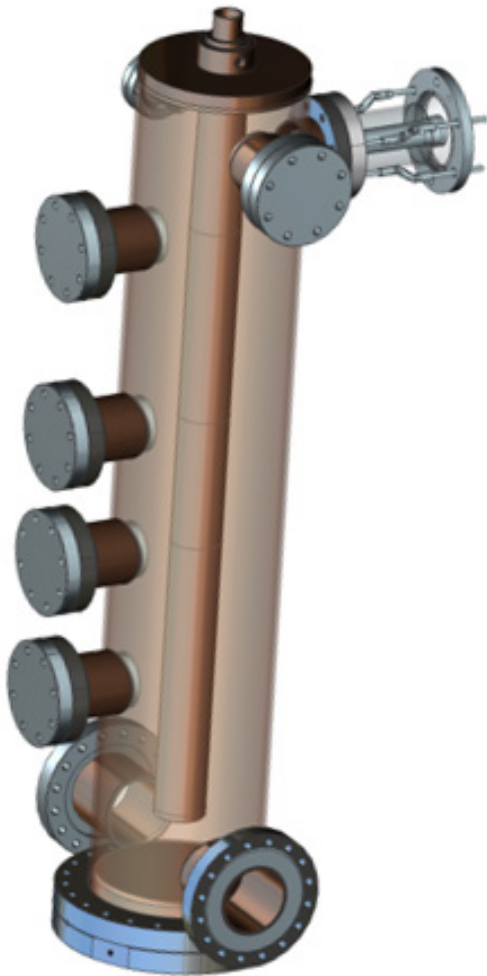
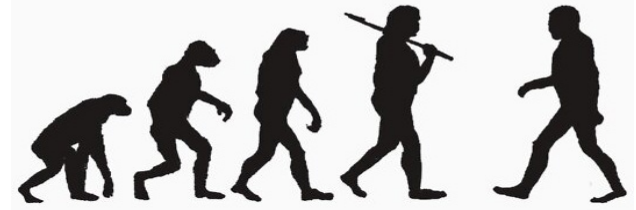
Jan. 2020 DOE announced BNL as the site for the EIC over the JLEIC, creating a new partnership between the labs.



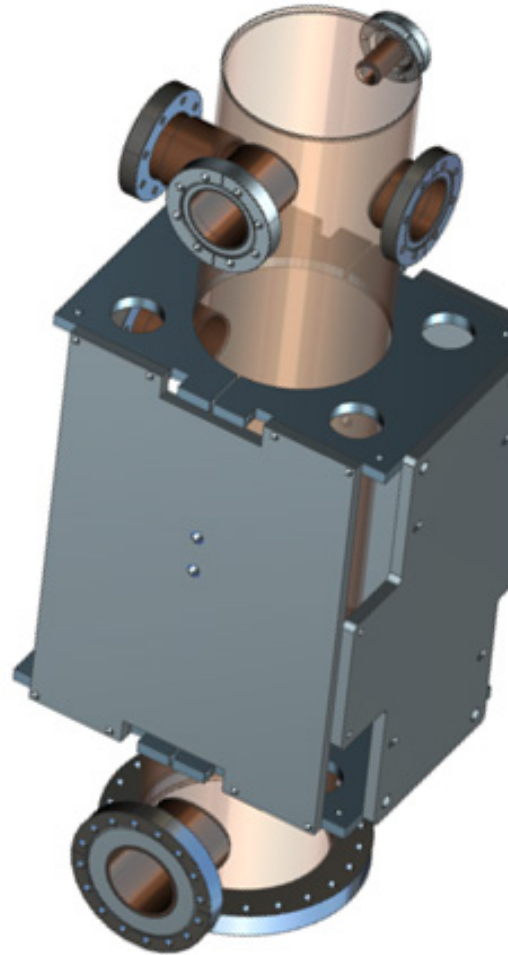
Design: May 2018 – Aug. 2022

Fabrication: Dec. 2019 – Sep. 2022

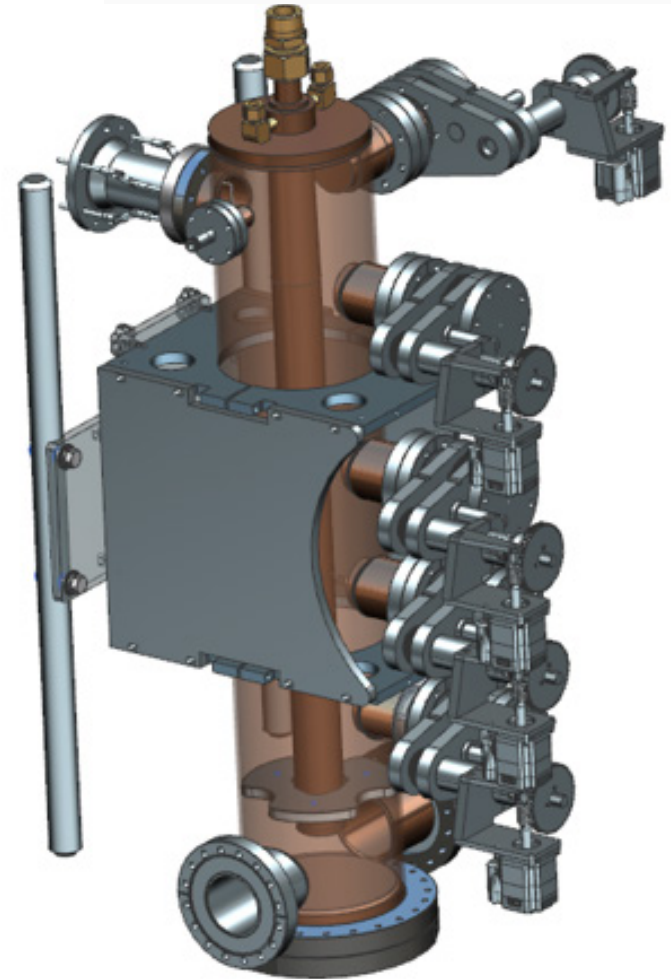
Go Back, We Screwed Up.



A

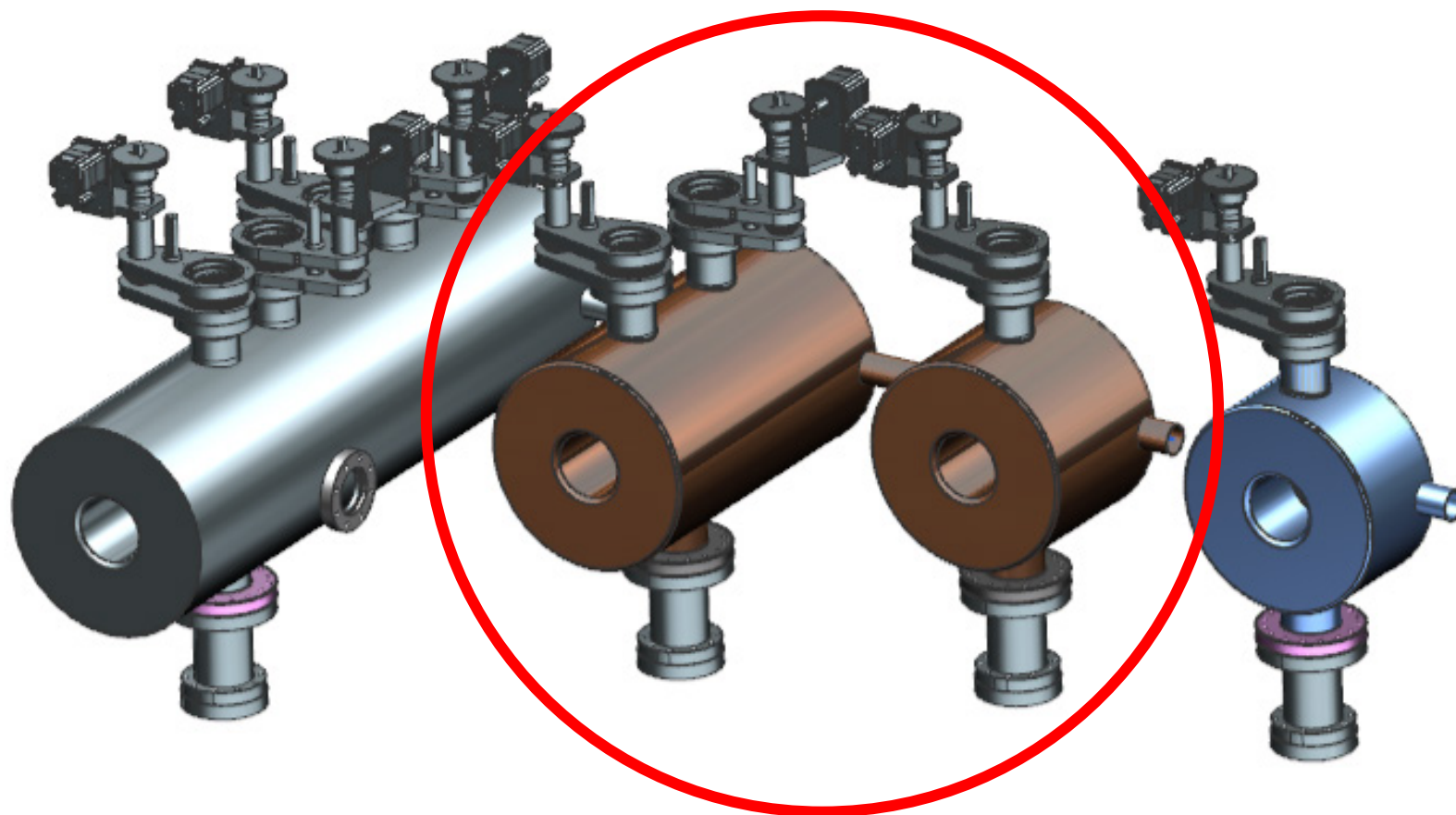


B



C

Preliminary BNL Design



Kicker Body - CMM Work **December 2019**

CMM:

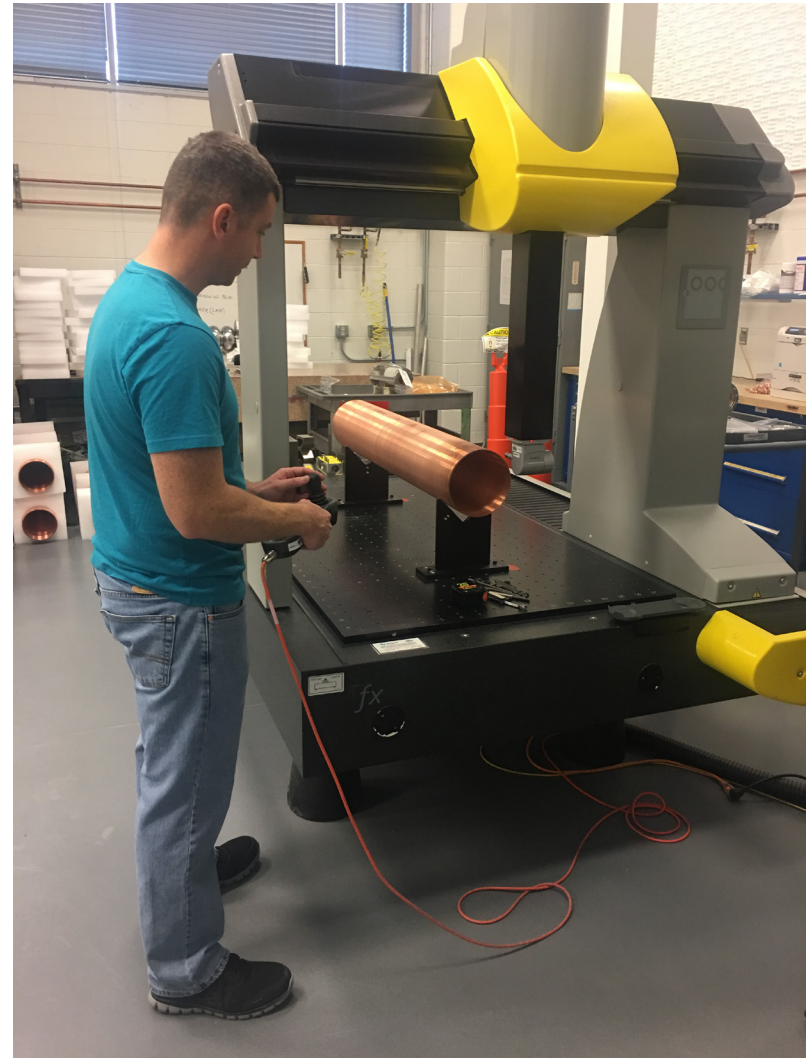
- Roundness
- 4 mm thick walls for EBW
- Straightness
- Concentricity

Challenges:

- Higher priority work
- Time for PC-DIMIS ~2 days
- Measurement time ~2 days

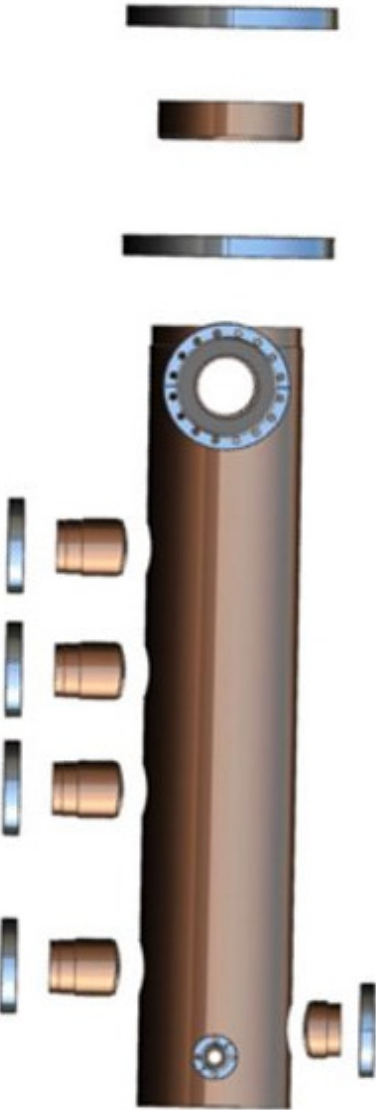
Actions:

- Best Tube → Body
- Second Best → Back-up Body
- Two Tubes → Practice EBW + Brazing

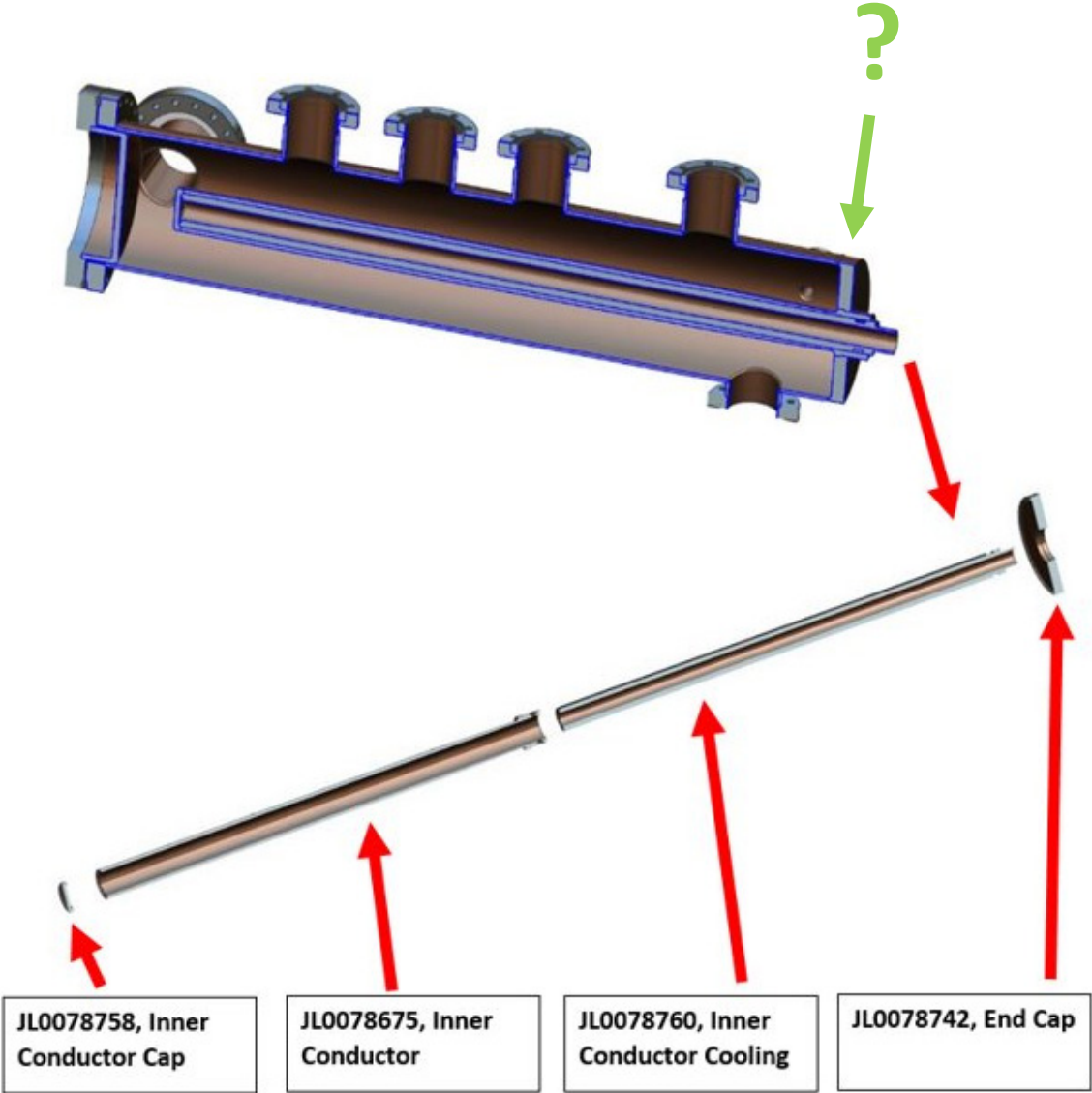


CMM Work for Kicker Body by Aaron Dekerlegand

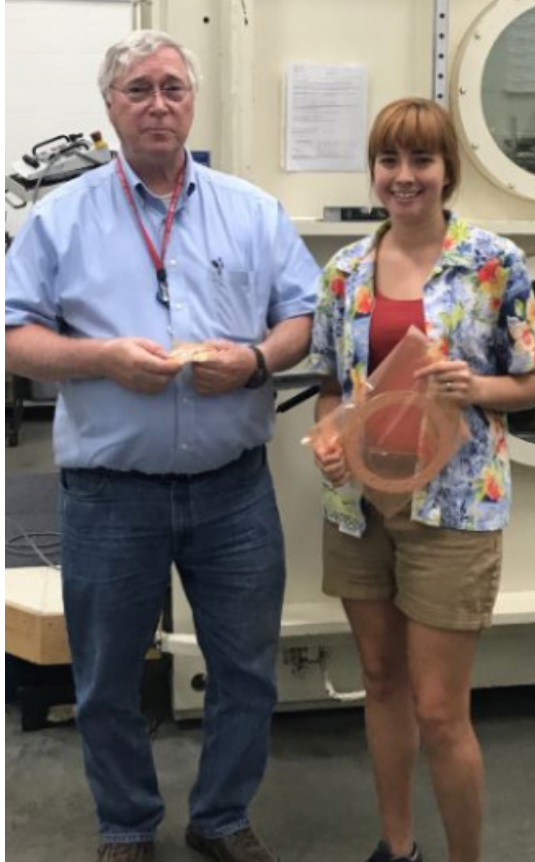
Brazing



EBW



EBW Machine Upgrade Dec 21, 2020 - March 15, 2021



Bill Clemmons
Summer REU 2017
Retired 2019

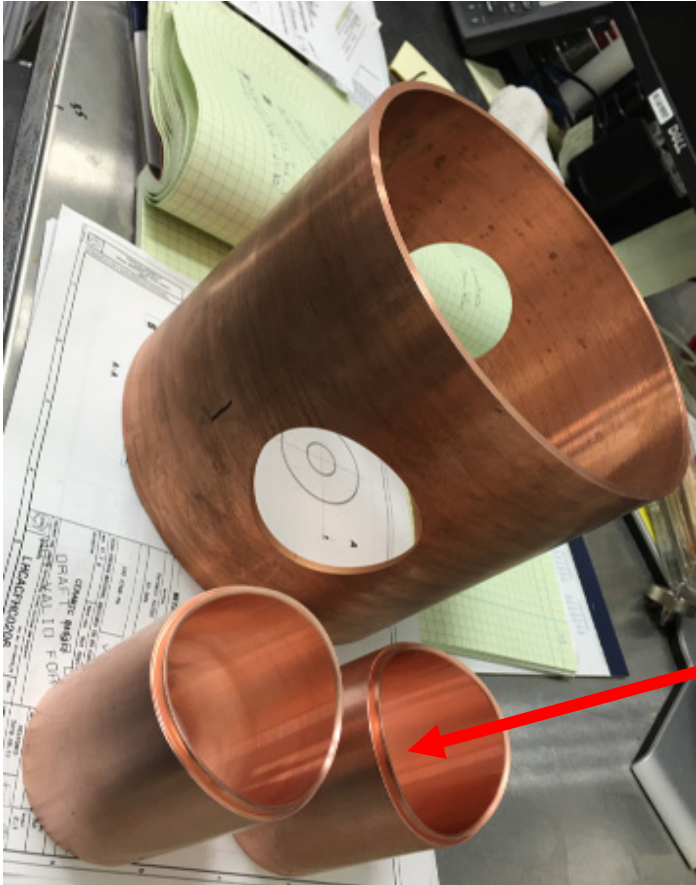


Jim Follkie showing off the
gutted EBW chamber.
Smile Jim!



Adam O'Brien (**NEW HIRE**)
Planning for EBW of kicker
parts

Brazing Practice Jan. 21-28, 2020 EBW Practice

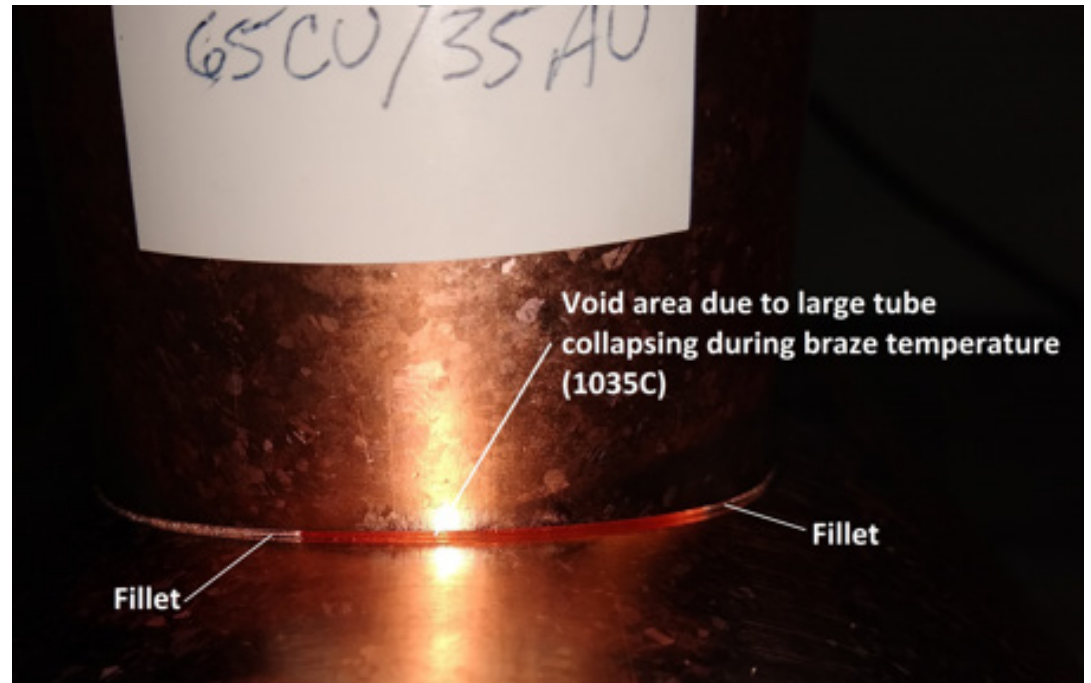
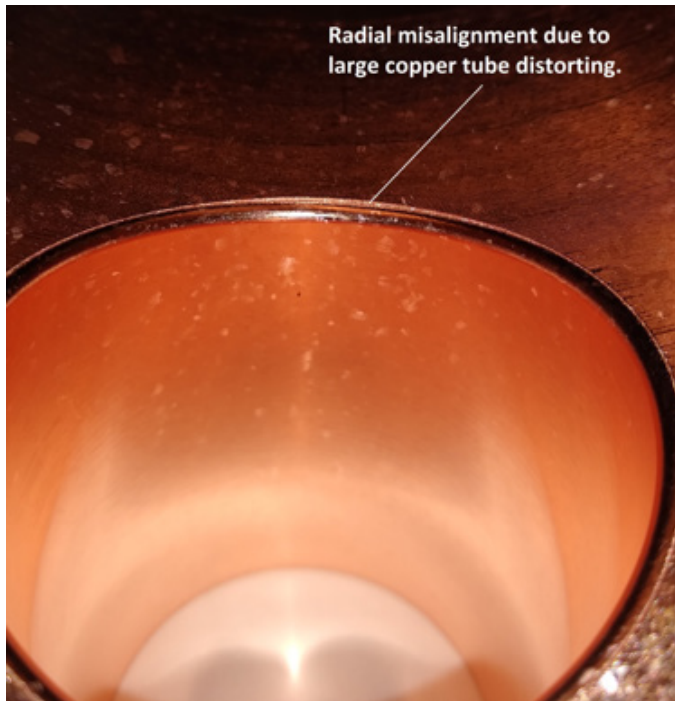
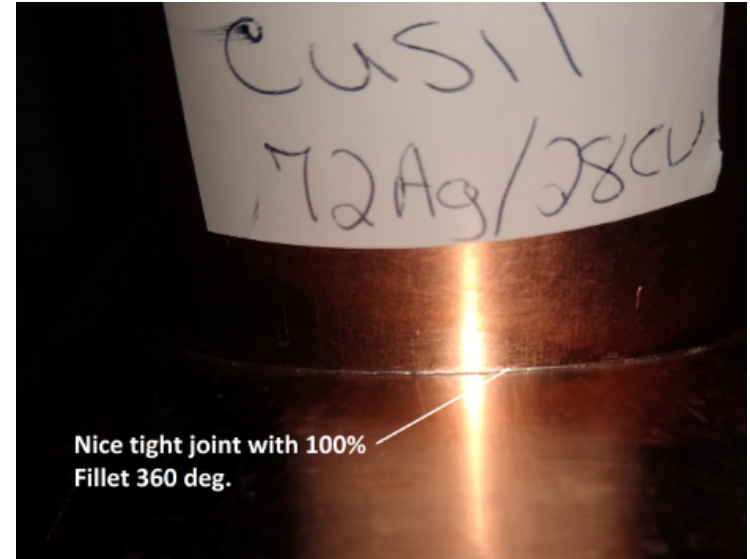
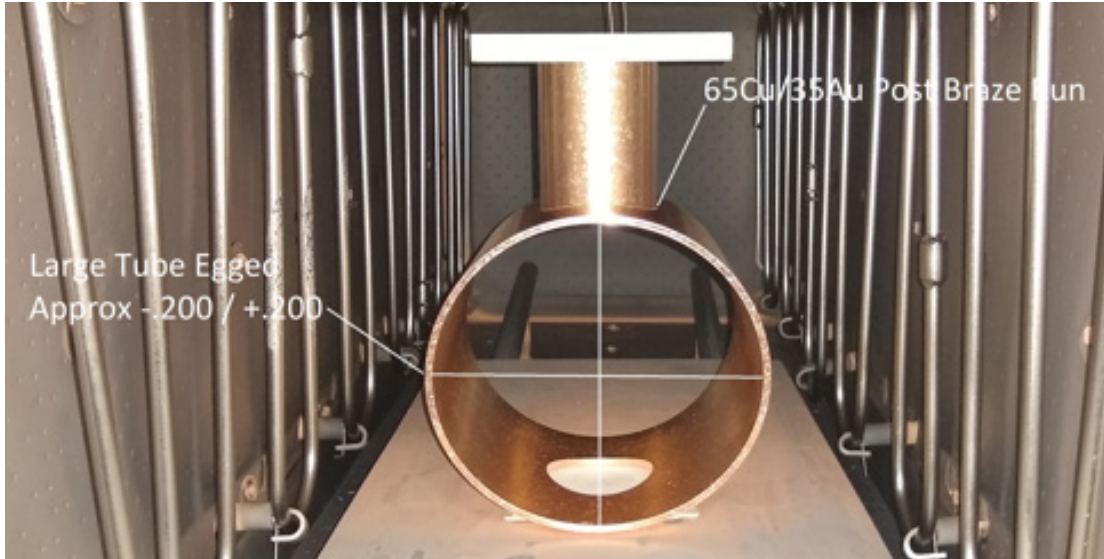


CNC Machining by
JLab's Daniel Boulais

*EBW Samples Machined by
JLab's Jerry Moore*

Brazing Practice Feb. 6-13, 2020

NOTE: C10100 Anneals 370-650 C



January 21-28, 2020

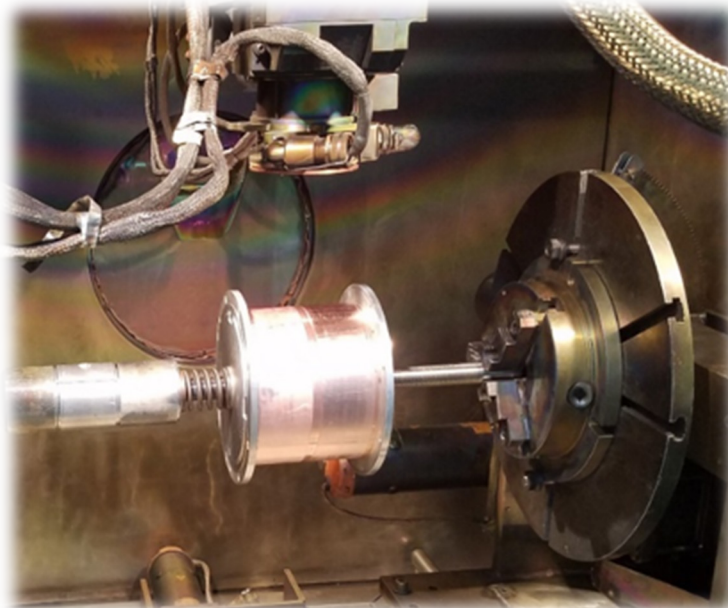
Machining of EBW and
Brazing Practice Parts



*Rings machined by
JLab's Jerry Moore*

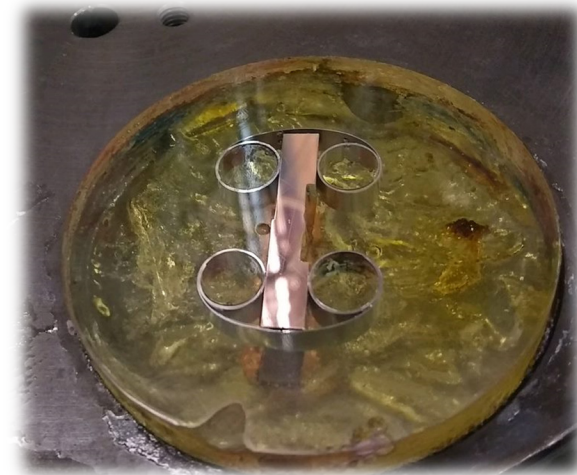
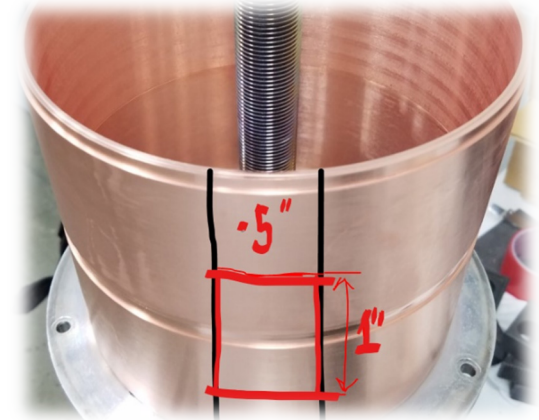
Aug., Sep., Dec. 2020

*Jim Follkie First EBW Practice Run.
No penetration for the step joint*



August-September 2020

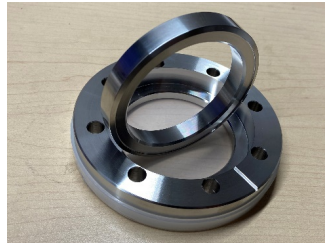
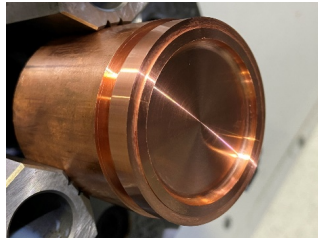
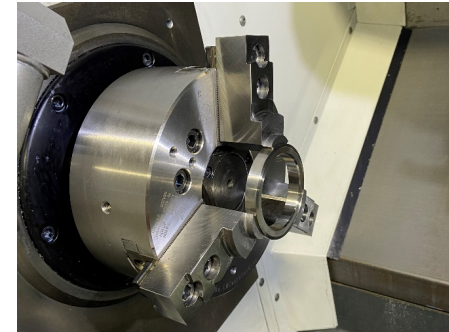
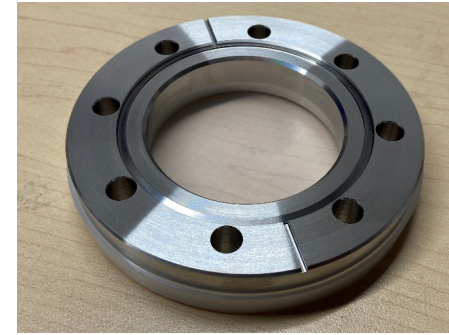
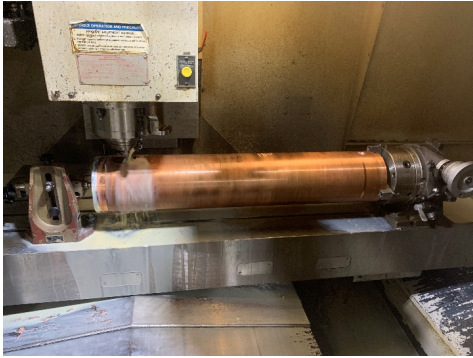
Making EBW Inspection Sample



*Inspection and Samples
provided by
Anne-Marie and Josh*

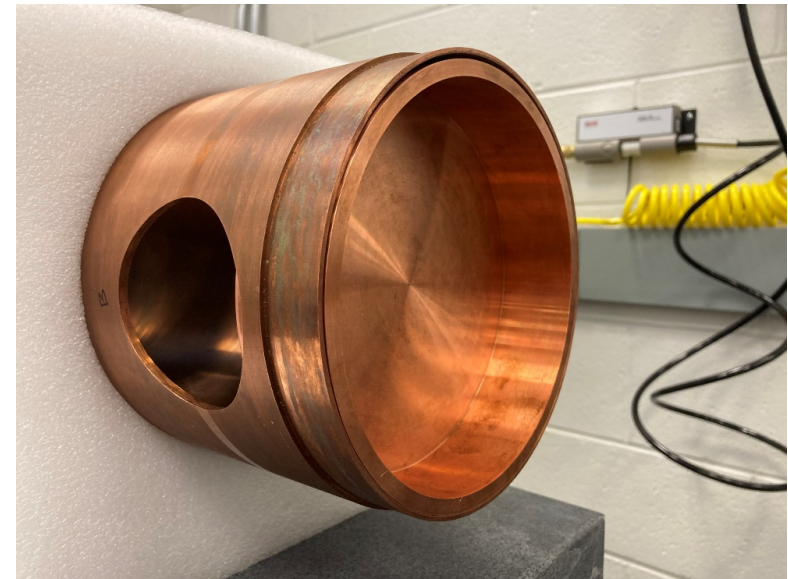
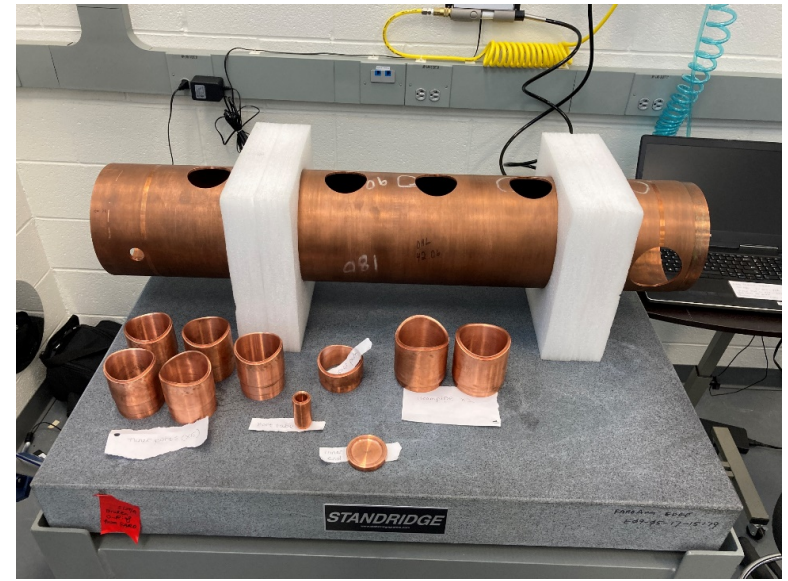
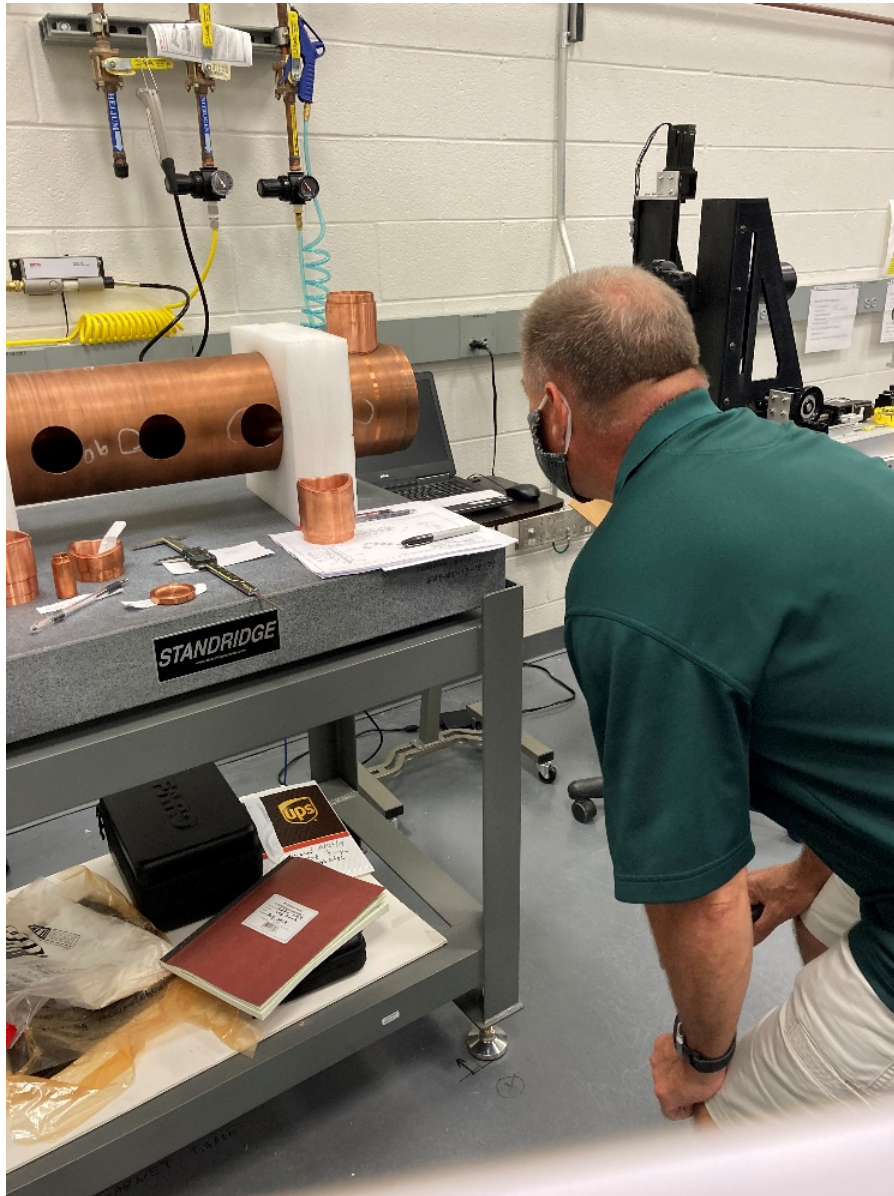


April-May Bidding and Award, July – Aug. 17 Machining



inSolves

Aug. 24 JLab Receives Crate
Sep. 12 Scott Williams Inspection



Nov. 2021 - Feb. 2022 JLab Machining

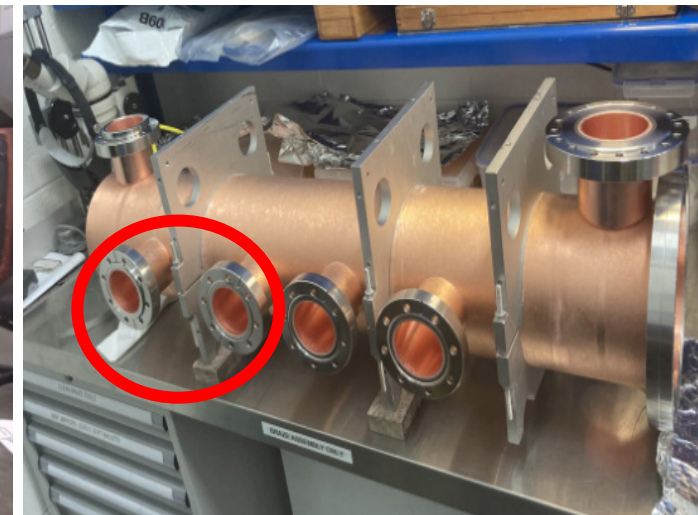
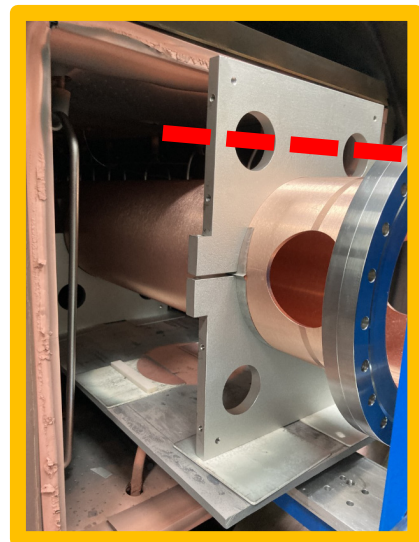
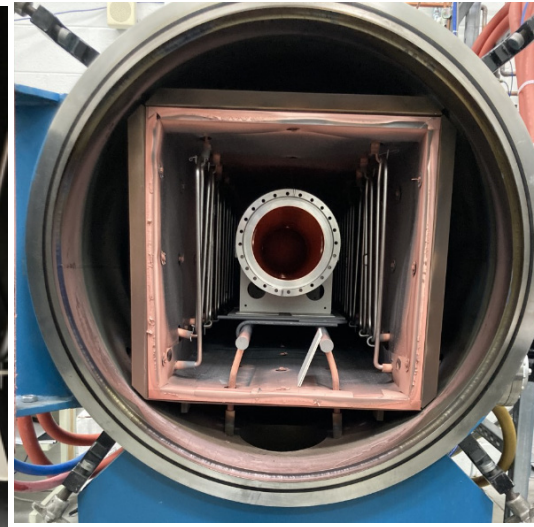
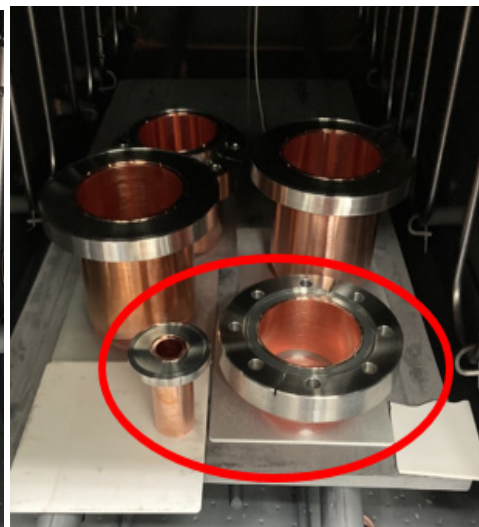


March - Aug. 2021

First Seven Braze Cycles @ 1035 C

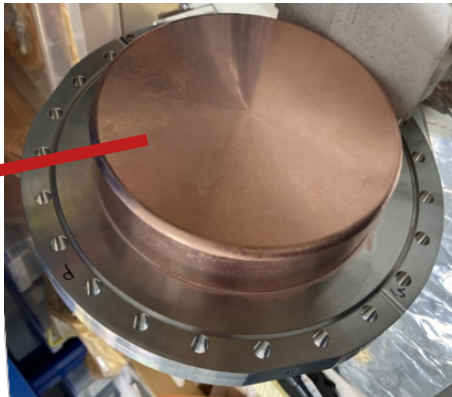
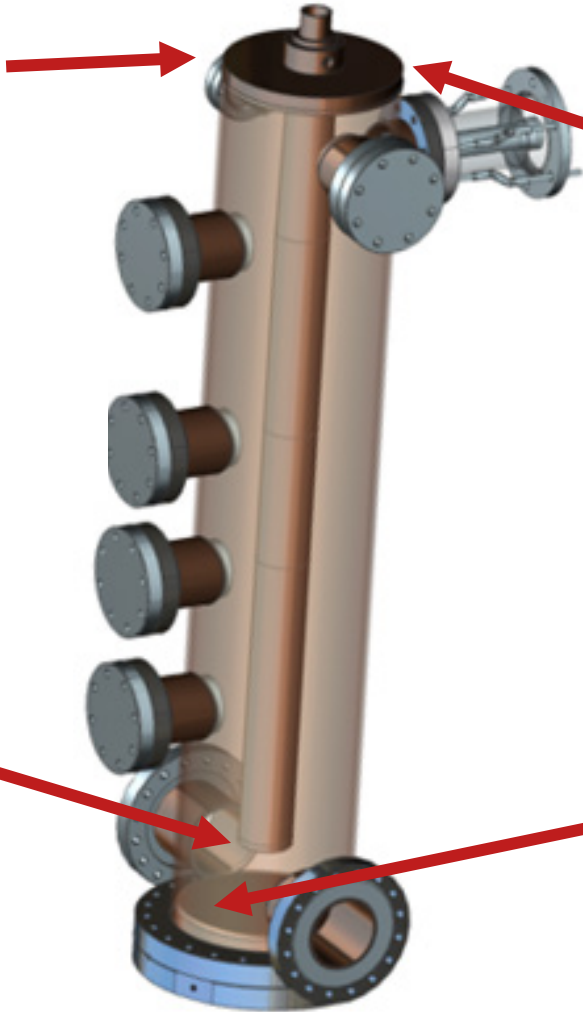
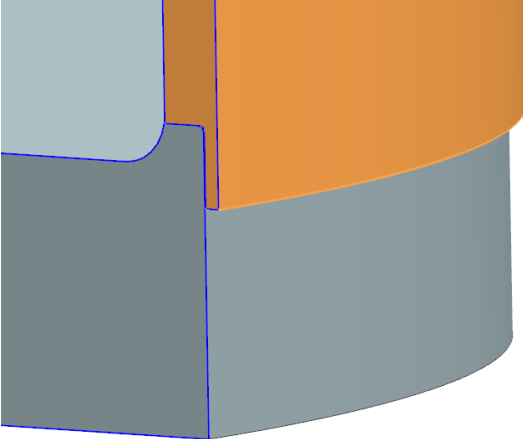
Jan. - Feb 18, 2022

Last Seven Braze Cycles @ 700-990 C

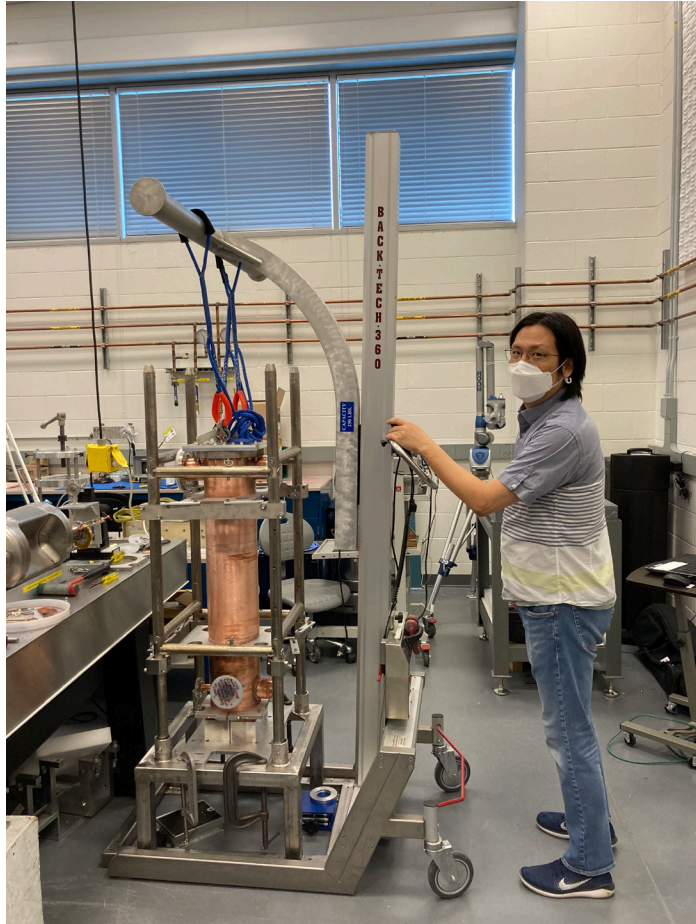


NOTE: SS Anneals 1000-1075 C

May - June Machine Shop Trimming



May – June RF Tests and Trimming for Fine Tuning



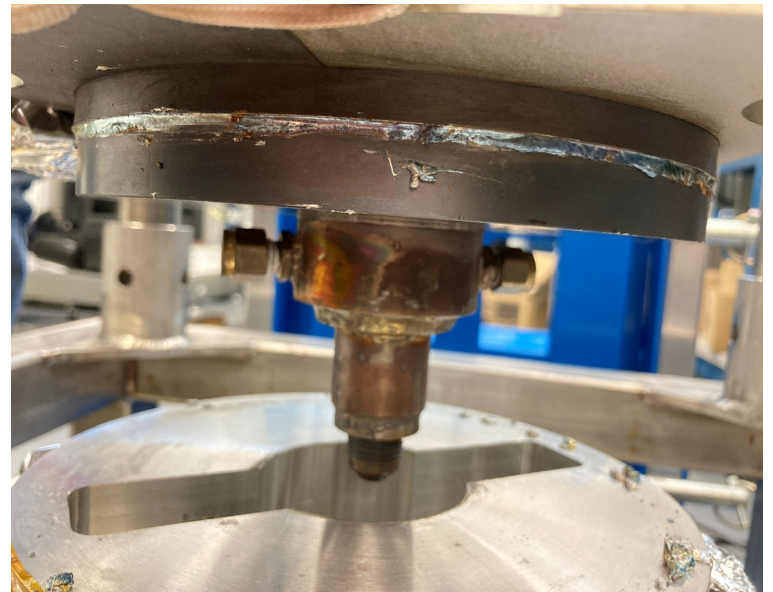
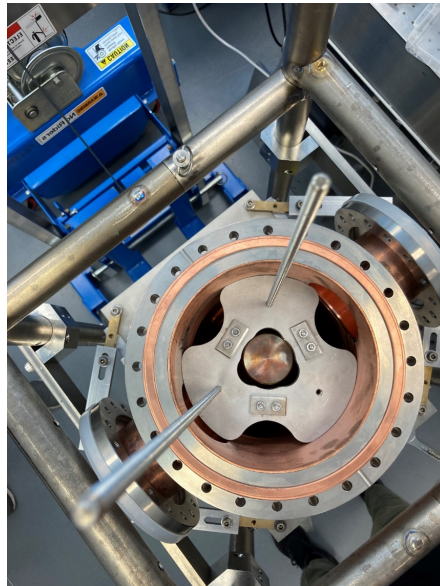
step	f_1	f_3	f_5	f_7	f_9
initial	86.257	258.024	432.223	603.296	776.994
1	86.411	259.050	431.905	604.610	778.186
2	86.514	259.361	432.445	605.376	778.865
3	86.611	259.649	432.894	606.042	779.016
final	86.611	259.689	433.014	606.181	777.566
target	86.588	259.774	432.956	606.138	779.319

Initial – Before trimming

1. 2 mm cut into the body
2. 1 mm cut on I.C. and on the body
3. 1 mm into body, 1.2 mm on I.C.

Final - EBW inner conductor cap.

July 27- Aug. 1- 5 Present Status of Cavity Fabrication



S-Bond 220 92% Sn, 3.5% Ag, 2.5 % Ti, 0.1% Ce, and 0.1% Ga

The HAWG: Harmonic Arbitrary Waveform Generator HAWC: Harmonic Amplifier and Waveform Combiner

DOE SBIR DE-SC0020566

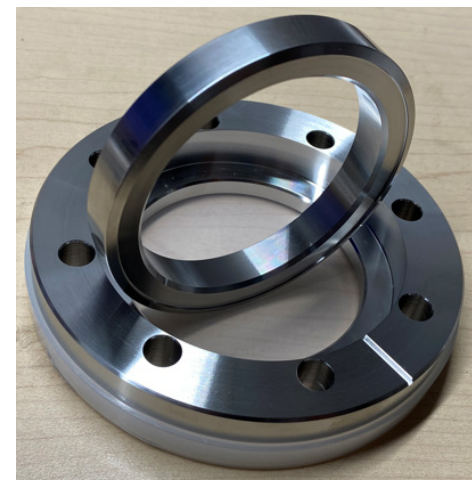
Electrodynamic

Brock Roberts, 5/21/21





May 2019 Steve
Barbarits at the JLab
Small Business
Conference



Mike MacCrae & Jarred

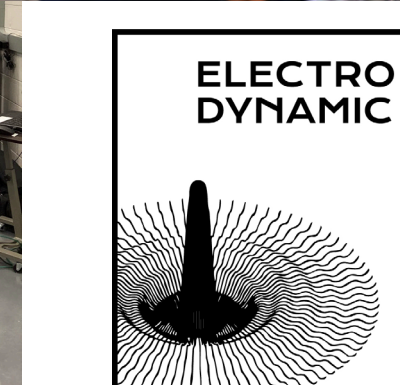
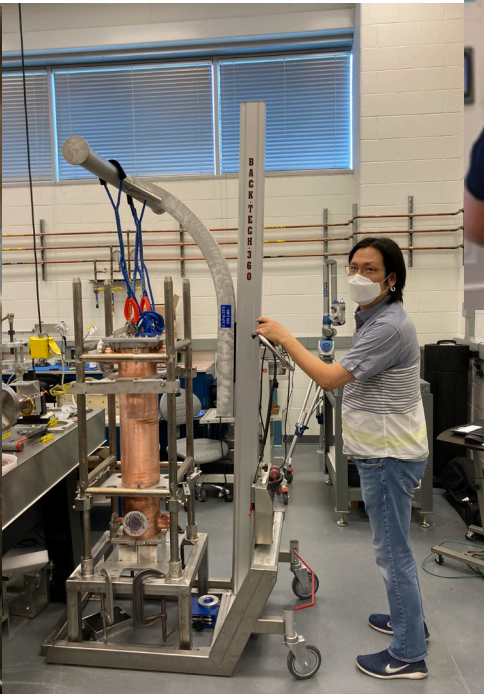
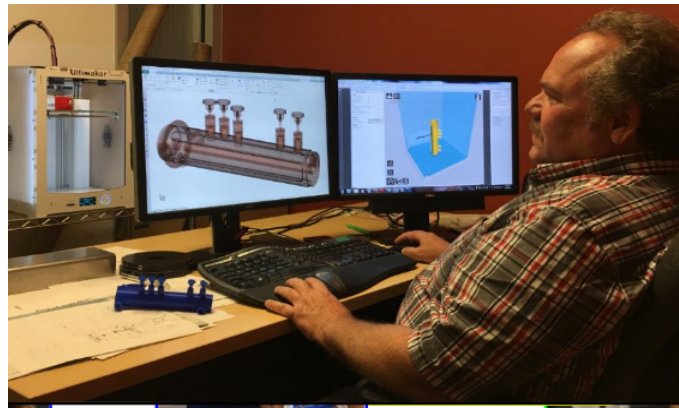


Che Burchett & Roger Allgood



Clay Bapst & Dylon Ison

Thank You Jefferson Lab Team!



References

- [1] U.S. Department of Energy Selects Brookhaven National Laboratory to Host Major New Nuclear Physics Facility, 2020. <https://www.energy.gov/articles/us-department-energy-selects-brookhaven-national-laboratory-host-major-new-nuclear-physics>
- [2] S. V. Benson et al., “Development of a Bunched Beam Electron Cooler Based on ERL and Circulator Ring Technology for the Jefferson Lab Electron-Ion Collider,” in Proc. COOL’17, Bonn, Germany, Sep. 2017, pp. 72–76. doi:10.18429/JACoW-COOL2017-WEM12
- [3] F. Willeke and J. Beebe-Wang, “Electron Ion Collider Conceptual Design Report,” 2021. doi:10.2172/1765663
- [4] G. T. Park, J. Guo, R. A. Rimmer, H. Wang, and S. Wang, “Beam exchange of a circulator cooler ring with an ultrafast harmonic kicker,” Phys. Rev. Accel. Beams, vol. 24, no. 6, p. 061 002, 2021. doi:10.1103/PhysRevAccelBeams.24.061002
- [5] Y. Huang, H. Wang, R. A. Rimmer, S. Wang, and J. Guo, “Ultrafast harmonic rf kicker design and beam dynamics analysis for an energy recovery linac based electron circulator cooler ring,” Phys. Rev. Accel. Beams, vol. 19, no. 8, p. 084 201, 2016. doi:10.1103/PhysRevAccelBeams.19.084201
- [6] S-Bond Solder Alloys: <https://s-bond.com/products/s-bond-solderalloys>