

Design, Manufacturing, Assembly, and Lessons Learned of the ppSSR2 325MHz PIP-II Couplers



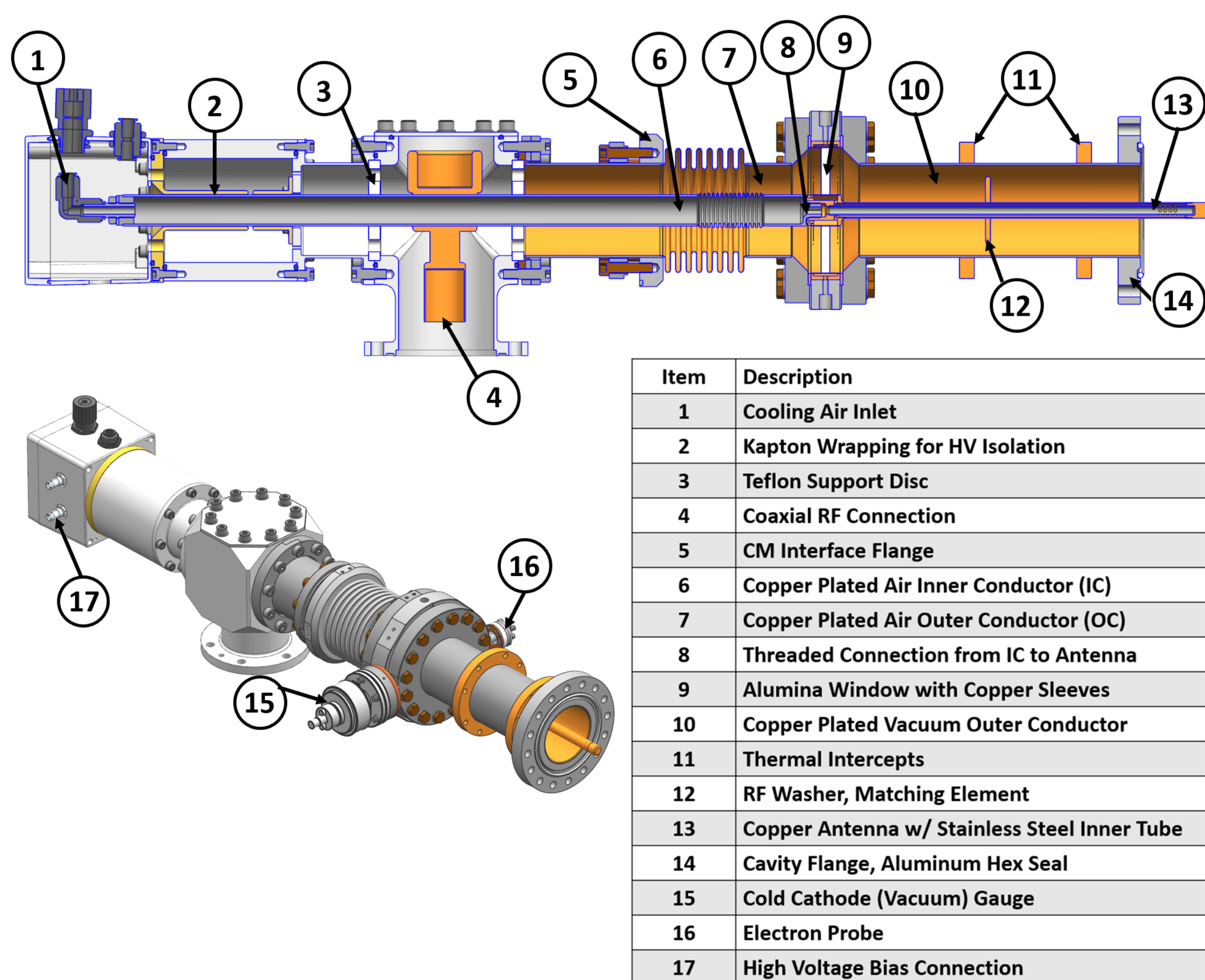
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ABSTRACT

Five 325~MHz high-power couplers will be integrated into the pre-production Single Spoke Resonator Type-II (ppSSR2) cryomodule for the PIP-II project at Fermilab. Couplers were procured by both Fermilab and IJCLAB for this effort. The design of the coupler is described, including design optimizations from the previous generation. This paper then describes the coupler life cycle, including design, manufacturing, and assembly, along with the lessons learned at each stage.

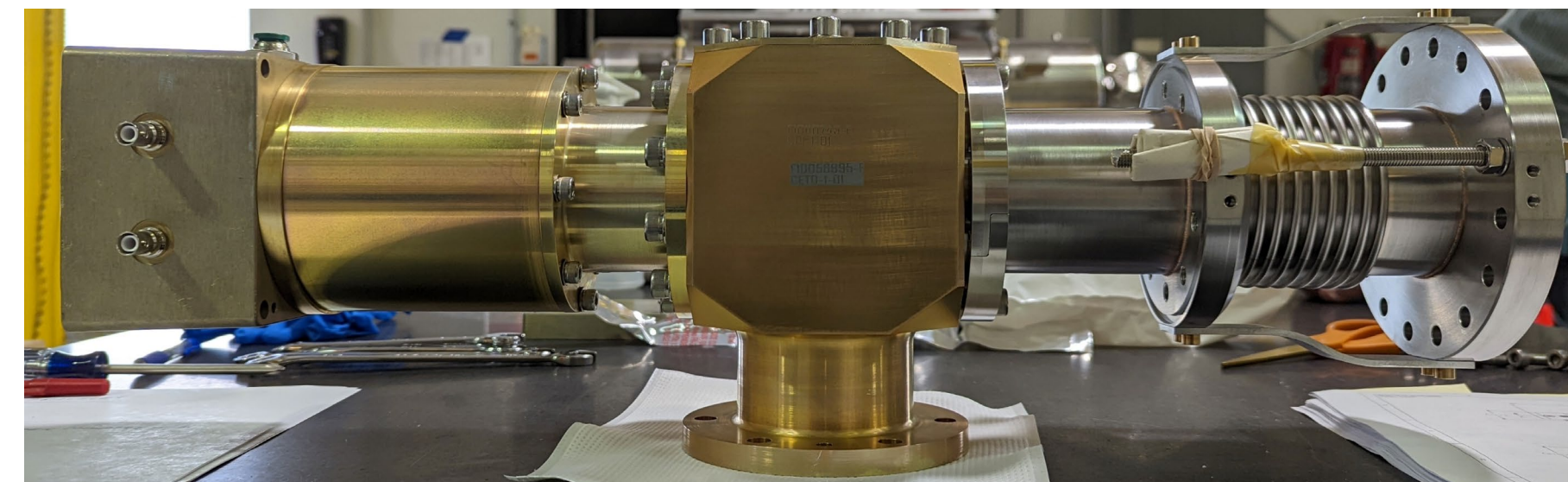
DESIGN



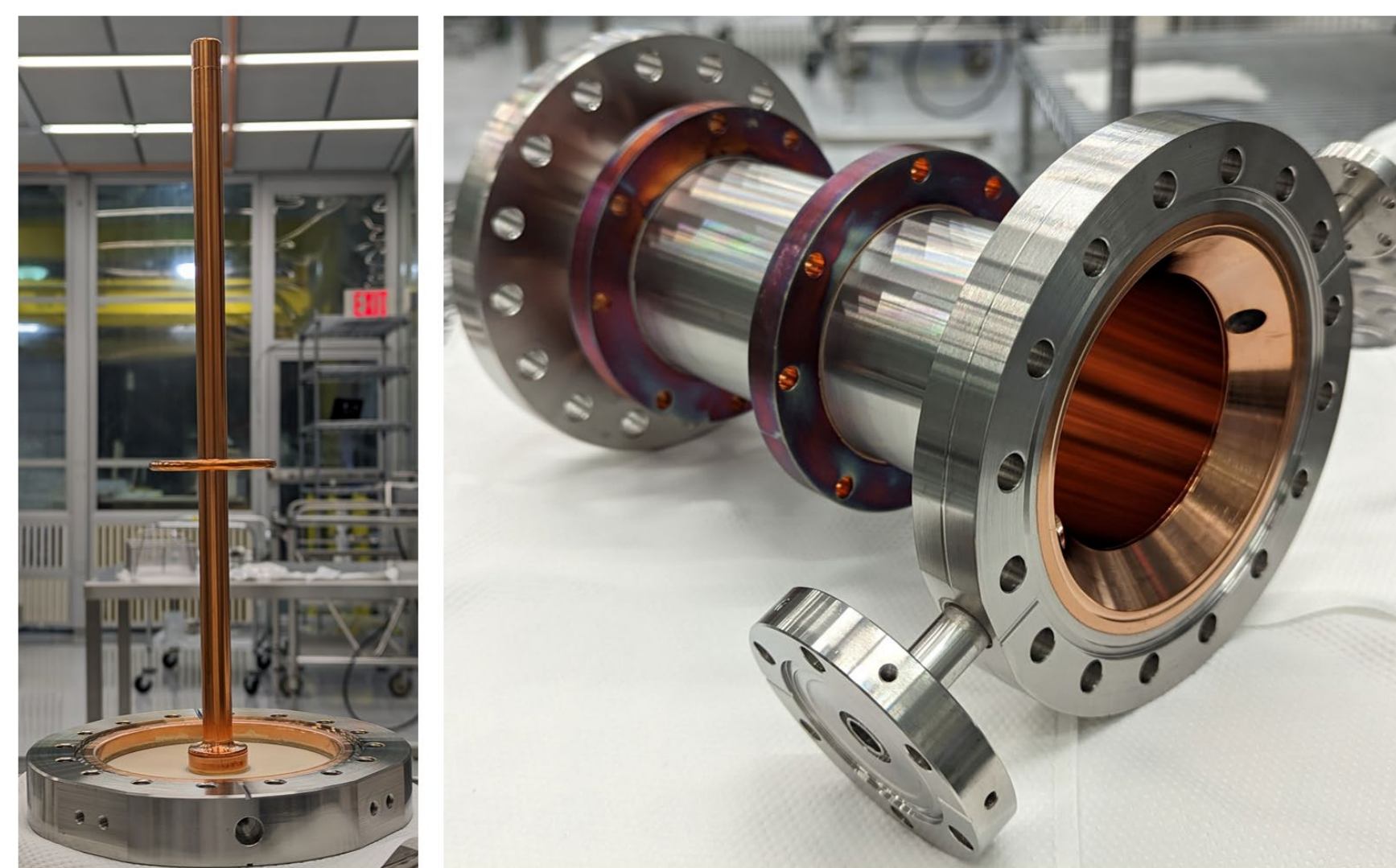
Proton Improvement Plan-II



INCOMING INSPECTION



FNAL AIR SIDE, ACCEPTED



IJCLAB VAC SIDE, ACCEPTED

Challenges Faced

- General uncleanliness
- Damaged sealing surfaces
- Underfilled brazed, facing cavity
- Bent antennas – some due to brazing process (FNAL), others due to mishandling during packaging (IJCLAB)
- Foreign SS particulate adherent to the antenna tip (FNAL)
- Surface finish on antennas not ideal (FNAL)



FNAL VAC SIDE, REJECTED



SHIPPING DAMAGE



Lessons Learned

- A final detailed visual inspection should be performed by the vendor prior to shipment
- Use solid stock for antenna body

MANUFACTURING

IJCLAB Lessons Learned

- Significant reliance on sub-contractors can lead to significant delays and quality issues
- Individual part pairing leads to better brazes

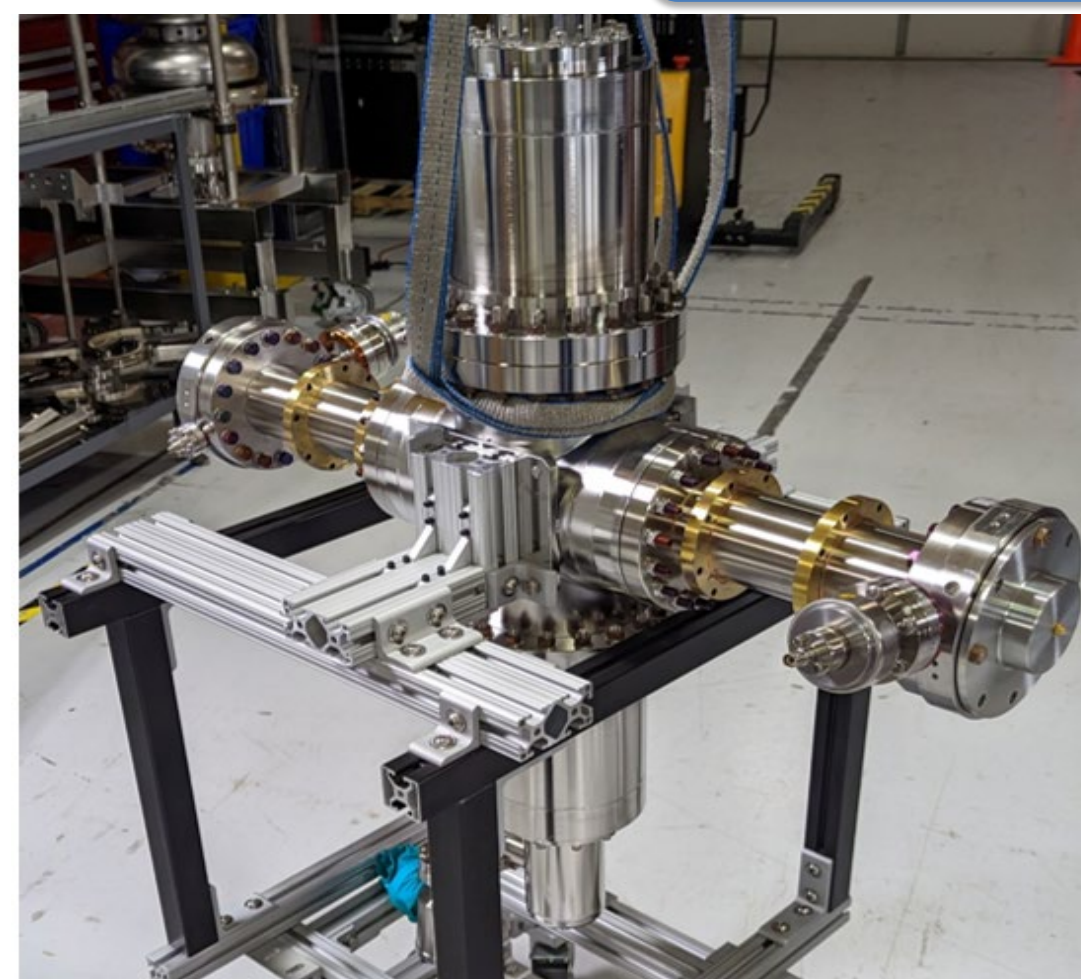
FNAL Lessons Learned

- Powdered braze material should NOT be allowed
- Flanges MUST always have protective covers
- Antenna straightness requirements should reflect the real impact on Qext
- Vendors MUST be required to redesign brazing joints based on their experience

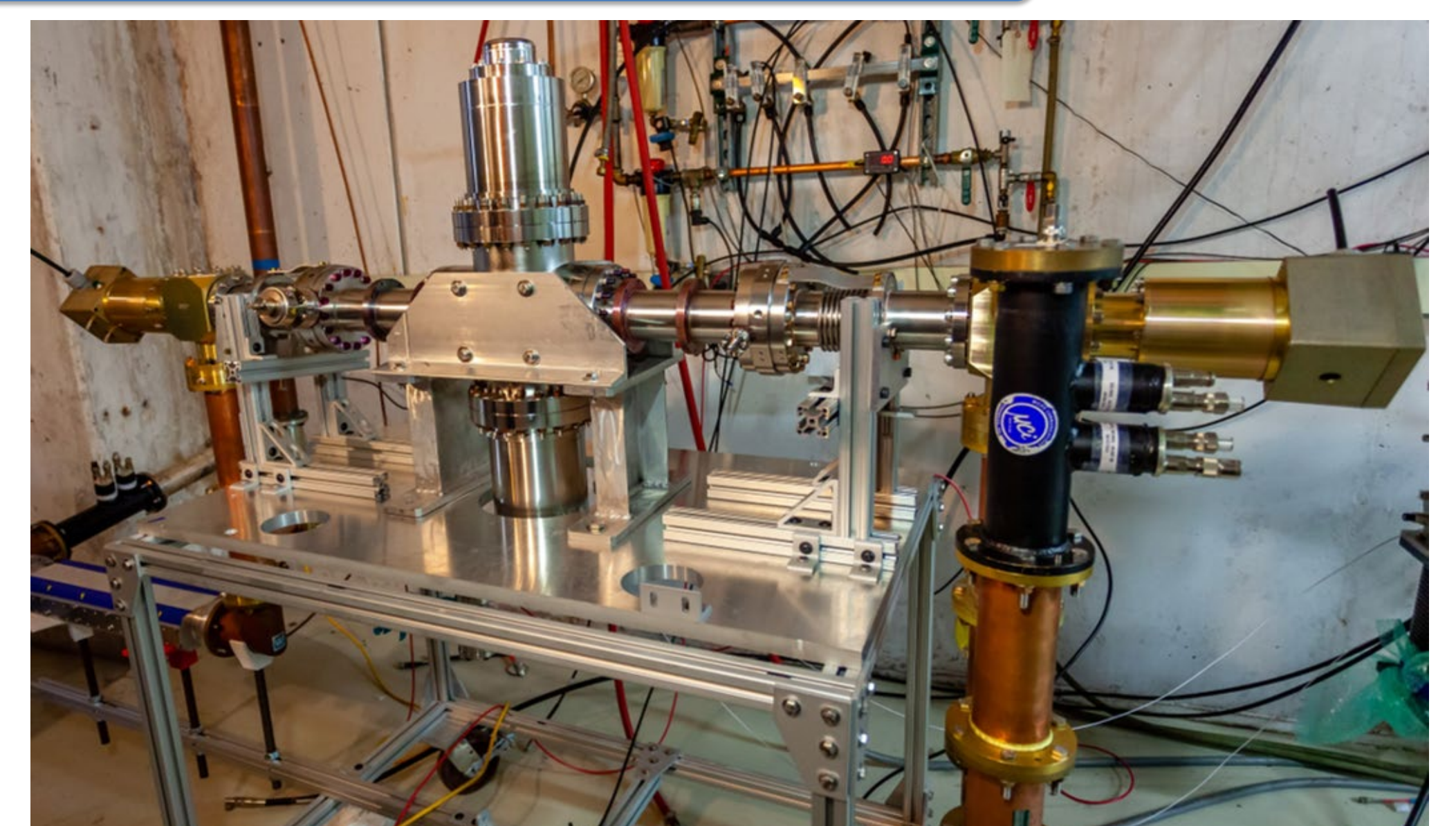
Shared Lessons Learned

- Visitation to vendors & sub-contractors is crucial to finding issues and ensuring basic rules and procedures are followed
- First unit inspection by FNAL/IJCLAB should occur immediately prior to shipment, not months prior

ASSY, TRANSPORT, BAKING



CLEAN ROOM CART



RF TEST STAND ASSY

Lessons Learned

- Improved mounting features can cut down on labor
- Modifications to chamber are needed to use bent antennas

SUMMARY

In summary, the ppSSR2 couplers procured by FNAL and IJCLAB met the necessary technical requirements, showing both vendors can deliver couplers. Small production runs of couplers are prone to more QC issues. The lessons learned will help to benefit production couplers.



EMAIL LINK