

# 650MHz 2-Phase Flanged Connection Test

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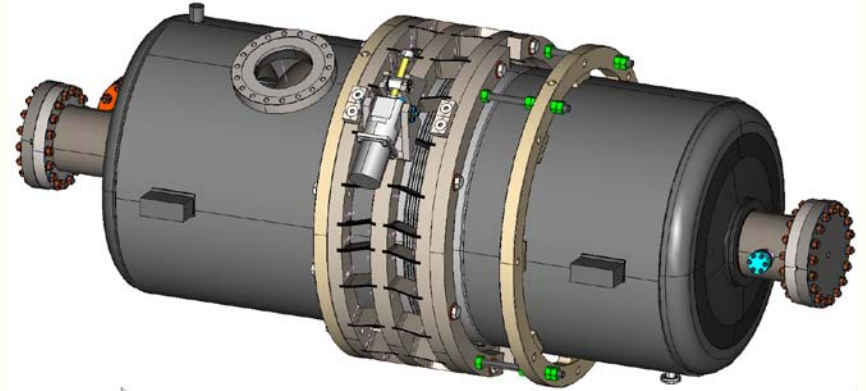
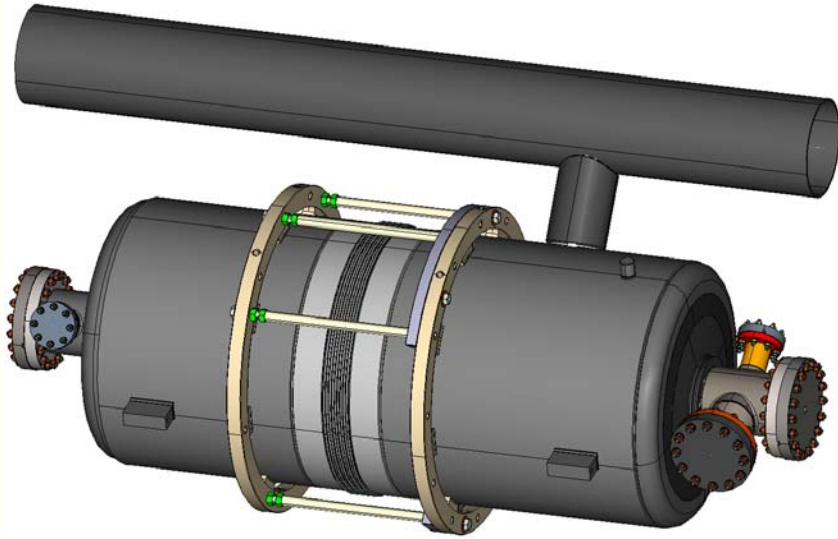
# Introduction



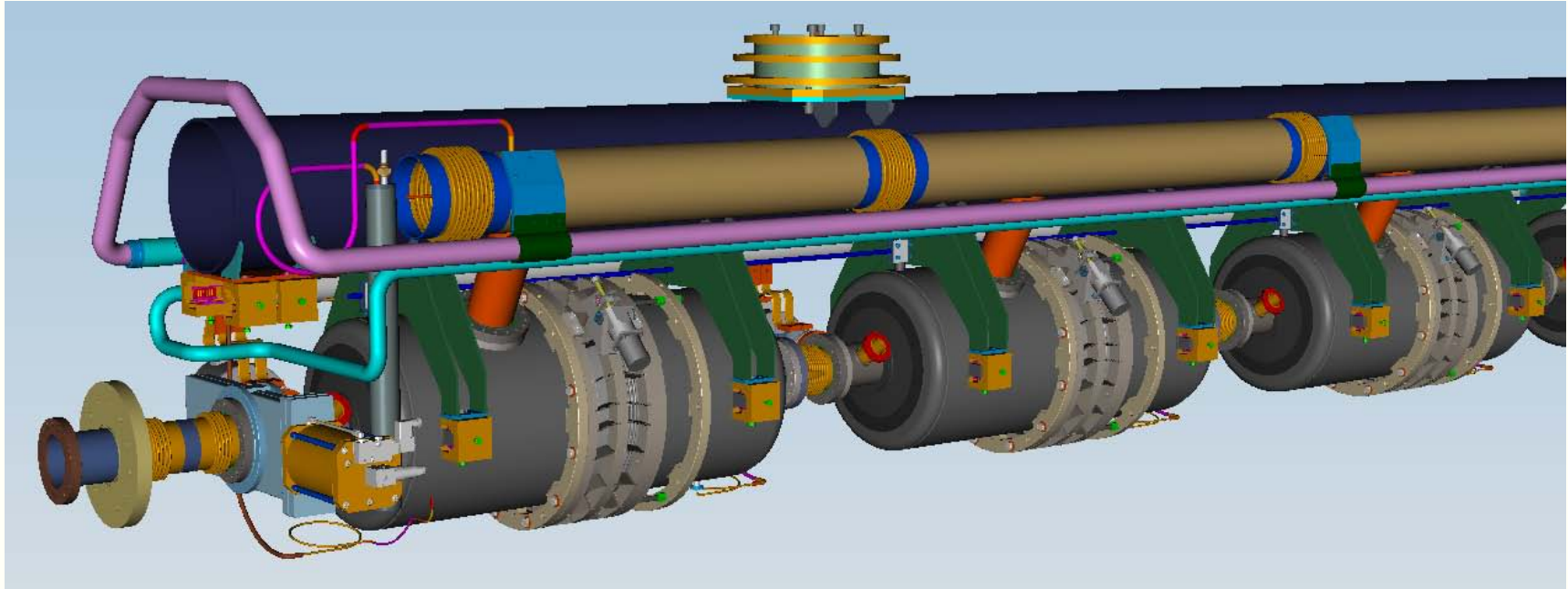
- **FNAL proposed a design to eliminate the titanium 2-phase pipe from the helium vessel design in favor of a 2-phase stainless steel pipe incorporated into the cryomodule piping scheme, this would require a stainless steel/titanium flanged connection.**
- **Preliminary tests were conducted on the titanium and stainless-steel flanged connection for seal reliability under vacuum and in cryogenic conditions**



# Helium Vessel Design Concepts



- Helium vessel design shows configuration with 2-phase pipe and with 2-phase flange.
  - Some advantages of the 2-phase flanged connection:
    - Much simpler to fabricate – 2-phase pipe parallelism has been problematic for vessel vendors.
    - Eliminate the need to cut off both ends of pipe in the cavity string and orbital weld 8 (16 welds) interconnect bellows. The titanium orbital welds in the cavity string prove to be challenging.
    - Eliminates the need to cut and re-weld the pipe when further cavity processing is required on dressed cavities, ie. EP, BCB.....



- **The 2-phase pipe for cryomodules can be fabricated and tested ahead of time, saving at least a week or more in cryomodule assembly.**



316L Stainless Steel



Grade 2 Titanium

- **Flange test assemblies were fabricated to replicate the helium vessel to cryomodule connection**
  - **Grade 2 titanium connection is the same as the beam flange and will use a common hex seal**
  - **316L stainless steel 2-phase connection uses a groove socket to hold seal in place for an inverted connection (seal shown in photo)**





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# Flange Connection Cold Shock



- **Flange assembly was leak checked prior to cold shock testing**
  - **No detectable leaks were found**
- **Flange assembly was submerged in LN2 while system was actively pumping**
- **Assembly was removed once boiling activity stopped**



- **The first six cold shock tests were done with a fast warm-up. Heated blower accelerated the warm-up of flange assembly to room temperature**



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# Flange Connection Cold Shock



- Helium leak check was performed as soon as the assembly was back at room temperature
  - No detectable leaks were found during any of the six cycles





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# Flange Connection Cold Shock



- **Six additional cold shock cycles were performed except this time assembly was allowed to warm up to room temperature gradually. During this warm-up, the assembly was placed in a bag and flooded with helium to observe leak detection during warm-up**
  - **No detectable leaks were found during any of the six cycles**

- **Preliminary test results were very positive and no problems were found.**
- **Hex seal was replaced between the fast warm-up and gradual warm-up cycles. The titanium flange seal surface was inspected for damage and non were found.**
- **Given these results, design efforts should continue in developing the 2-phase flanged connection.**
- **At this point no other tests are planned for this particular assembly – but I am open for suggestions for future tests.**



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**Thank You!**