



# Fabrication Status of the first 802 MHz Prototype Cavities for PERLE

F. Marhauser

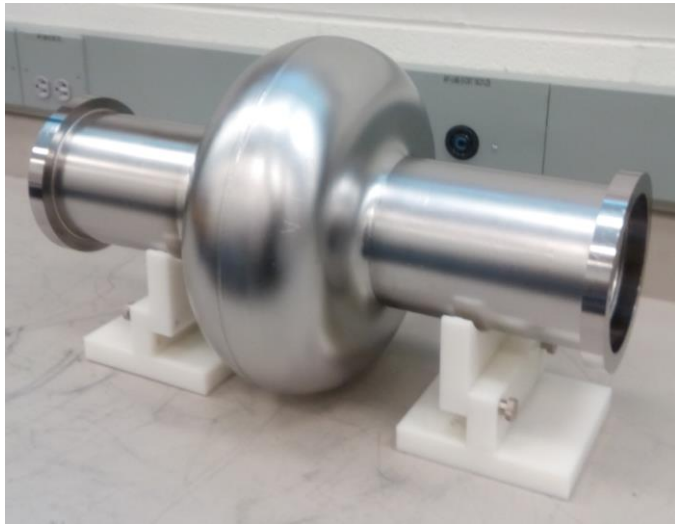
LHeC Workshop CERN

11-13 September 2017

# Overview

- Jefferson Lab has a contract with CERN to build
  - One single-cell fine-grain niobium 802 MHz cavity (manufactured)
  - Two single-cell OFHC 802 MHz cavities
  - One 5-cell fine-grain 802 MHz cavity
  - The remaining cavities are advancing rapidly
- In addition, Jefferson Lab has looked into:
  - Higher Order Mode (HOM) coupler design
  - Cryomodule design
  - This design work is preliminary
    - Funding is required to make more progress

# Deliverables (based on SOW with CERN)



- First 802 MHz Niobium single-cell cavity has been completed at JLab, the cavity is now being post-processed prior to vertical RF testing
- 2 copper 802 MHz cavities will be produced for R&D purposes and will be sent to CERN



One bare Niobium five-cell 802 MHz design is being fabricated, completion expected by end of Sept. 2017

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# Status of Deliverables

Cavity	Qty.	Material	Half cells deep-drawn	Beam Tubes deep-drawn/rolled	Flanges machined	End group EBW (end cell + tube + flange)	Dumb-bells EBW	Machining/Trimming	Cavity EBW
1-cell	1	FG Nb	2/2	2/2	2/2 NbTi flanges	2/2	n/a	done	done
1-cell	2	OFHC Cu	4/4	4/4 not EB-welded and machined	4/4 SS 316 LN	not yet started	n/a	equator trimming after EBW	-
5-cell	1	FG Nb	10/10	2/2	2/2 NbTi flanges	2/2	4/4	in progress	-

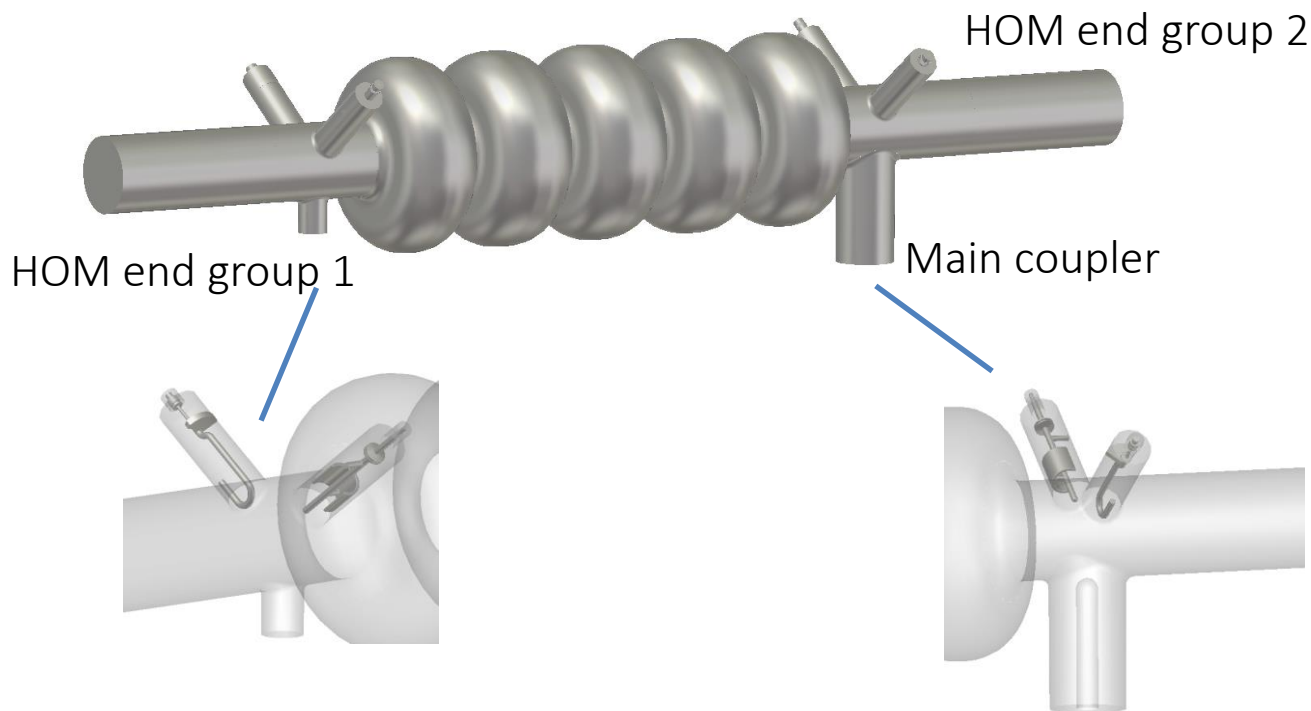


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# Which HOM-Coupler Technology ?

- First approach should be to utilize existing coupler technology, but this needs scaling to new frequency and tube ID
- For instance: scale LHC HOM couplers (and FPC)



- 4 HOM couplers per cavity ?
  - LHC-type coaxial loop coupler is narrowband coupler for dipole modes
  - LHC-type coaxial antenna/capacitive coupler is more broadband

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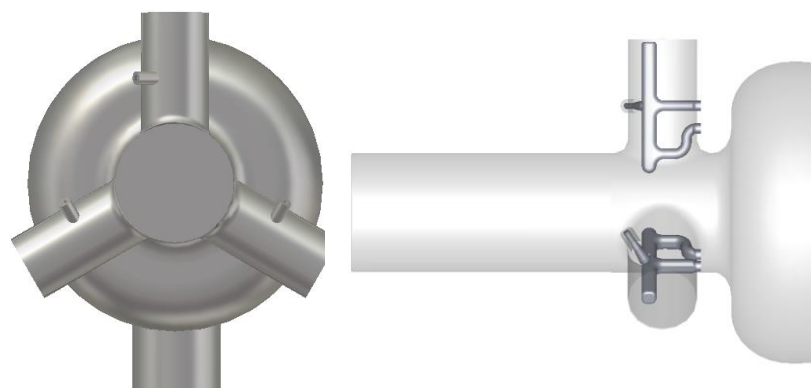
# Which HOM-Coupler Technology ?

- A better solution would be utilizing 3 couplers for HOM end group
- Minimizes dependence on mode polarization

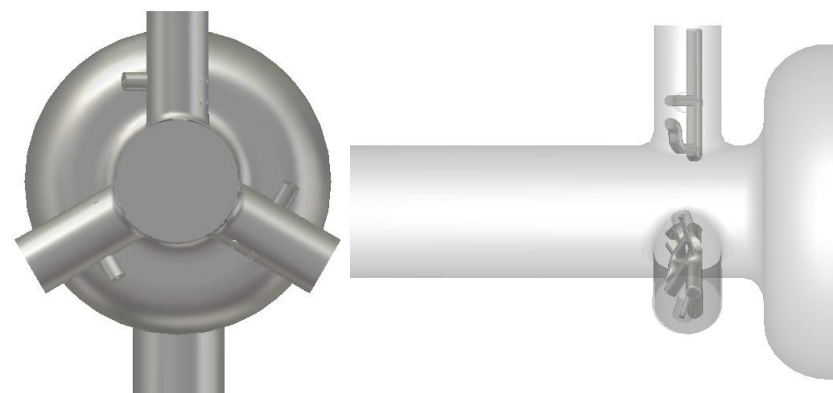


HOM end group

Main coupler



Scaled JLab-type couplers



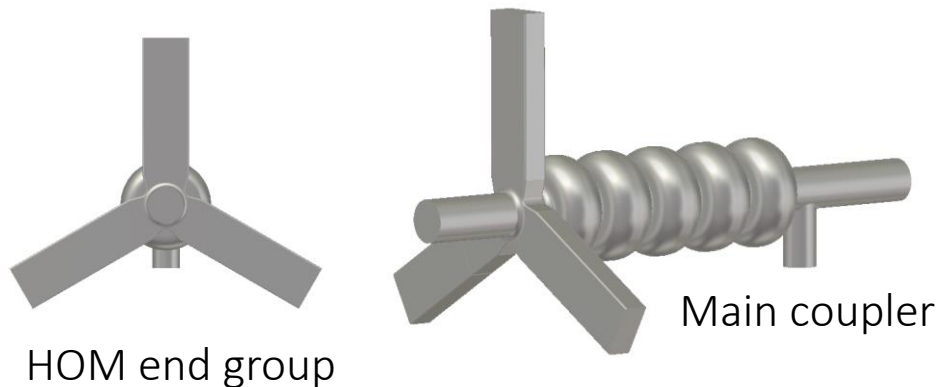
Scaled TESLA-type coaxial couplers

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# Which HOM-Coupler Technology ?

- HOM waveguides only required if beam current increases significantly



Scaled JLab High Current (HC) waveguide couplers



1.5 GHz HC cavity prototype

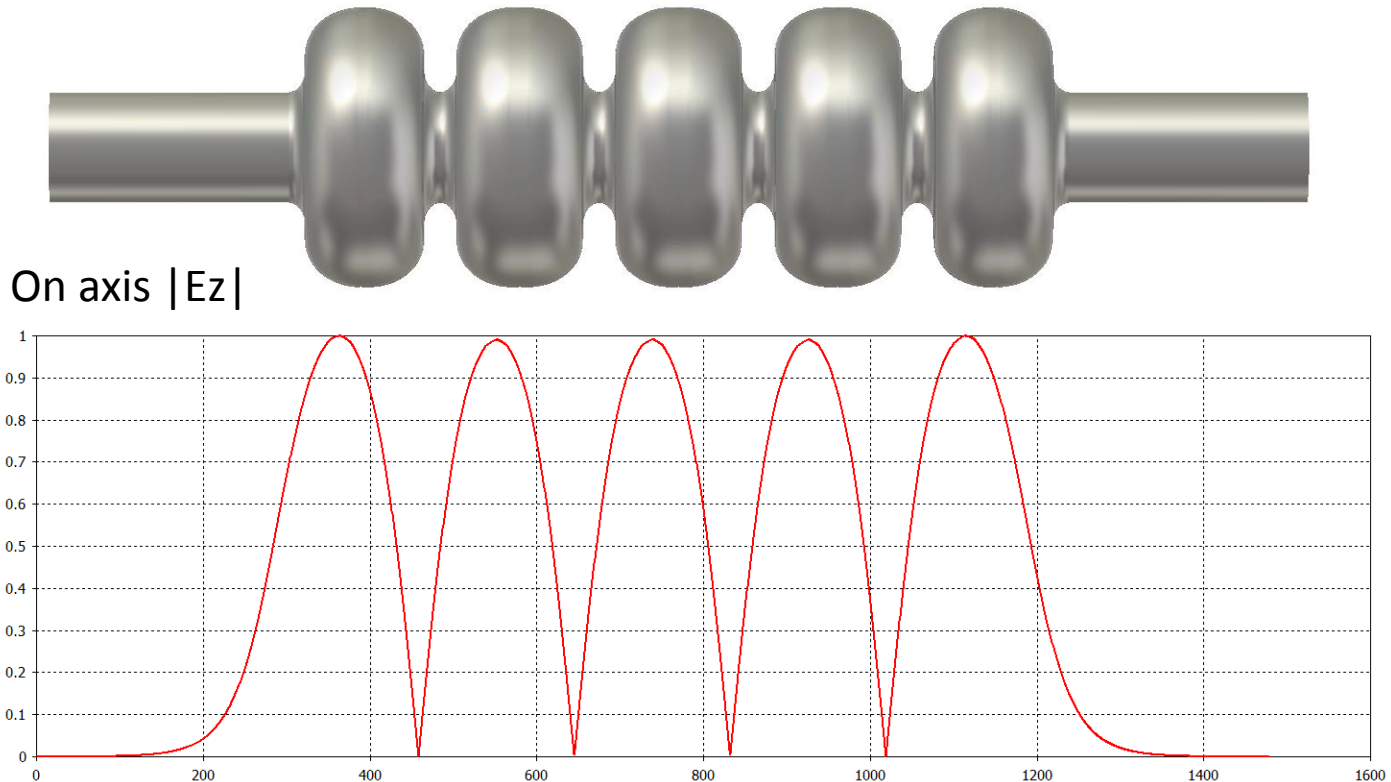


750 MHz HC cavity prototype

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# JLab/PERLE

- For the prototype PERLE cavity we have chosen a single-die design (end cells are trimmed shorter)
- PERLE cavity identical to CERN FCC prototype under construction
- Optimized for high current operation



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# Summary

- CERN FCC cavity prototypes are progressing well
  - Expected completion in September 2017
  - Cutting off the beam tubes from the bare 5-cell cavity and welding new end groups to the cavity to investigate HOM-damping scenarios would be a good next step
- Preliminary evaluation of HOM's has been carried out
  - Either coax or waveguide would work (waveguide is probably overkill)
  - Three couplers should be sufficient (needs to be checked)
  - Strong cell-to-cell coupling is good for HOM damping
- Design for PERLE cavity is identical to CERN FCC cavity
  - Ready for detailed end group design work
  - Prototype cavity could be built 6 months after funding becomes available if CERN 5-cell prototype cavity is modified
    - One year would be required starting from scratch
- Jefferson Lab will provide a budgetary estimate for an SNS-type cryomodule for PERLE