SSR2 processing for PIP-II

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IBS-FNAL Workshop

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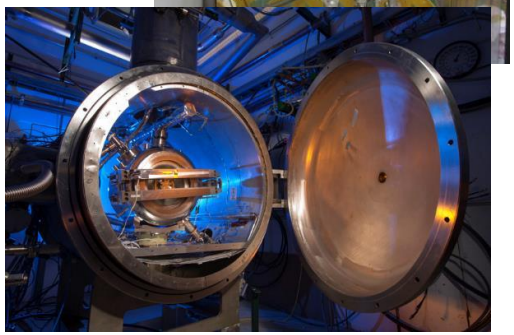
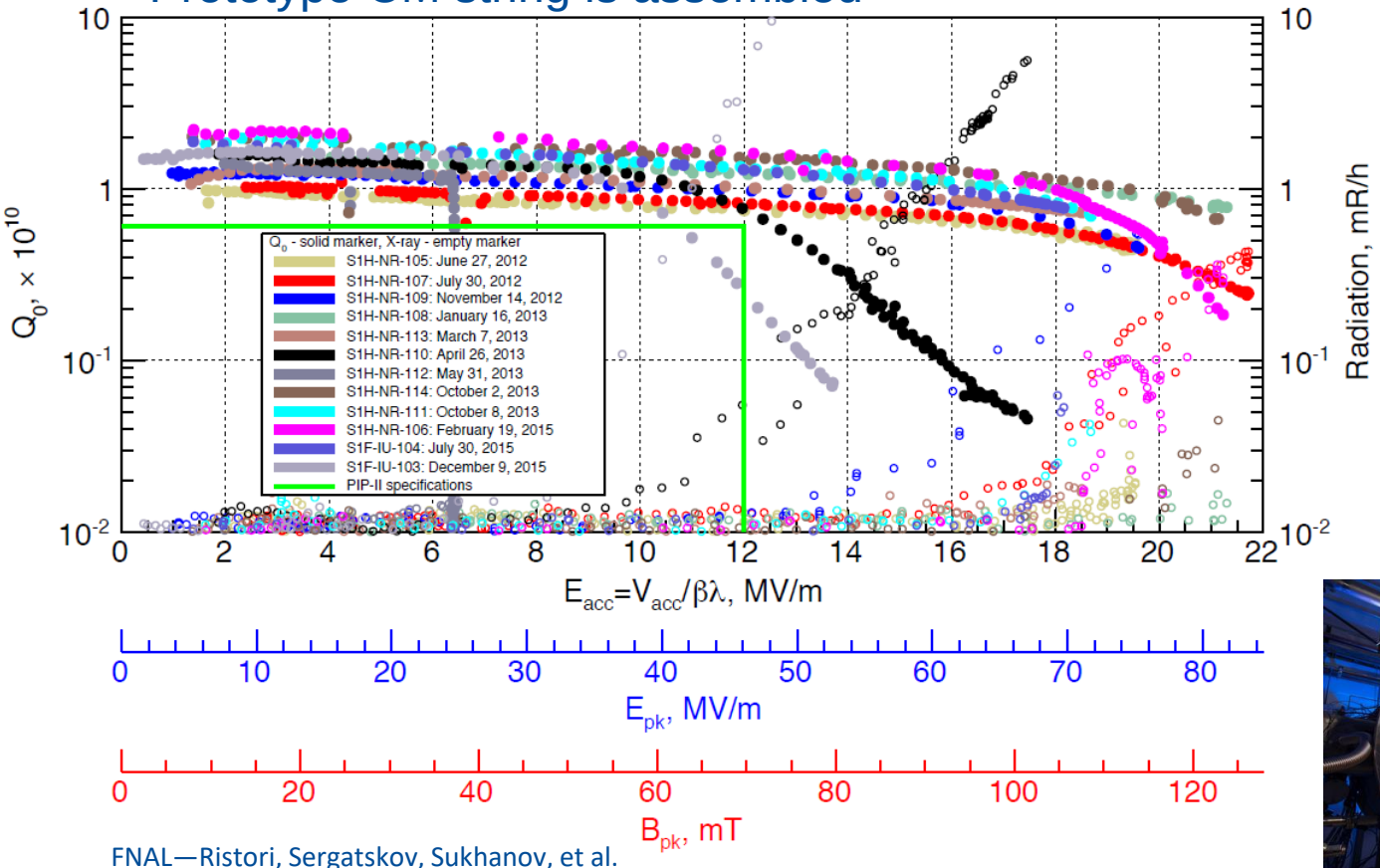
Outline

- SSR and non-elliptical cavities processing experience at FNAL/ANL
  - SSR1 results
- Processing flowchart for SSR2 cavities:
  - BCP bulk and light
  - US cleaning & HPR
  - Degassing at 600 C
  - 120 C bake prior to VTS
  - VTS and STC cold tests
- Summary

SSR1 cavities results

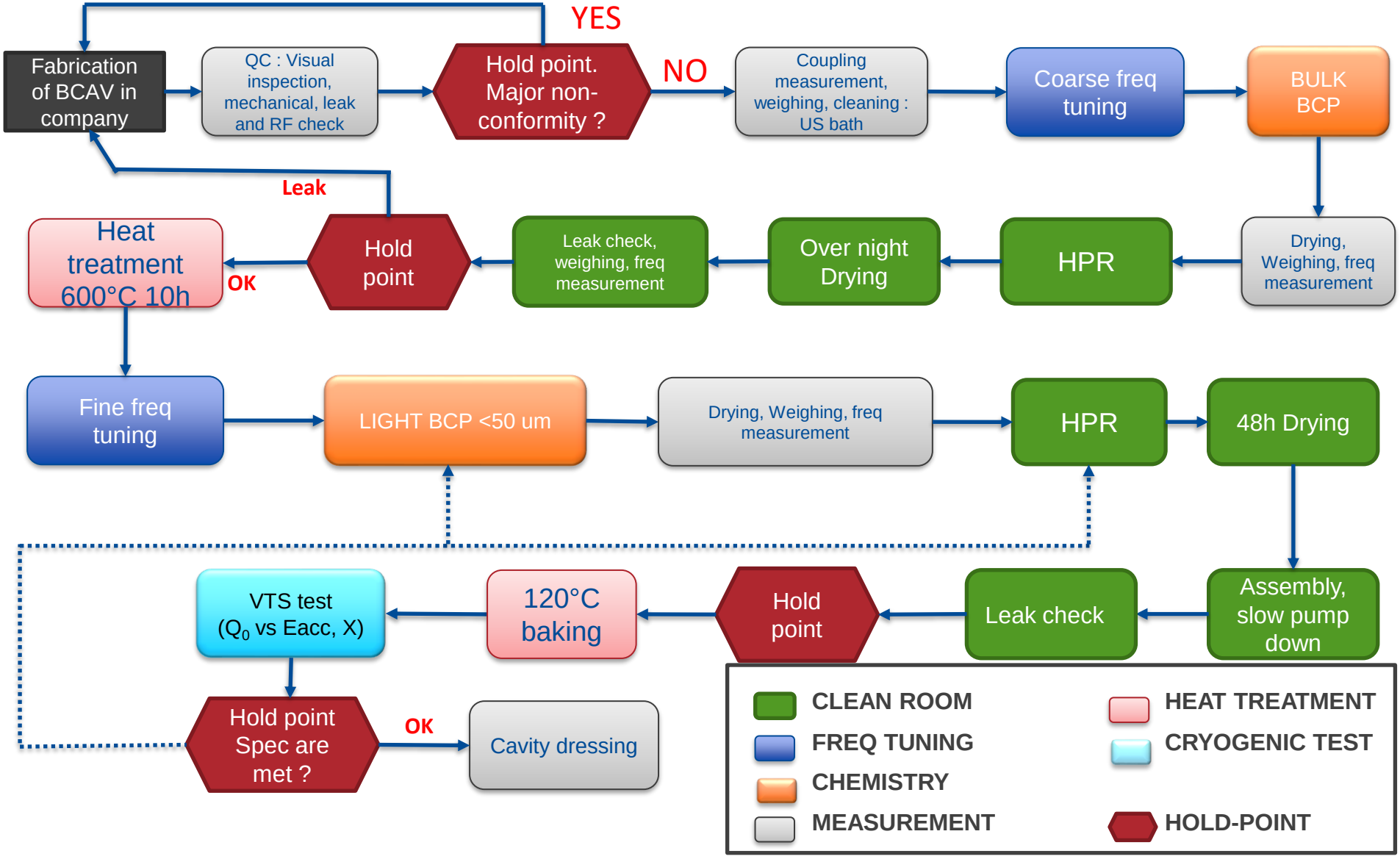
- 10 qualified bare cavities through VTS + 1 through STC
- 2 IIFC (IUAC) collaboration cavity tested in VTS (1 qualified)
- All processed and tested at FNAL/ANL
- Prototype CM string is assembled





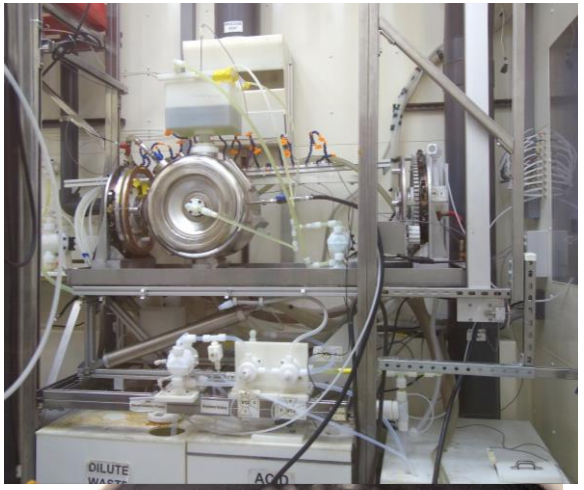
FNAL—Ristori, Sergatskov, Sukhanov, et al.

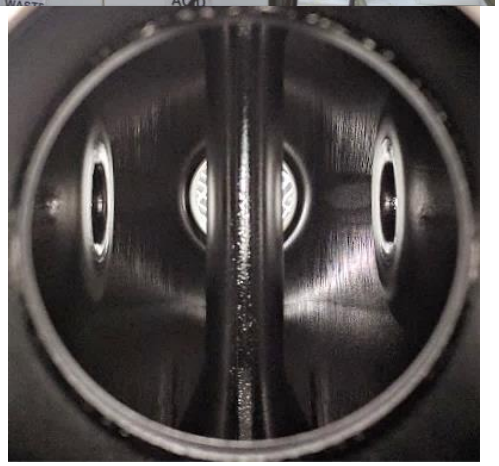
SSR2 cavities processing and testing flow



SSR bulk and light BCP experience

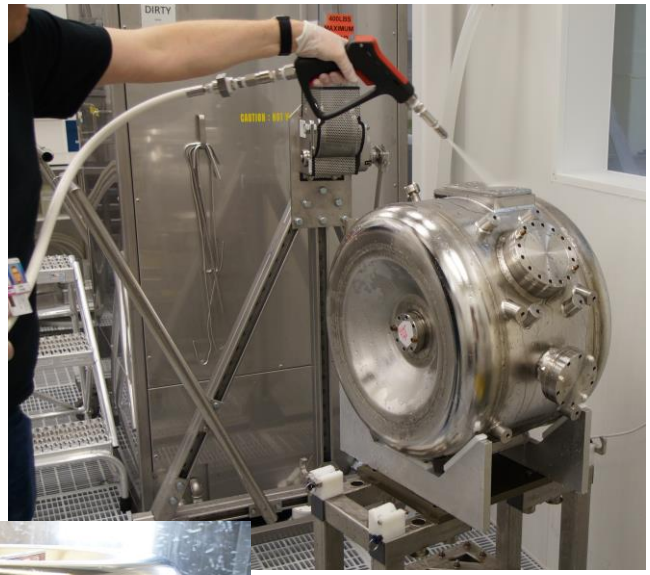
- FNAL/ANL facilities have experience with both light and bulk BCP of spoke resonators: conventional BCP in two different orientations through CP and VP.





SSR vertical and horizontal and exterior HPR

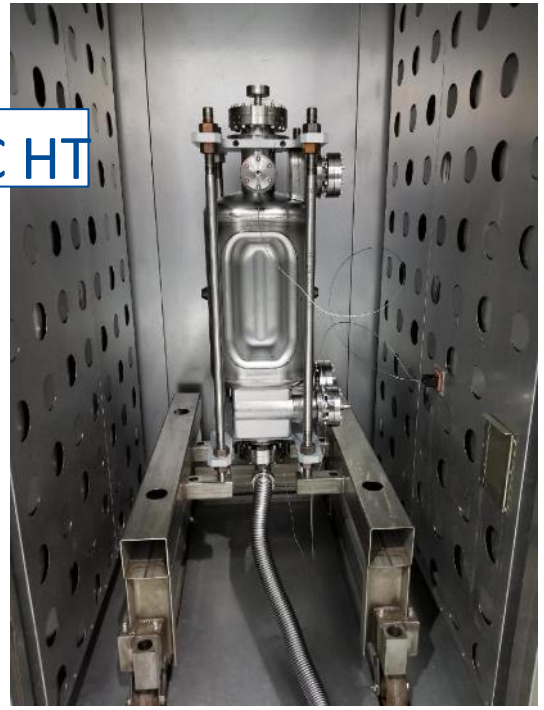
- Clean room facilities have processed both bare and dressed SSR1 HPR and US cleaning.



SSR heat treatments

- FNAL facilities allow for 600 C and 120 C heat treatments
- Facilities have been validated through other FNAL projects:

LCLS-II, PIP-II and HL-LHC-AUP



VTS and STC test cryostats

- Vertical test facility at FNAL in IB1 for bare SSR cavities cold test
- Spoke Test Cryostat (STC) is used to qualify dressed SSR cavities.
- Both cryostat were used for SSR1 cavities.

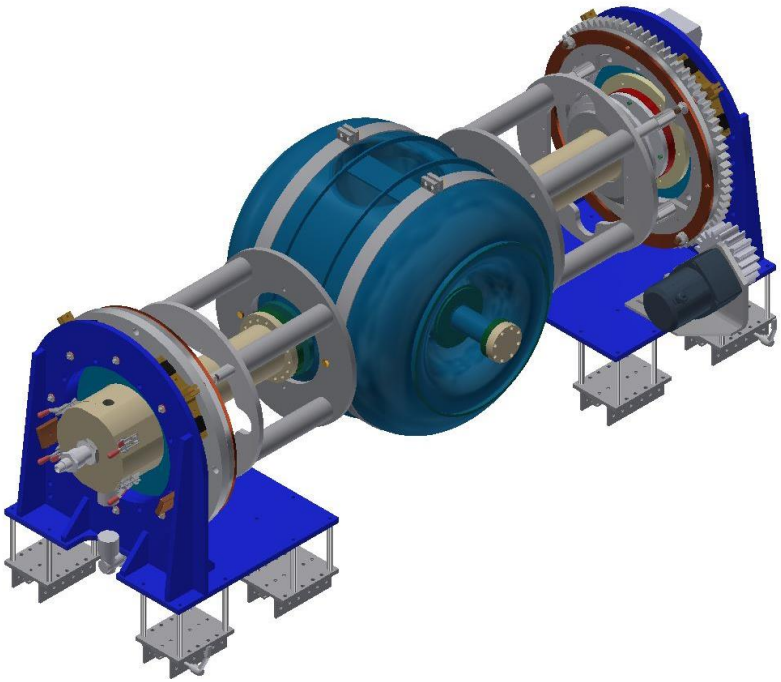
SSR1 at VTS

SSR1 at STC

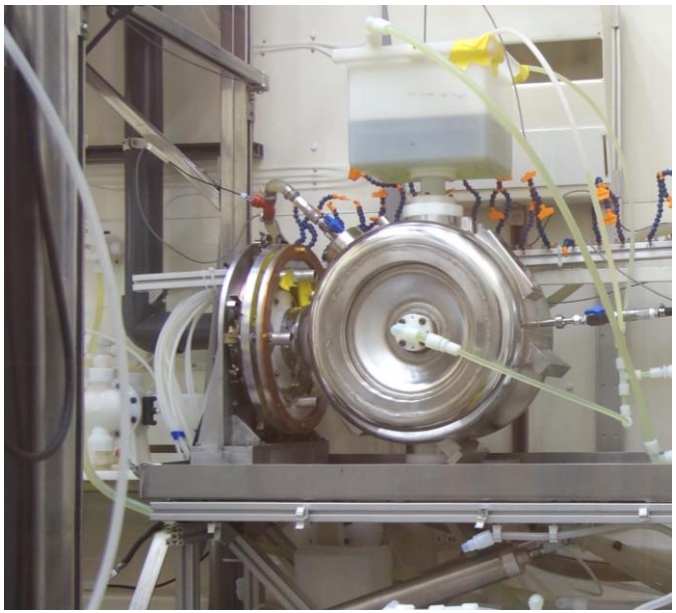
SSR2: bulk and light rotational BCP

Both bulk and light rotational BCP are completed by the cavity vendor in upgraded facilities, following RFD cavity experience: rotational BCP to improve surface finish and removal homogeneity.

Technology transfer to cavity vendor is completed.



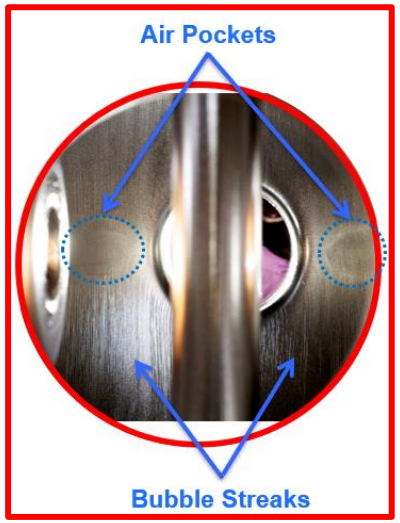
SSR2 cavity model on rotational BCP tool at ANL



SSR1 cavity during conventional BCP at ANL

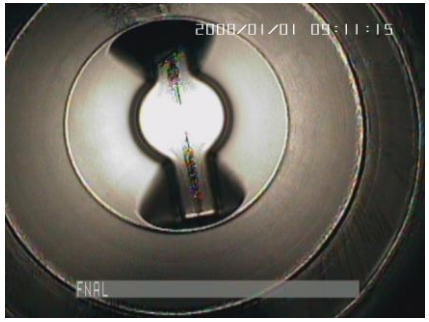
Reasons for rotational BCP, experience with RFD cavity I

- Visual inspection after light rotational BCP showed the inner surface has a uniform matte looking.
- No signs of long and big bubble traces: slow rotation is preventing big bubbles formation in the acid mixture!
- **No signs of residue, air pockets or bubbles on the RF surface**

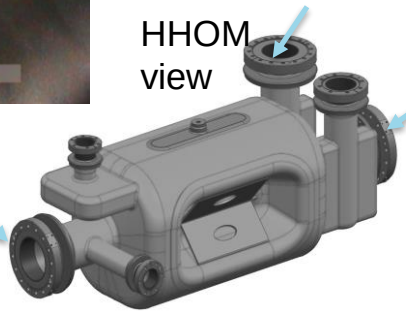


SSR1 RF surface after conventional BCP

Beamtube1view



HHOM view



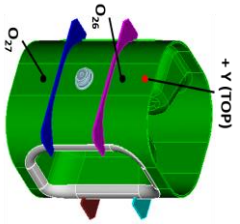
Rotational BCP tool for RFD cavity at ANL

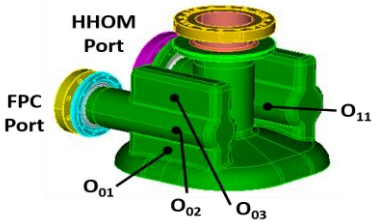
Reasons for rotational BCP, experience with RFD cavity II

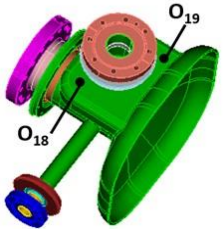
Material removal has been compared between the two BCP procedure: AVG removal is 48 microns for ANL, 40 microns for conventional BCP.

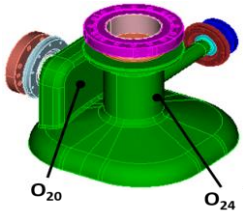
Uniform removal confirms better process compared to BCP prformed on static RFD: Standard deviation in etch data drops going from conventional to rotating cavity BCP.

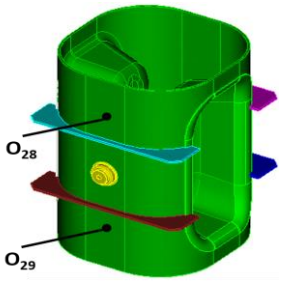
Location	ANL BCP 48 µm	conventional BCP 40 µm
HHOM	46.1	22.5
VHOM	55.0	58.6
FPC	48.6	28.4
BODY	44.5	25.1
POLE (left)	51.8	26.2
POLE (right)	51.3	28.7
MAX	66	213.7
MIN	25.4	8.5

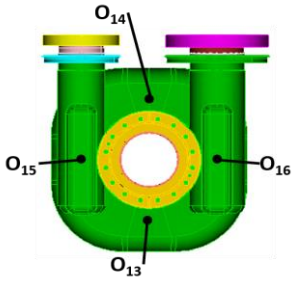












Summary

- A sound processing and testing plan is in place.
- Rotational BCP appears to be superior to conventional BCP:
  - Controllable etching rate, material removal uniformity improves drastically
  - Surface finish still matte, no bubble streaks or air pockets with rotation
- FNAL has been facilitating the technological transfer for rotational BCP at cavity vendors.