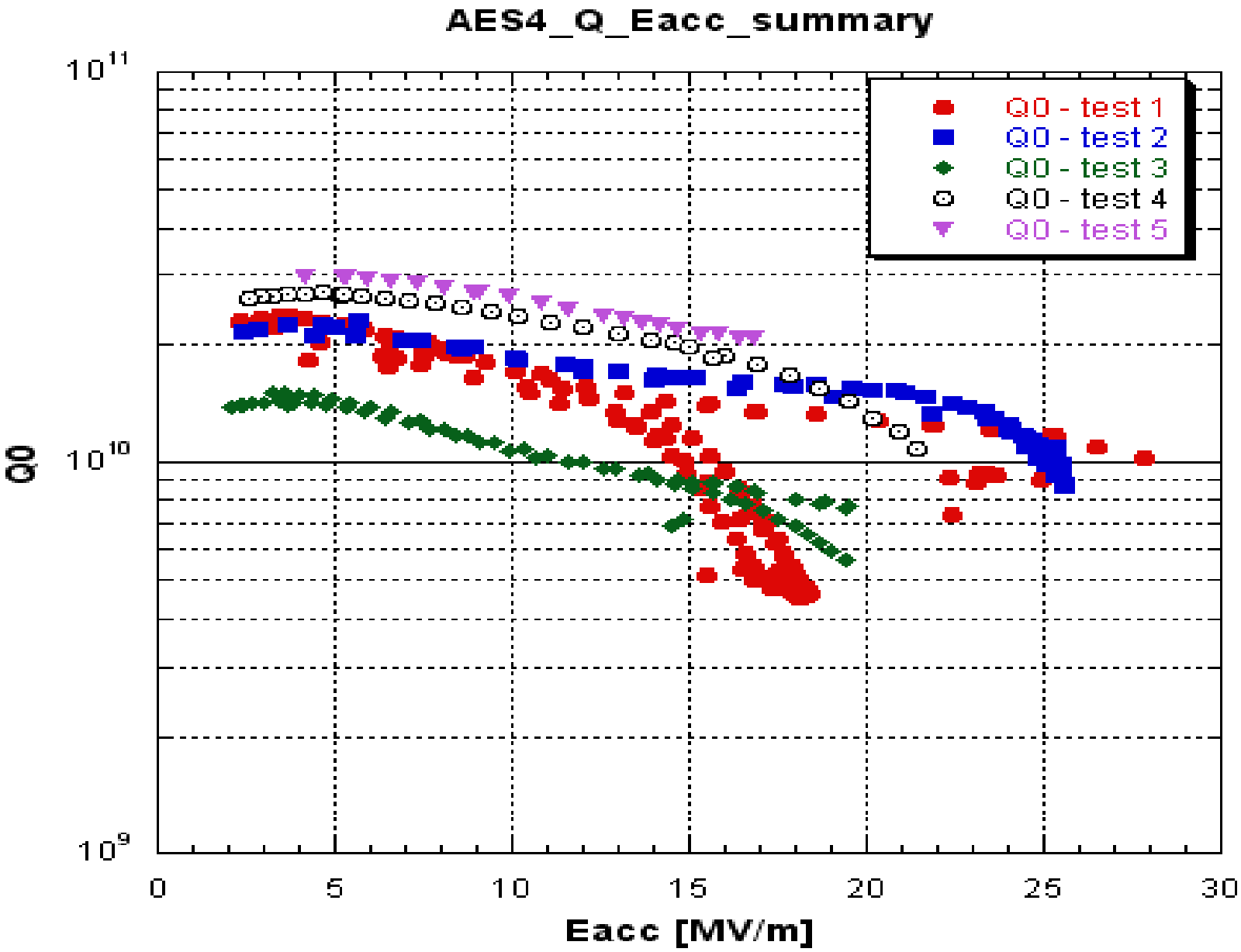
Progress Report
ILC 9-cell Cavity EP and Vertical Test at JLab

Rongli Geng

SRF Institute, Jefferson Lab

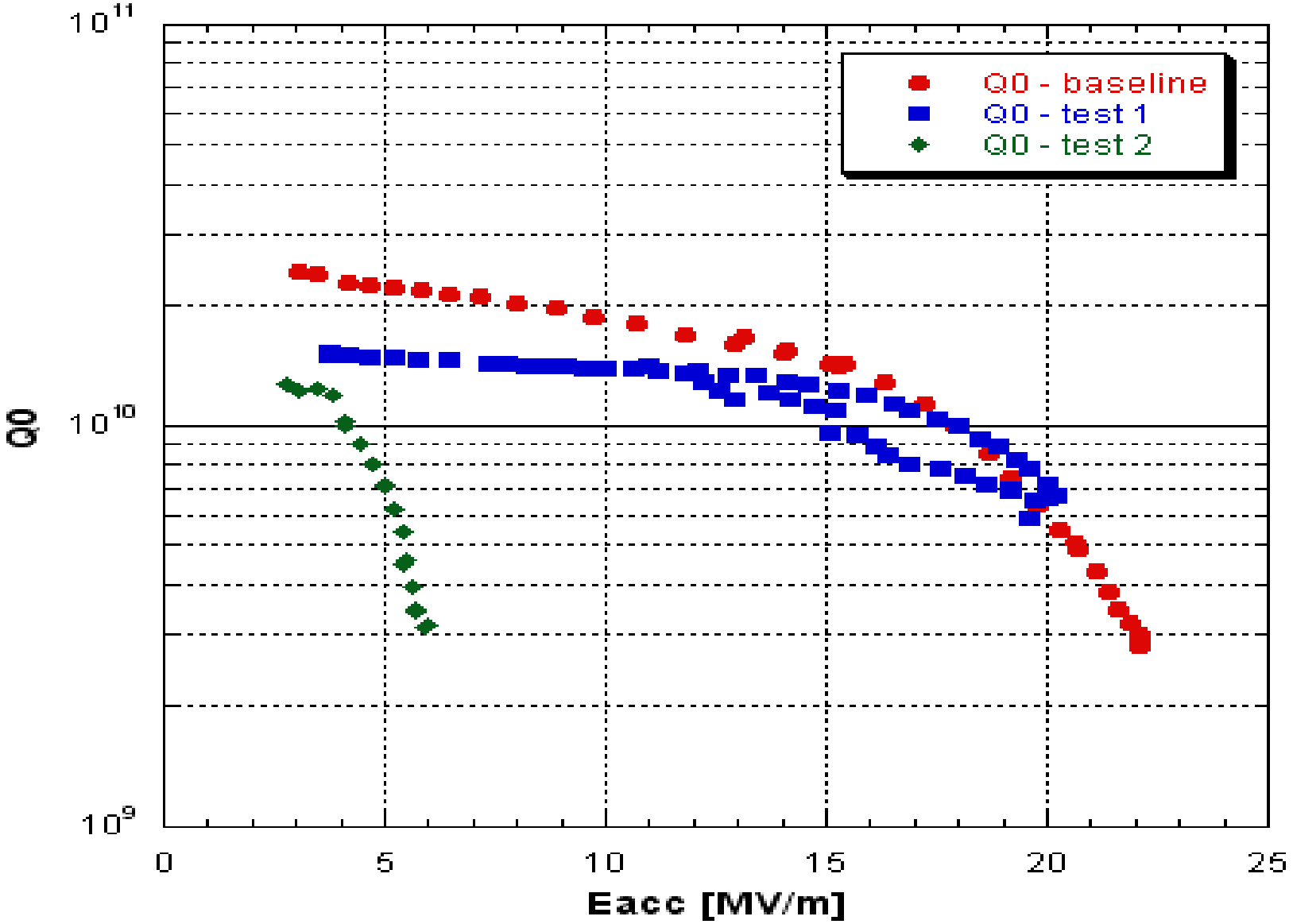
Reaching AES4 quench limit encountered challenges

- AES4 previously reached 28 MV/m (FE limited) and 25.5 MV/m (cable limited).
- August 21, 3rd test after 3rd EP 20 um: 19.5 MV/m, Strong X-rays. FE limit.
- September 19, 4th test after 4th EP 20 um: 21.5 MV/m, cable limit.
- October 4, 5th test after 5th EP 20 um: 17.0 MV/m, cable limit.


AES4_Q_Eacc_summary
Q0 - test 1
Q0 - test 2
Q0 - test 3
Q0 - test 4
Q0 - test 5
Q0
Eacc [MV/m]
10^11
10^10
10^9
0
5
10
15
20
25
30

A8 received 2 EP/V.T. cycles

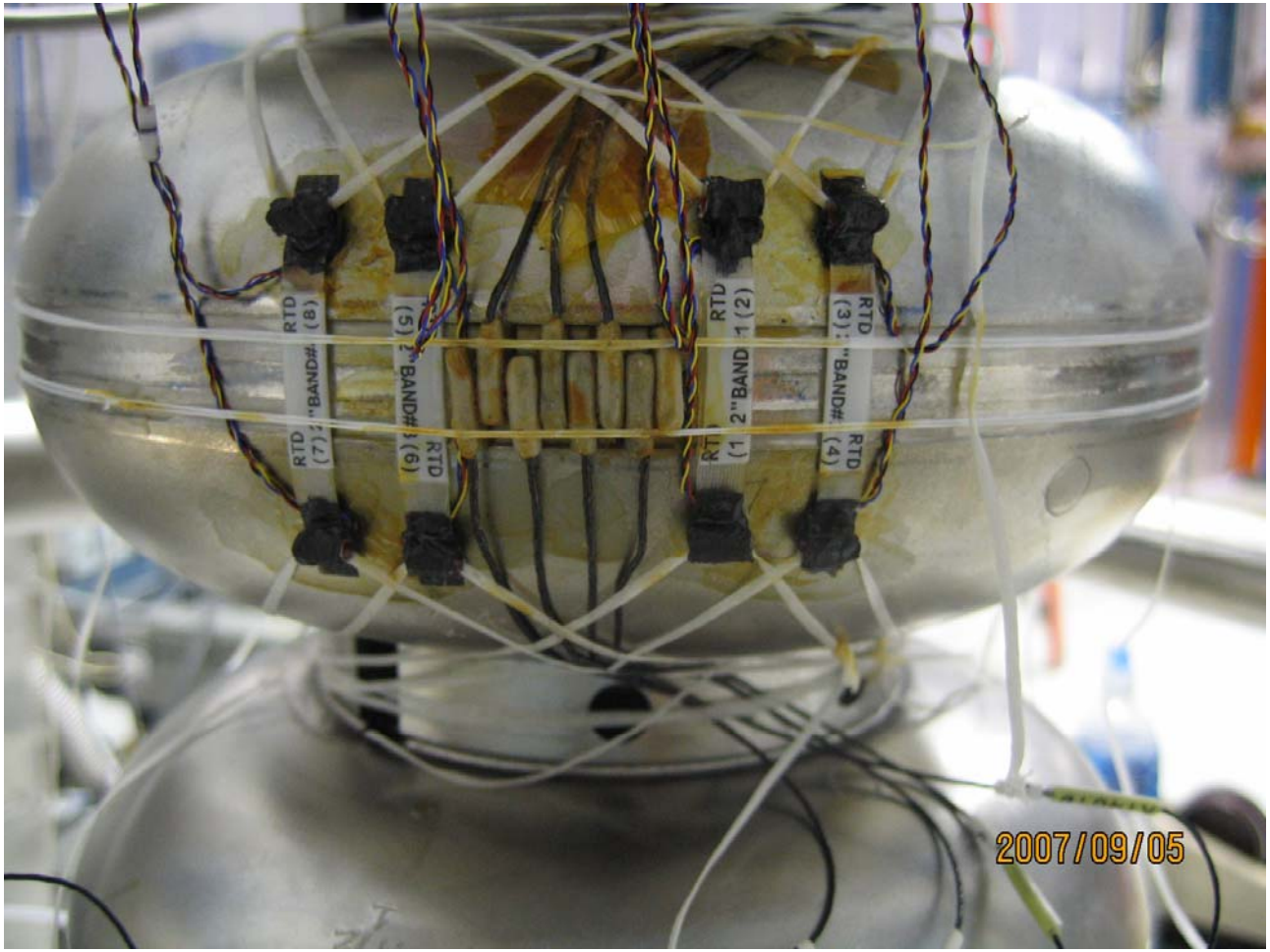
- A8 previously processed and tested at Cornell. Q-slope. 25 MV/m. Noticed vertical EP parameter changes.
- August 15, base line at JLAB after field flatness tuning HPR. Q-slop. 22.1 MV/m.
- August 28, 1st test after 1st EP 20 um, 20.0 MV/m. Strong X-rays. FE limit.
- September 25, 2nd test after 2nd EP 20 um. 6.0 MV/m. Early X-ray onset.

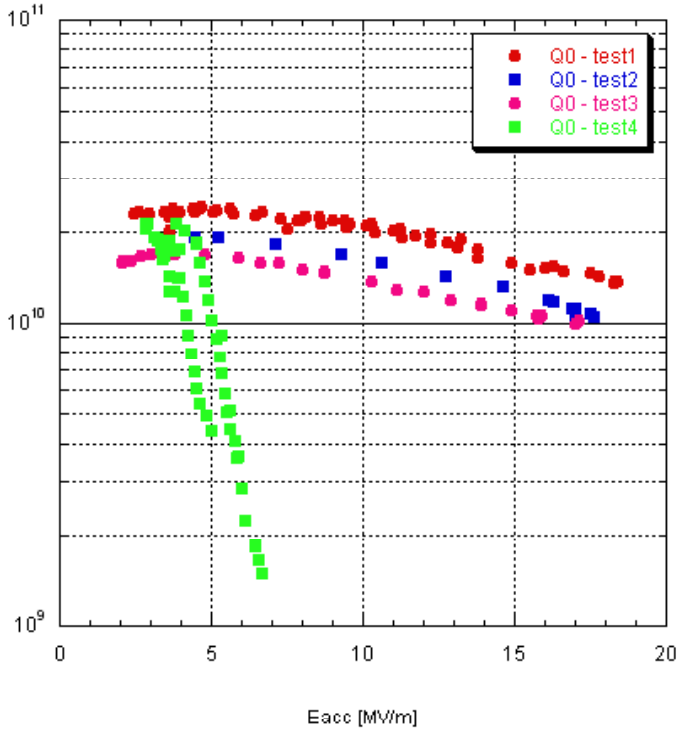

Q0 - baseline
Q0 - test 1
Q0 - test 2
Q0
10^11
10^10
10^9
0
5
10
15
20
25
Eacc [MV/m]

AES3 RF test with 16 thermometers delayed

- 2 EP/VT cycles completed, quench limited 18.7 MV/m, 17.6 MV/m. Cell pair #4/6 responsible due to pass-band mode.
- August 6, RF test with 8 thermometers. Cell #6 singled out. Suspected region determined.
- September 7, RF test with 16 thermometers. Rapid Q-decline with some X-rays. Quench field not reached.

16 thermometers attached to suspected region of AES3 cell #6





AES3 Q-decline

- 2 rings of discoloration (Nb oxide) in field probe side beam tube – caused by 12 hour HPR water jet bombardment.
- Not removed by 3 um BCP etching.
- AES3 3rd EP 20 um done, oxide rings removed.

ICHIRO#5 in progress for RF test

- Field flatness tuning completed (significant change obvious during transportation).
- Tuning completed.
- Adjustable input coupler Qext value set.
- Cavity/supporting fixture fitted into HPR/VT cage.
- Base line test after HPR only.

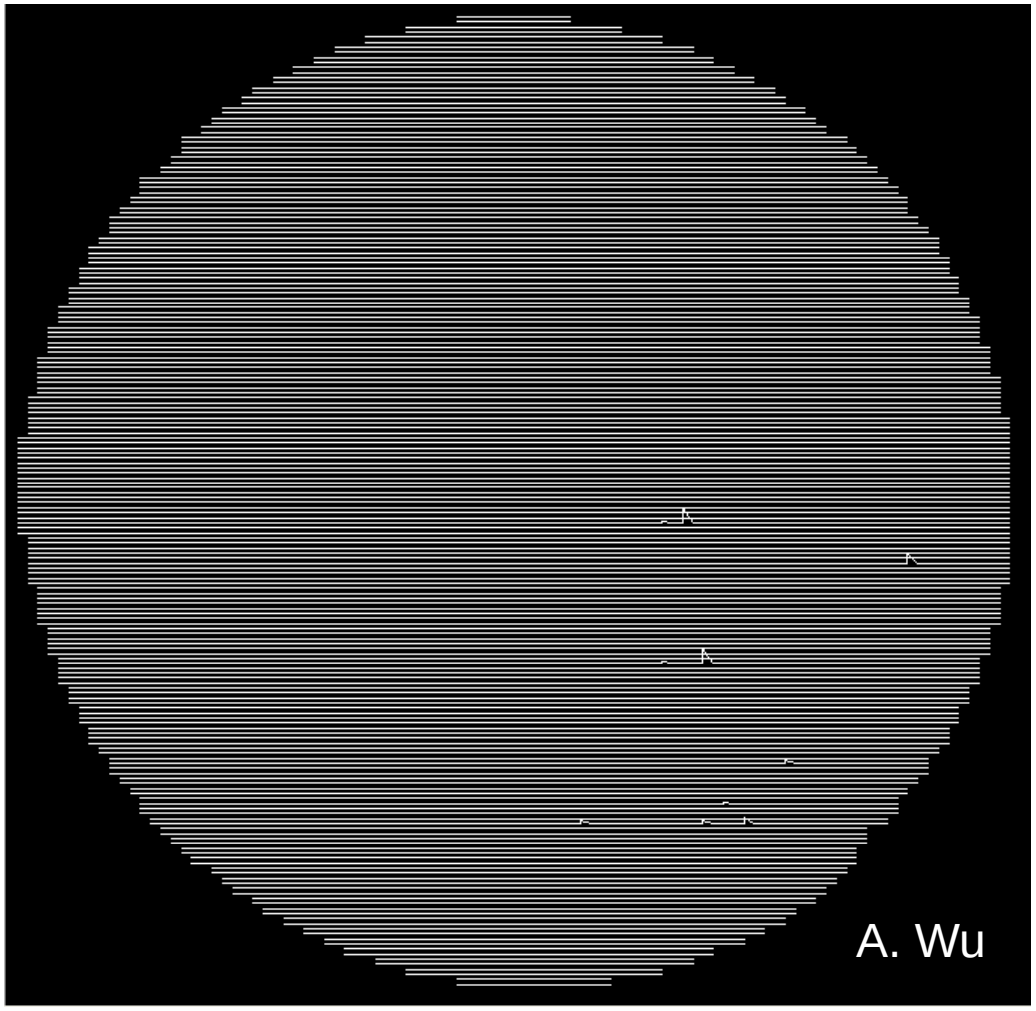
Recent field emission behaviors

- Quite a few 9-cell tests limited by FE since August.
- Possible causes: increased contaminants in EP system due to heavy use; cavity assembly new trainee; trapped contaminants in beam tubes; oxide due to extended HPR water jet bombardment.
- Several engineering/administrative solutions implemented: increase micro-90 concentration; extend HPR wand travel range; review and reinforce assembly procedure.
- Latest AES4 test no X-rays (4X higher micro-90 concentration).
- Initiated contamination/cleaning studies (see below).

Cleaning studies for reducing FE

- Nb sample electropolished together with 9-cell cavity.
- Initial post-EP surface SEM/EDX.
- Field emission characterization with SFEM. DC 140 MV/m. SEM/EDX study of individual emitter.
- + Ultrasonic cleaning with micro-90. re-examine with SEM/EDX and SFEM.
- + HPR. Re-examine.

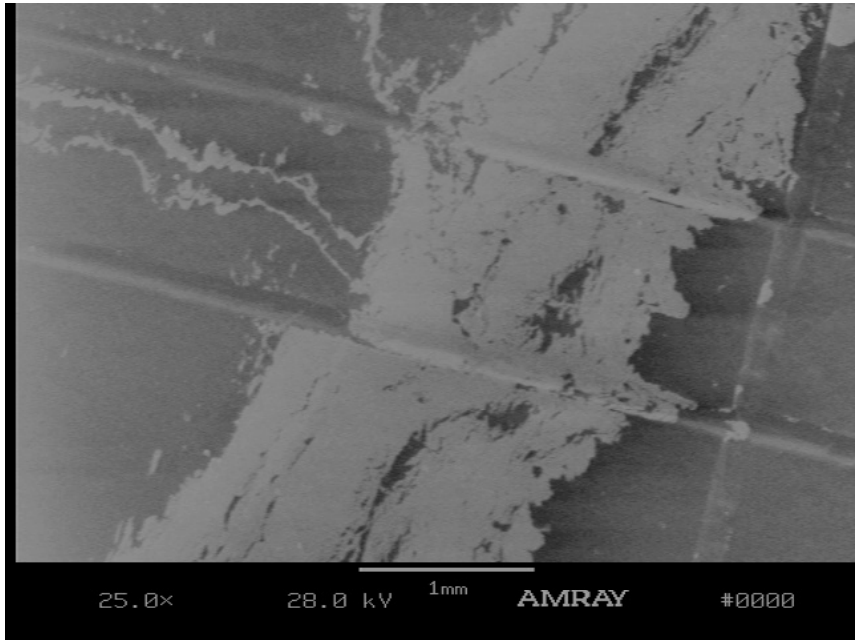
First sample EP’ed together w/ AES4



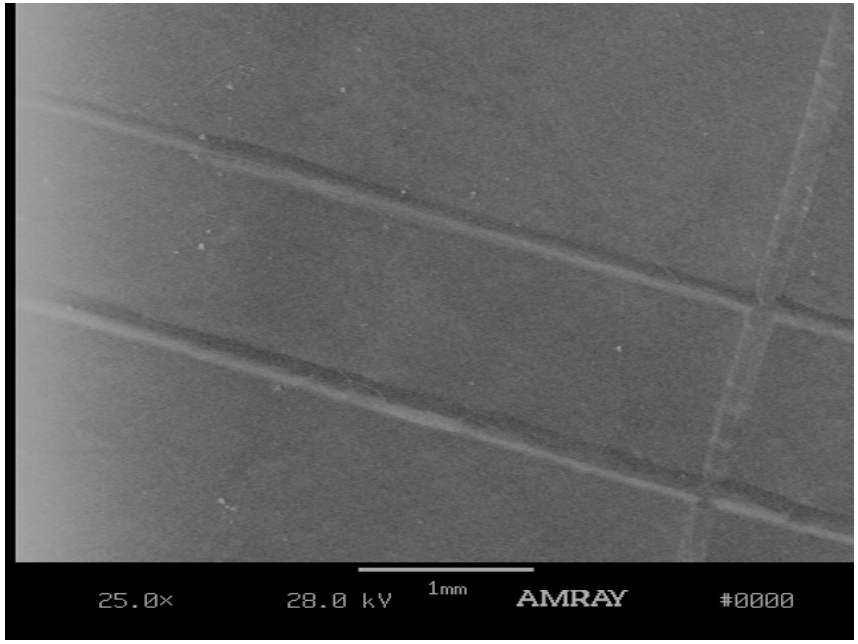
First trial
Only half area scanned

First sample before and after ultrasonic cleaning w/ micro-90

before



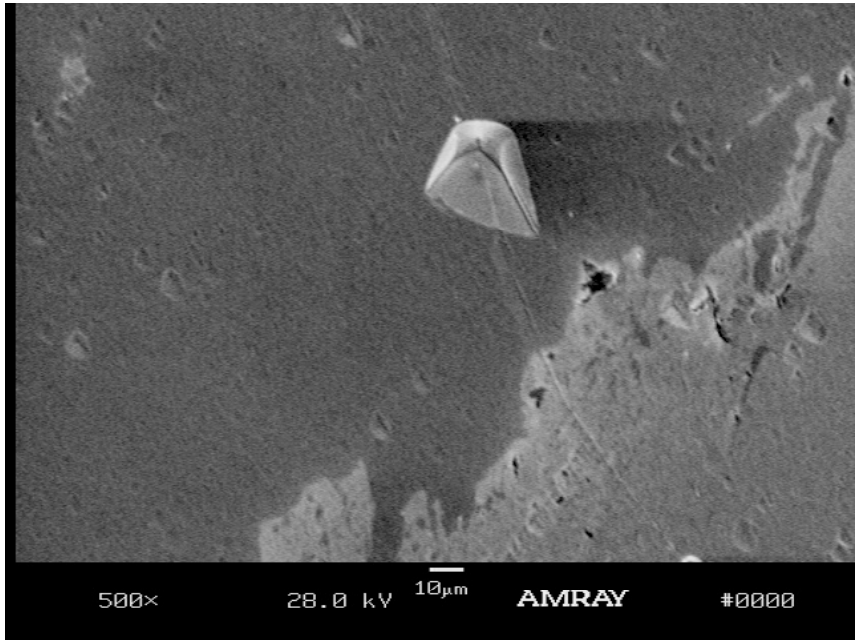
after



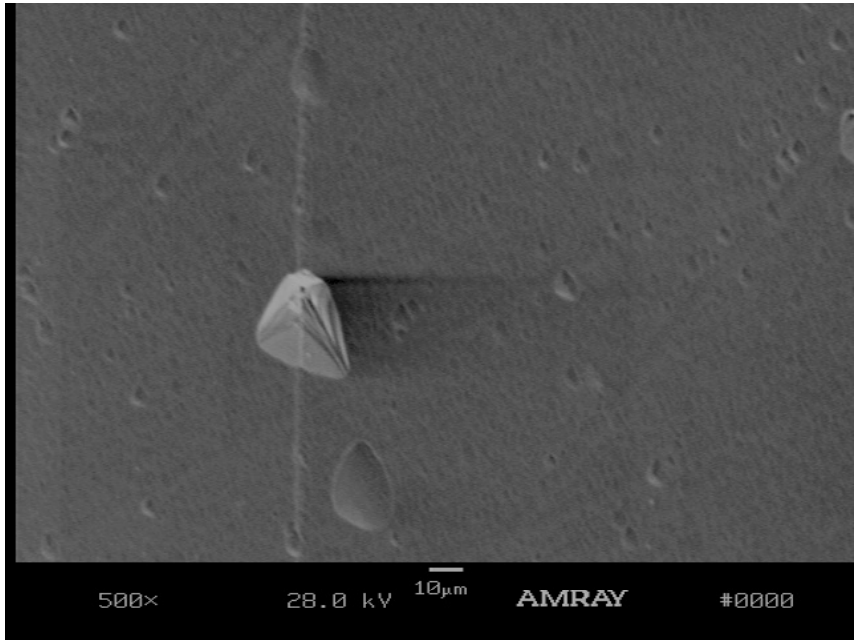
Preliminary EDX analysis: no foreign element except Nb

First sample before and after ultrasonic cleaning w/ micro-90

before



after



Near Term Plan

- Base line RF test ICHIRO#5. Next week.
- AES3 RF test with 16 thermometers. Next week.
- A8 3rd EP 20 um and RF test.
- AES4 re-test with HPR only.
- AES2 3rd EP 20 um and final RF test. (1st and 2nd test quench limited 19.6, 18.0 MV/m). 5 suspected cells. Plan to post-purify at JLAB.
- Continue cleaning studies of Nb samples EP'ed together with 9-cell cavity.
- Cleaning studies with single-cell cavity: EP single-cell within 9-cell EP system.

Resources, facilities & new cavities

- FY08 direct ILC fund from DOE for single-cell and cleaning studies received.
- Continued resident FNAL technician at JLAB necessary. Overlapping for training crucial. Immediate action needed.
- JLAB EP facility maintenance necessary (heavy use in FY07).
- Cavity expectation besides 9-cells: one or two single-cell cavity from qualified vendor