Processing & Testing of ICHIRO5

New Results from Jefferson Lab for ILC S0 High Gradient R&D

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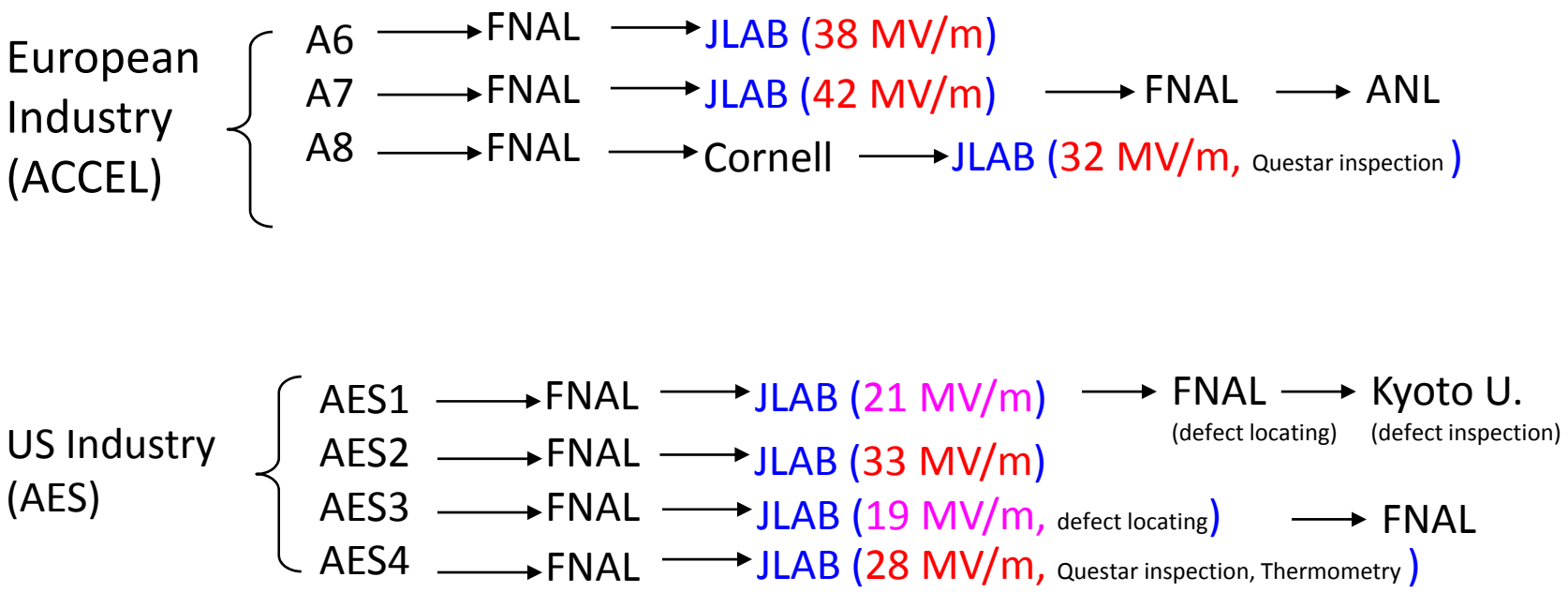
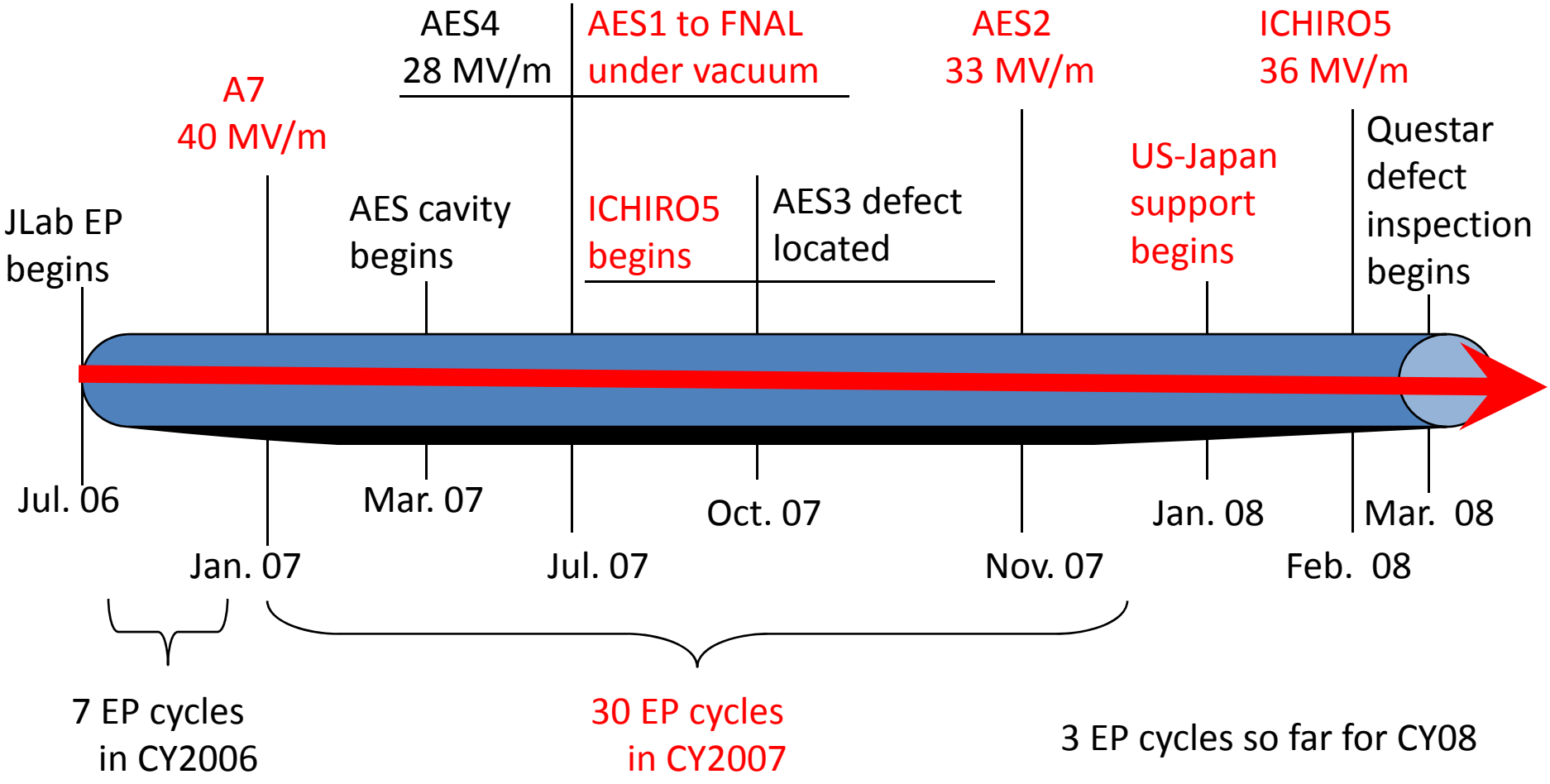
SRF Institute, Jefferson Lab

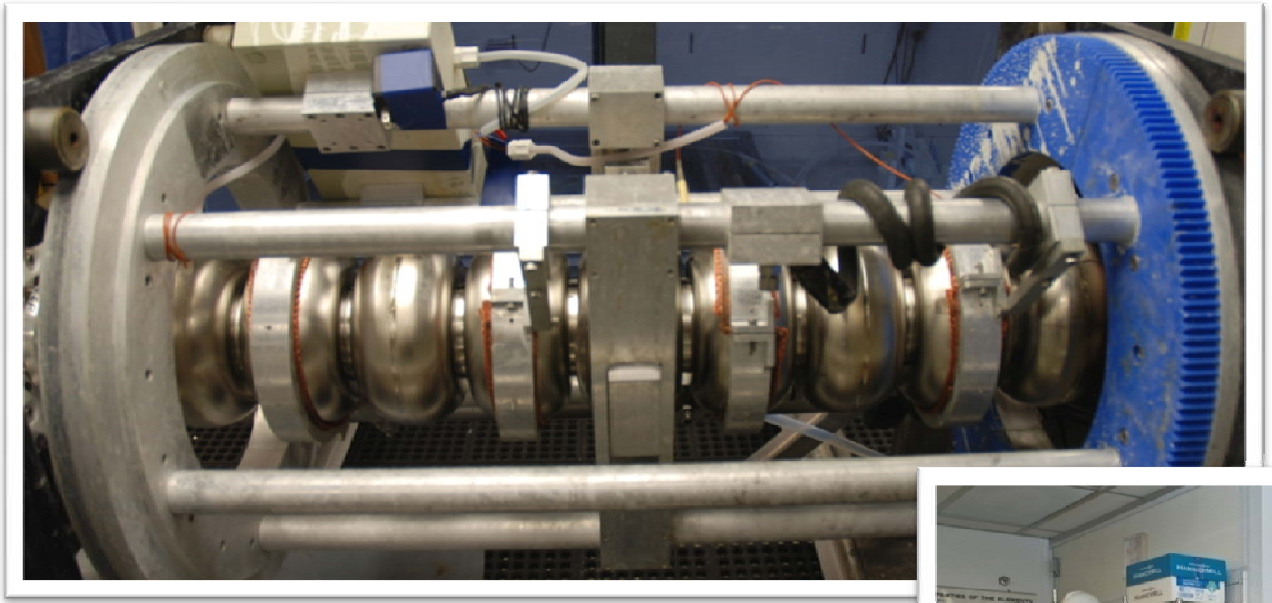
ILC S0 cavities studied at JLab & best gradient



JLab S0 High Gradient Milestones



ICHIRO5- 1st cross-region exchange S0 cavity



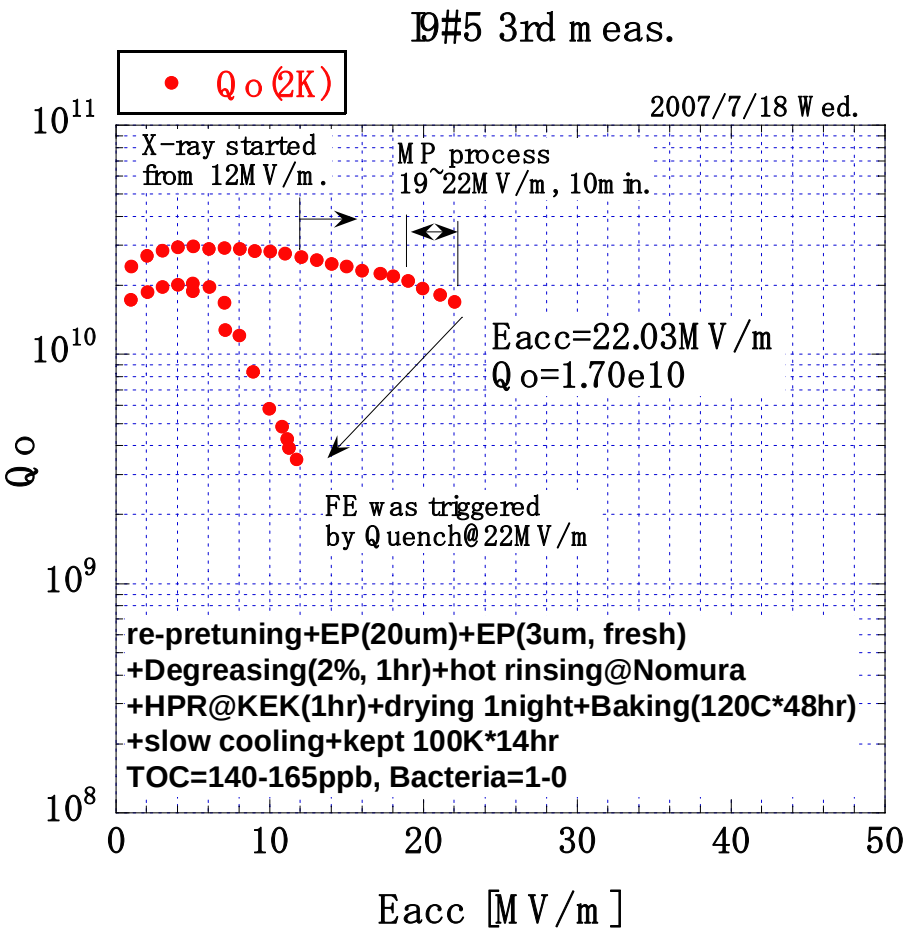
JLab/KEK/FNAL

ICHIRO5 baseline test at JLab

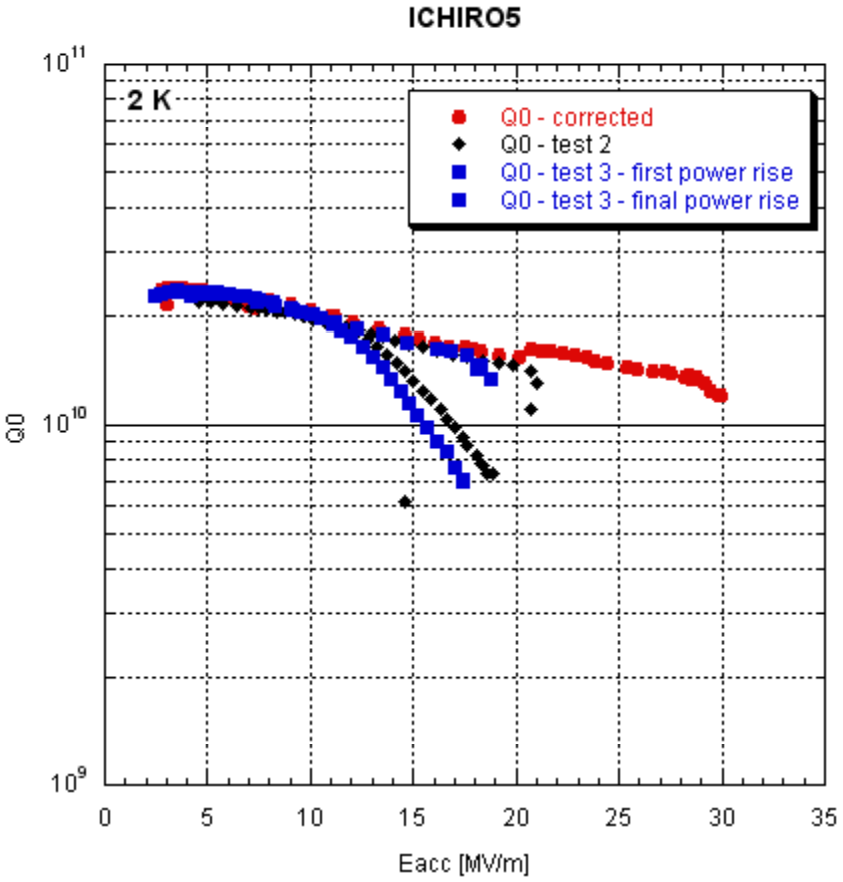
ICHIRO5 processing and testing at KEK
CBP(100㎜) + CP (10㎜) + AN (750 °C X 3hr)
EP 40 ㎜: 18 MV/m, FE limited
+ re-cleaning: 8 MV/m, FE limited
+ 20 ㎜ + 3 ㎜: 22 MV/m, FE limited

RF test	treatment	result	limit
1	US cleaning + HPR, RF test in D7	30 MV/m	LHe, loose antenna
2	Warm-up to RT, retest in D8	21 MV/m	FE, stable turn on hysteresis Q(Eacc)
3	Warm-up to RT, re-test in D7	19 MV/m	FE, stable turn on Hysteresis Q(Eacc)
4	EP 20 um + EP 10um + US + HPR +bake	36 MV/m	FE, emitter turn on then explosive event
5	US cleaning (2% micro-90) + HPR	35 MV/m	Quench, No X-ray
6	EP 20 um + EP 20 um + US (2%) + HPR + HPR + bake	28/16 MV/m	FE induced quench Strong emitter turn on

Final RF test at KEK



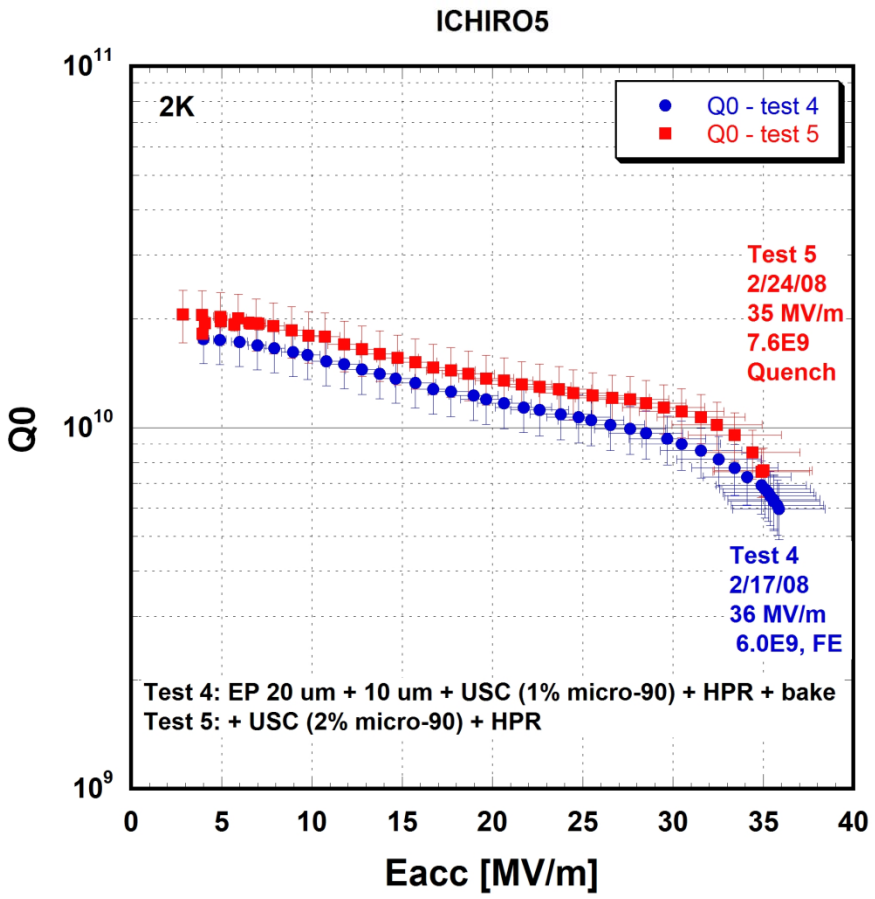
Initial RF test at JLab

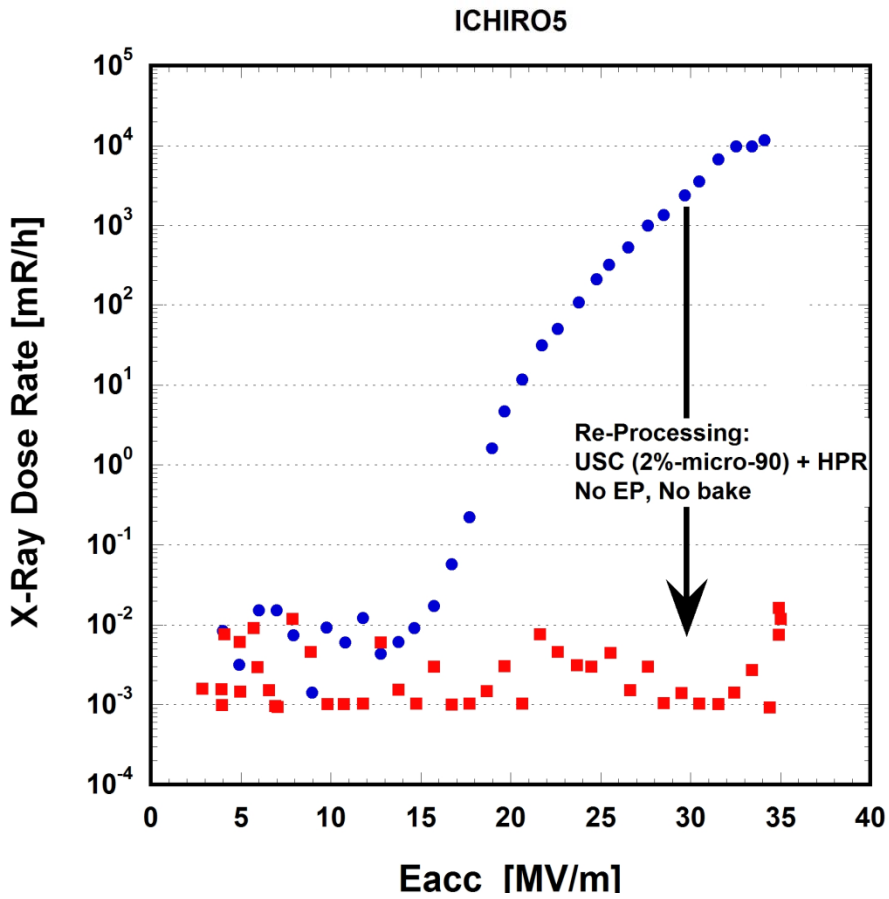


ICHIRO5 RF test after JLab EP

RF test	treatment	result	limit
1	US cleaning + HPR, RF test in D7	30 MV/m	LHe, loose antenna
2	Warm-up to RT, retest in D8	21 MV/m	FE, stable turn on hysteresis Q(Eacc)
3	Warm-up to RT, re-test in D7	19 MV/m	FE, stable turn on Hysteresis Q(Eacc)
4	EP 20 um + EP 10um + US + HPR +bake	36 MV/m	FE, emitter turn on then explosive event
5	US cleaning (2% micro-90) + HPR	35 MV/m	Quench, No X-ray
6	EP 20 um + EP 20 um + US (2%) + HPR + HPR + bake	28/16 MV/m	FE induced quench Strong emitter turn on

ICHIRO5 reached 36 MV/m with strong FE
After re-processing: 35 MV/m with no FE



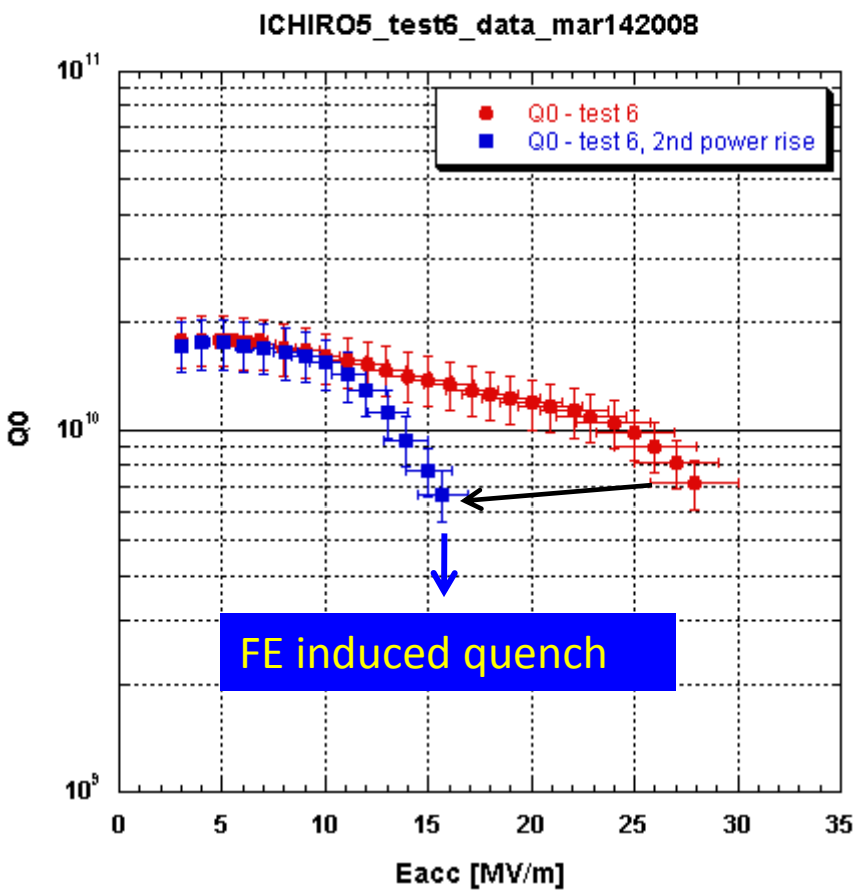


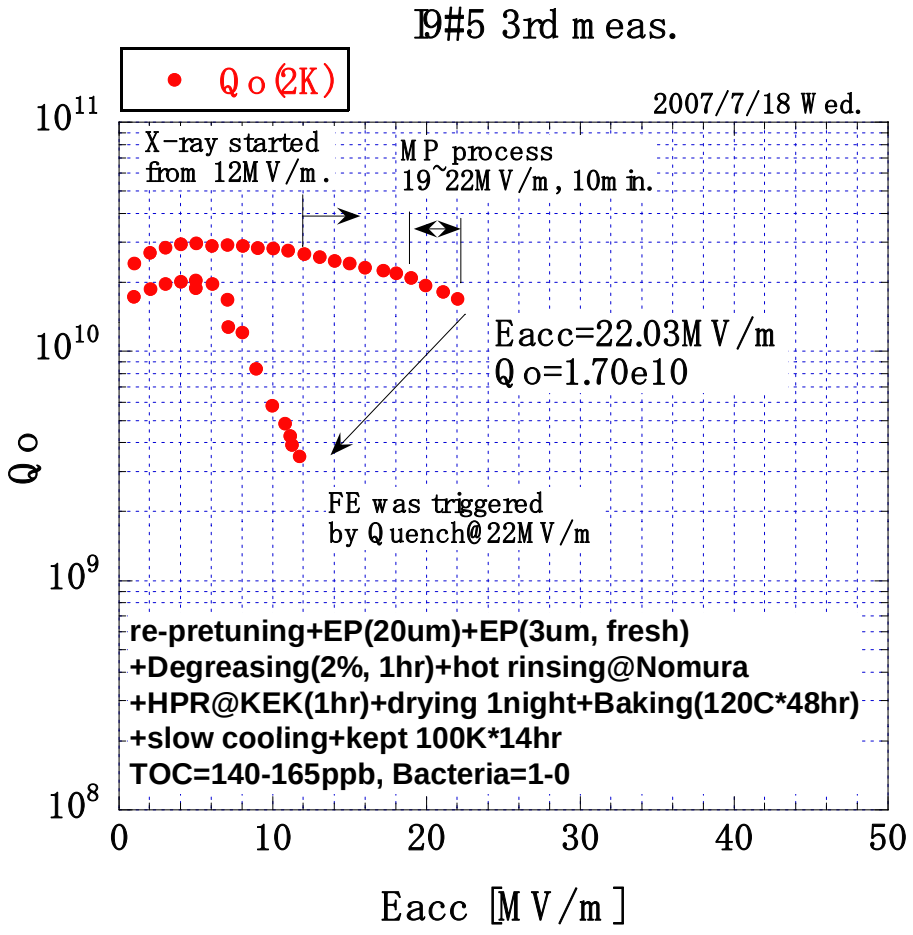
ICHIRO5 RF test after more JLab EP

RF test	treatment	result	limit
1	US cleaning + HPR, RF test in D7	30 MV/m	LHe, loose antenna
2	Warm-up to RT, retest in D8	21 MV/m	FE, stable turn on hysteresis Q(Eacc)
3	Warm-up to RT, re-test in D7	19 MV/m	FE, stable turn on Hysteresis Q(Eacc)
4	EP 20 um + EP 10um + US + HPR +bake	36 MV/m	FE, emitter turn on then explosive event
5	US cleaning (2% micro-90) + HPR	35 MV/m	Quench, No X-ray
6	EP 20 um + EP 20 um + US (2%) + HPR + HPR + bake	28/16 MV/m	FE induced quench Strong emitter turn on

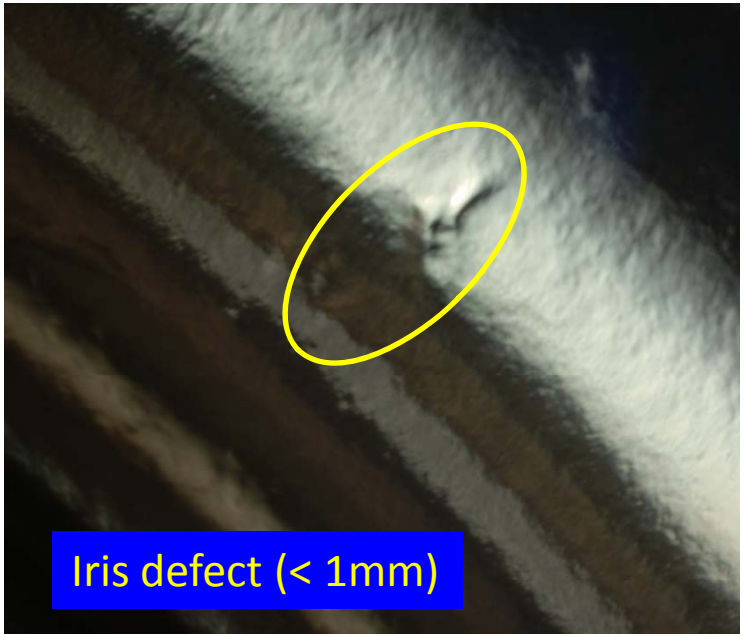
Last test: Strong FE turn on at 28 MV/m

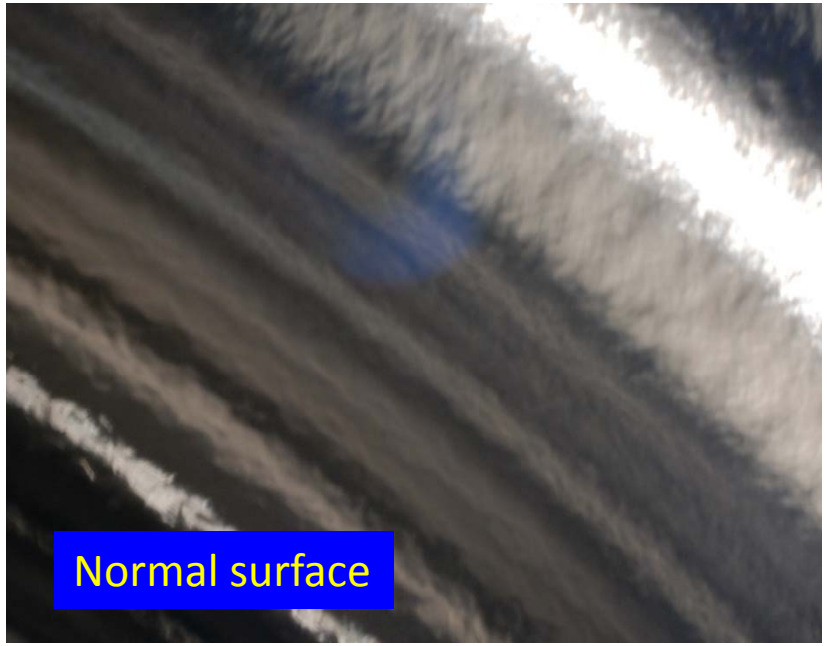
Similar behavior during 3rd test at KEK & 2nd and 3rd test at JLab



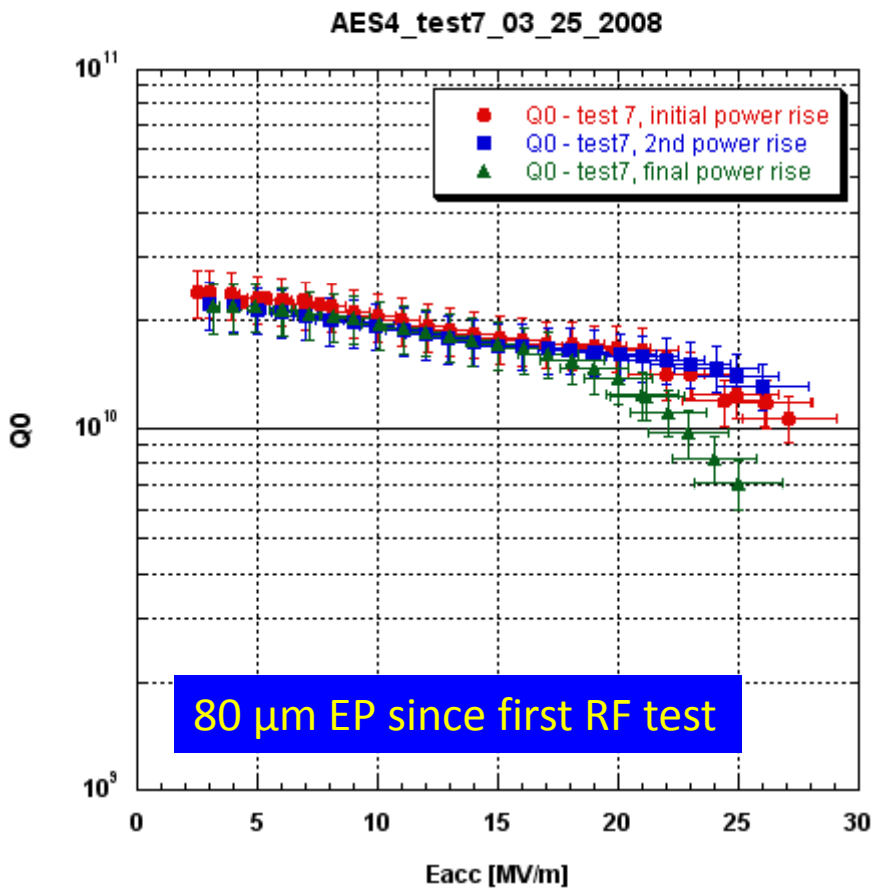


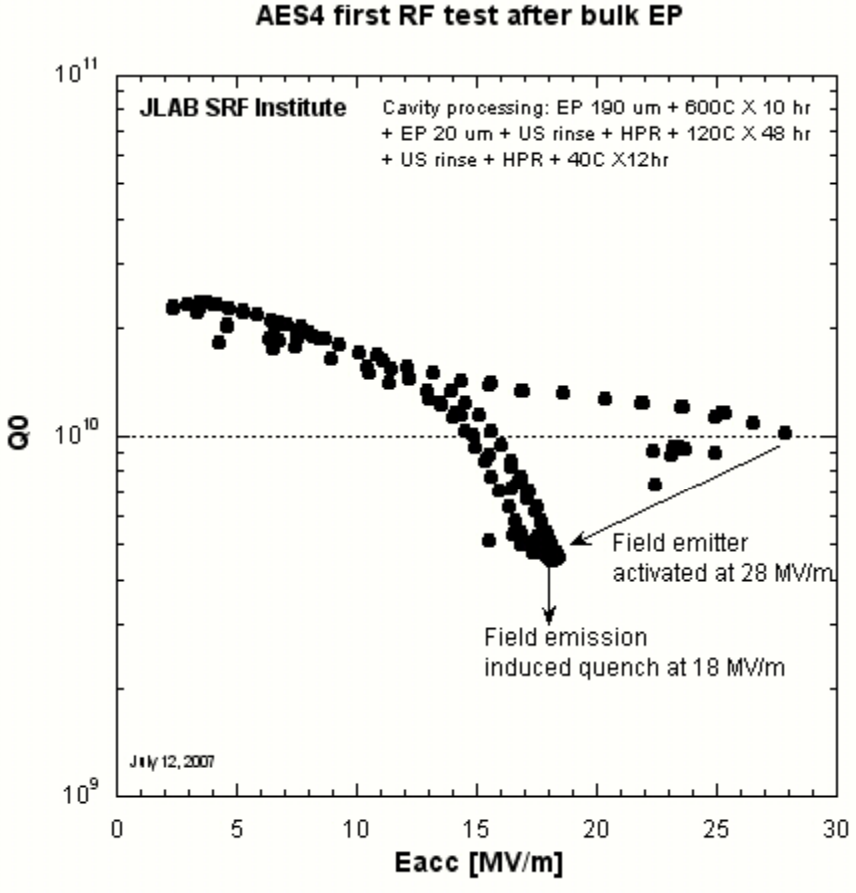
Long-distance microscope (Questar) RF surface inspection



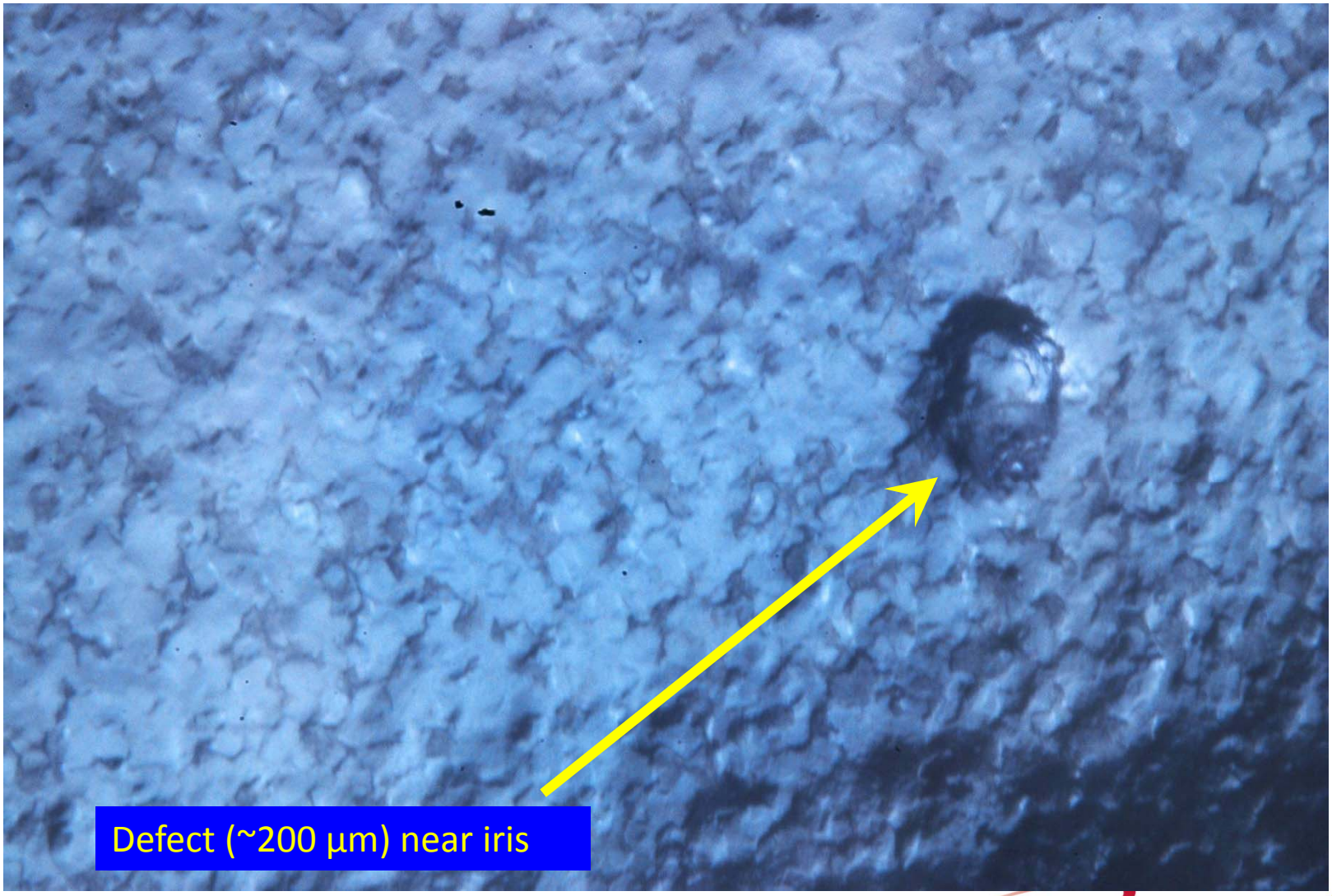


AES4 has similar behavior

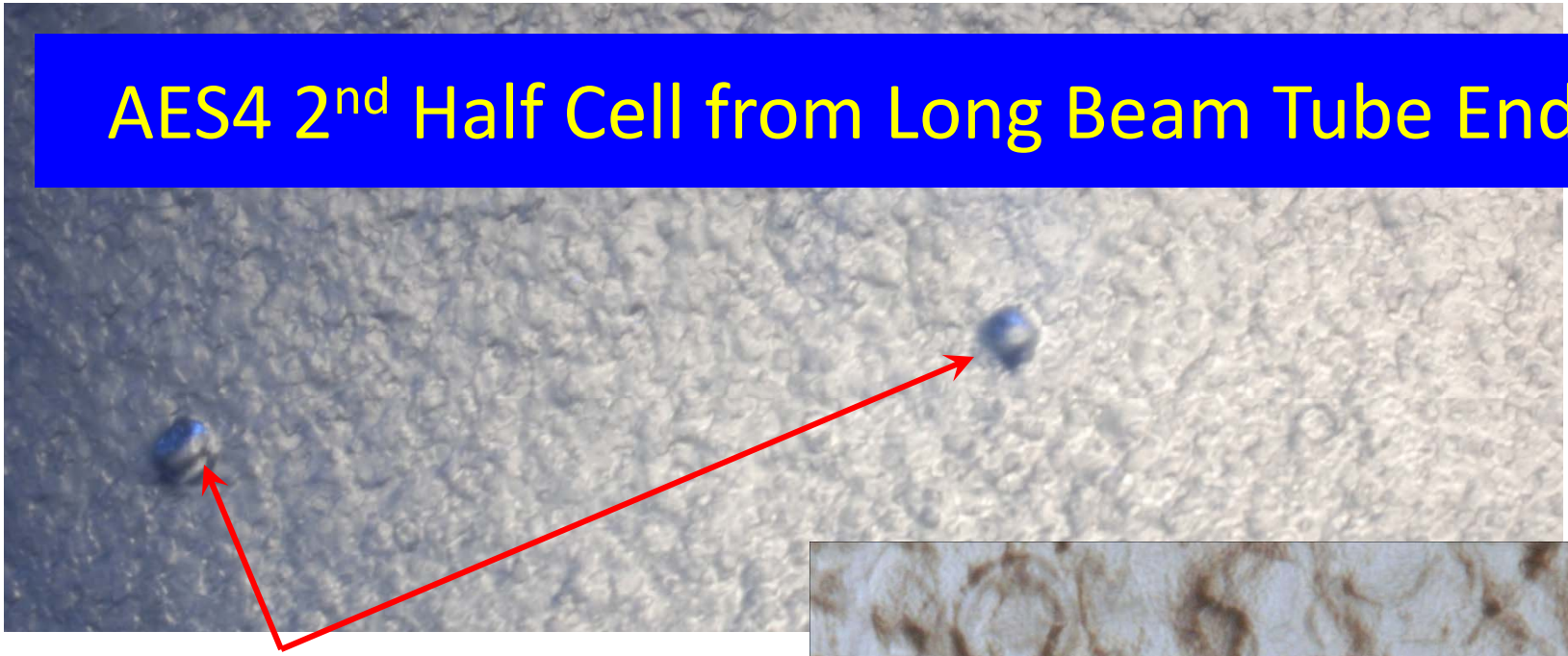




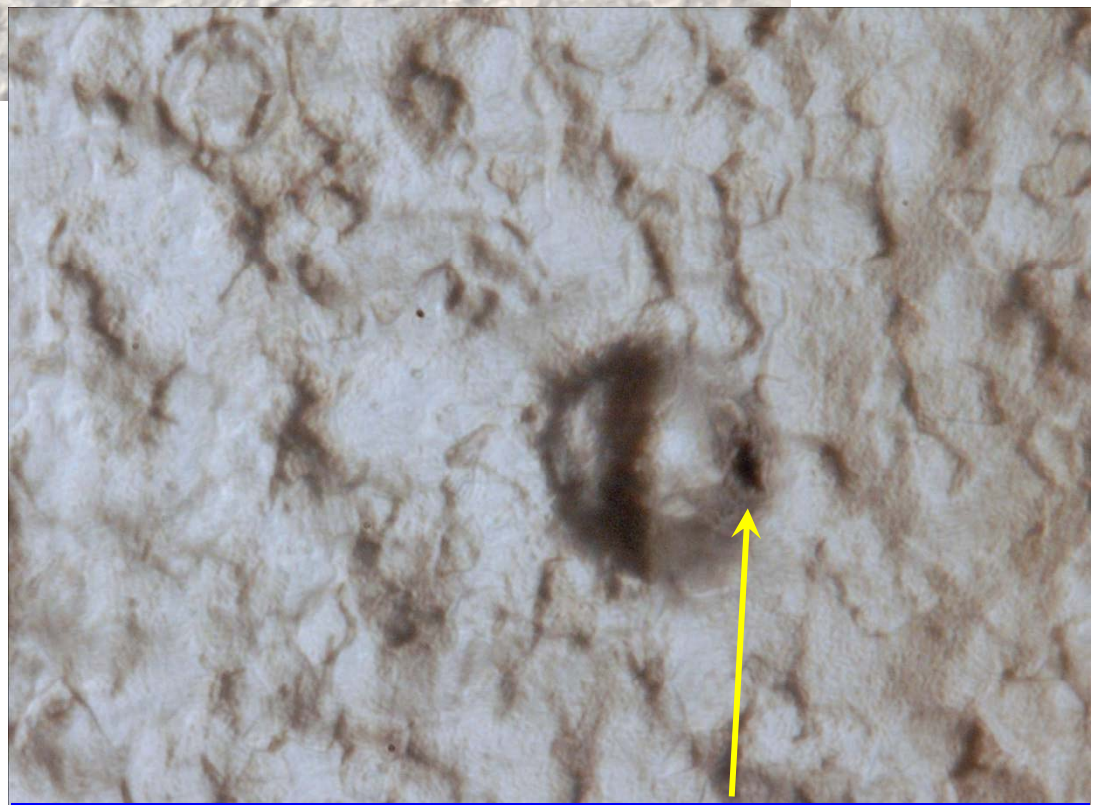
AES4 4th Half-Cell from Long Beam Tube



AES4 2nd Half Cell from Long Beam Tube End



3 defects (~ 100 µm),
with 2 shown,
at radial location
of stiffening ring

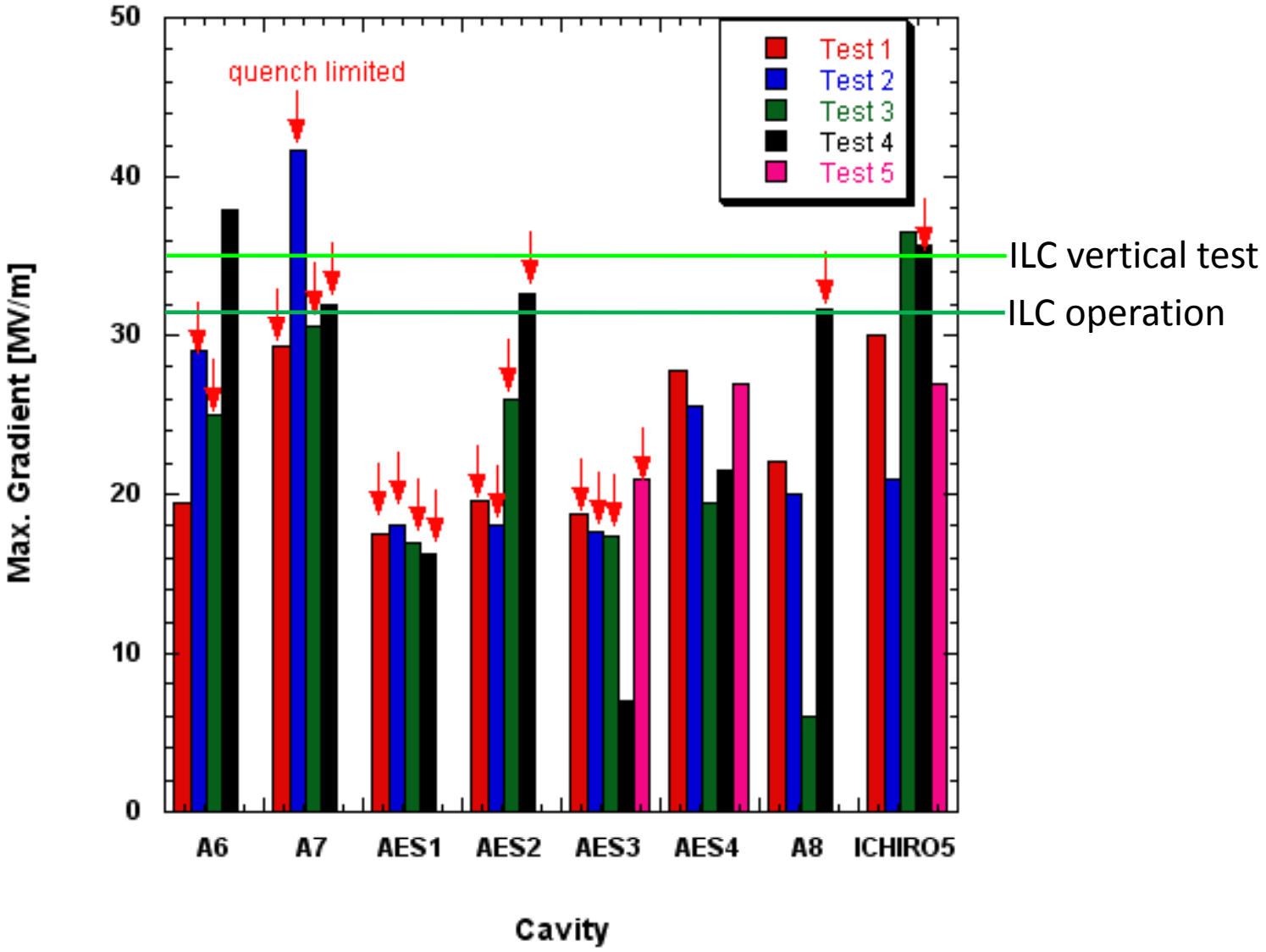


Blowup of one defect showing crater type details

AES4 defect locations consistent with pass-band measurements

2 X cell thermometry test done on April 18, data under analysis

More in later talk by Gigi Ciovati



For more details of JLab data and activities:
http://srf.jlab.org/JLabILCinfo/JLabILC.html

Concluding Remarks

- A strong JLab/KEK/FNAL collaborative effort.
- ICHIRO5 reached ILC goal gradient and Q.
- Re-processing by ultrasonic cleaning + HPR has shown remarkable success in reducing FE.
- The recurring FE turn-on may be associated with iris defect.
- A similarly behaving cavity AES4 under study with combined pass-band measurements, 2X cell thermometry, and long-distance microscope.

Concluding Remarks (cont.)

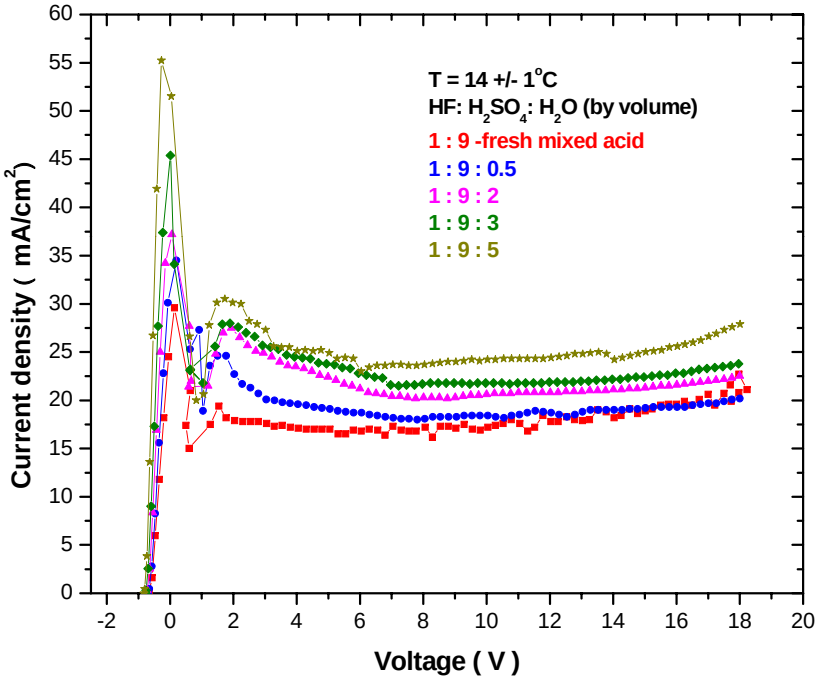
- JLab's significant 9-cell cavity processing and testing capability (30 EP/VT cycles per year) enhanced by added capability for cavity thermometry and high-resolution RF surface inspection.
- Basic EP studies, flat sample studies & single-cell EP program at JLab remain necessary components.
- ILC high-gradient R&D directly benefits other JLab projects (such as new SNS spare cavity processing). JLab has a strong gradient R&D portfolio for FY09 and beyond (more in later talk by Charlie Reece).

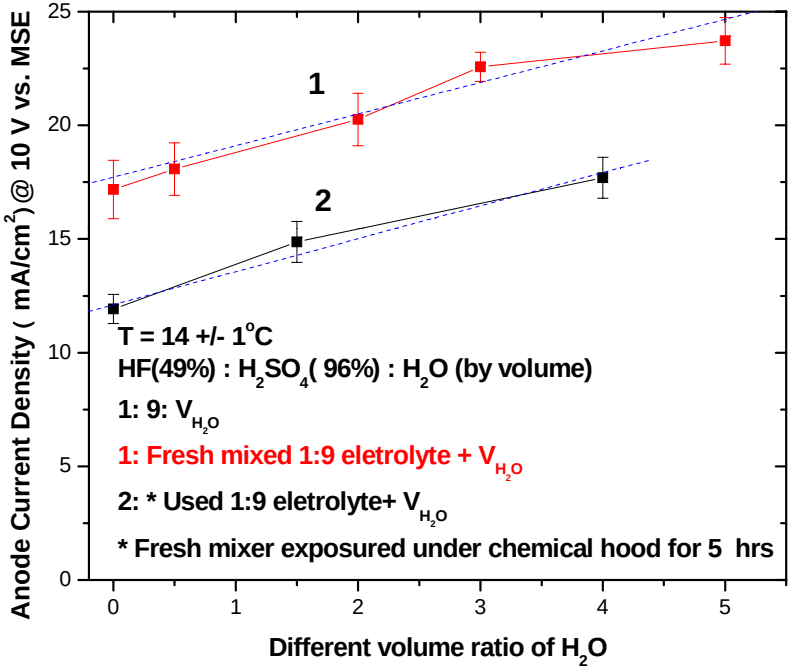
Acknowledgement

- Japan-US collaboration fund.
- KEK: Fumio Furuta, Kenji Saito, Hitoshi Hayano
  Nobu Toge, Kaoru Yokoya.
- FNAL: Damon Bice, Mark Champion
- JLab: Curtis Crawford, Pete Kushnick, Byron Golden.
  Charlie Reece, Bob Rimmer.
- GDE: Akira Yamamoto, Marc Ross.

Backup Slides

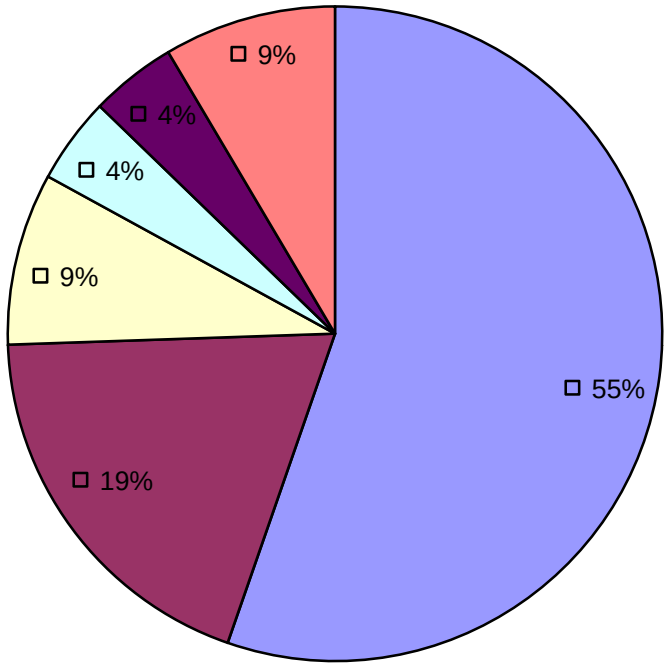
Basic EP studies
to address effect of water addition/subtraction





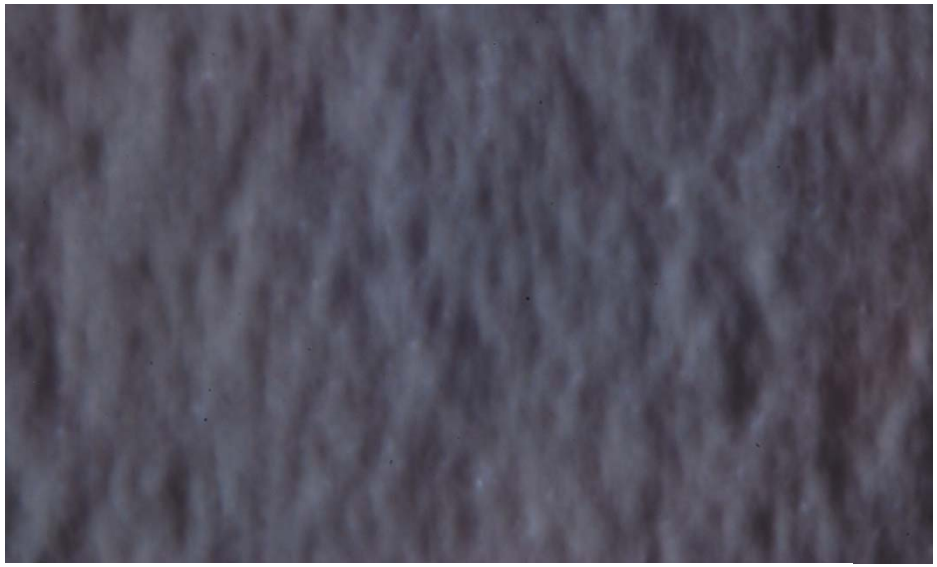
Hui Tian, Michael Kelley, Charlie Reece

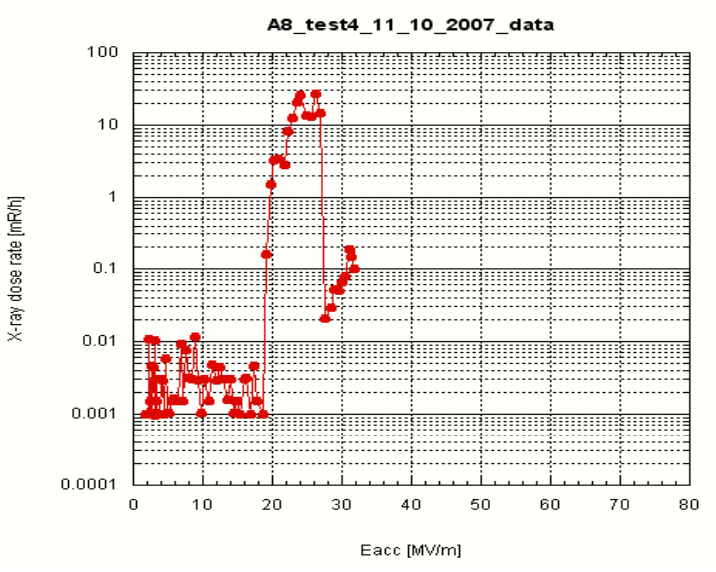
Gradient limiting mechanisms

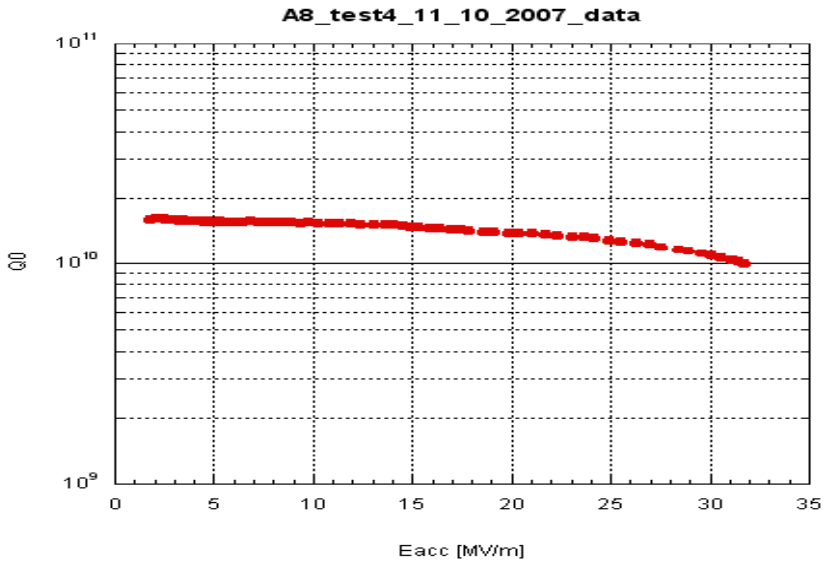


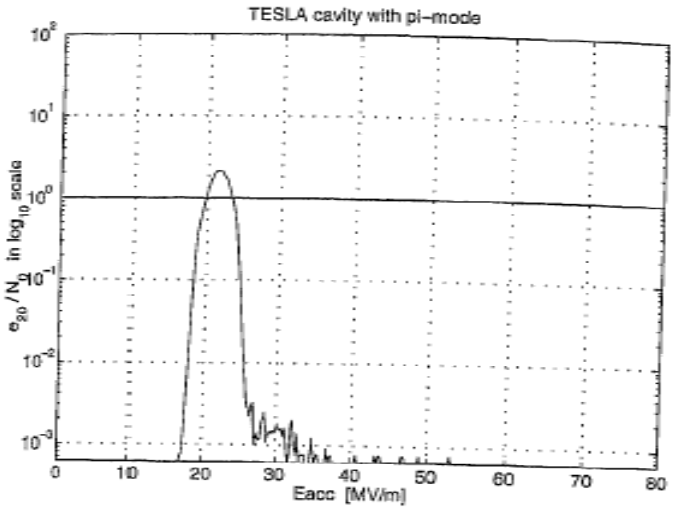
Total 47 RF tests

Typical RF surface of ACCEL#8 (32 MV/m) viewed by Questar

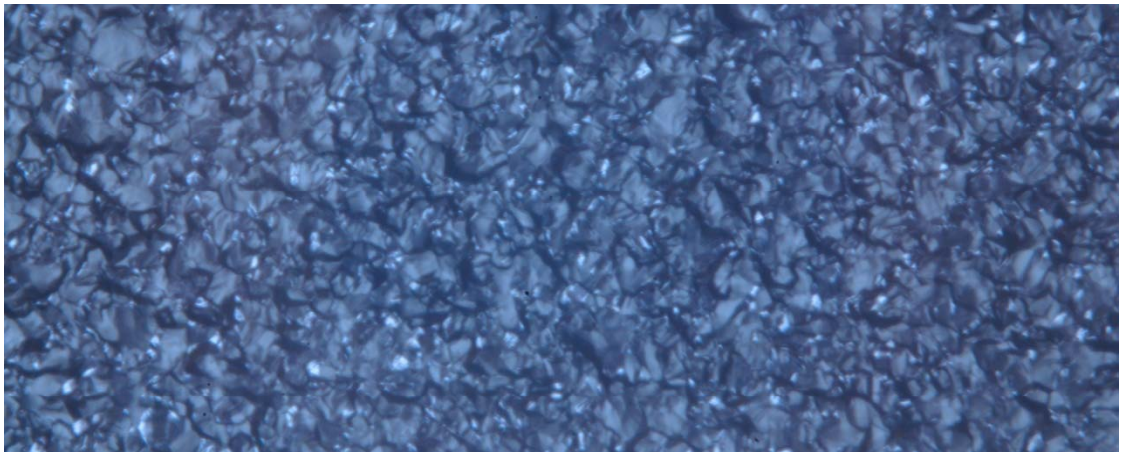


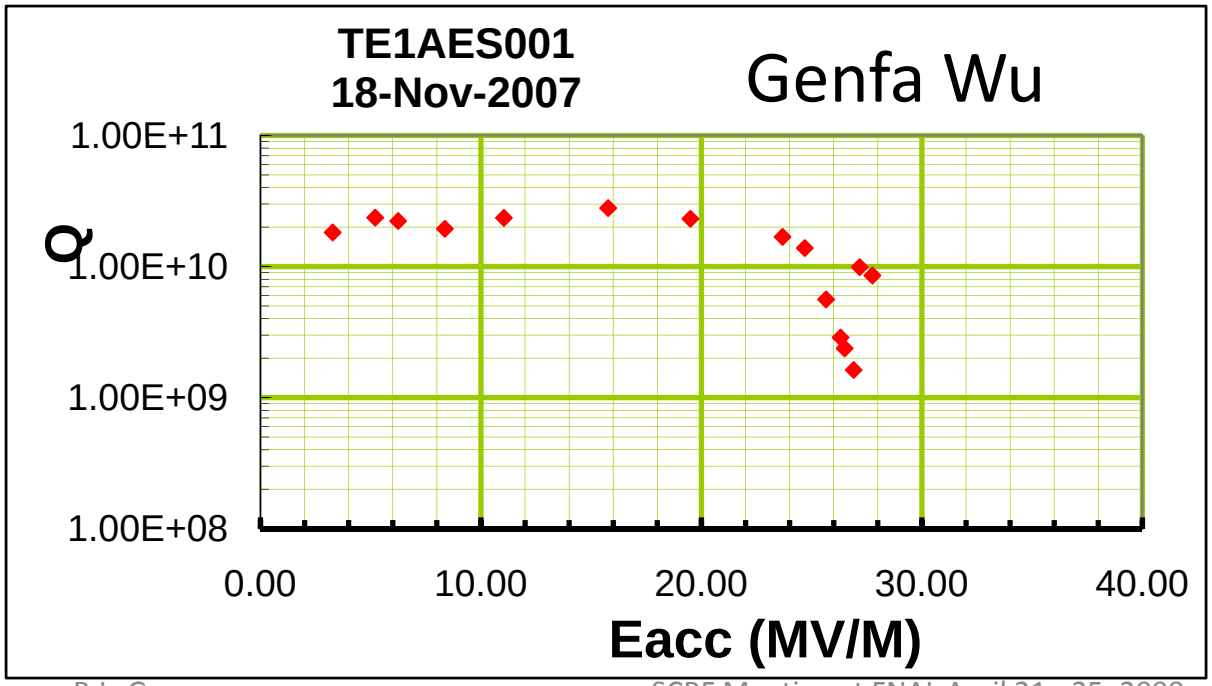


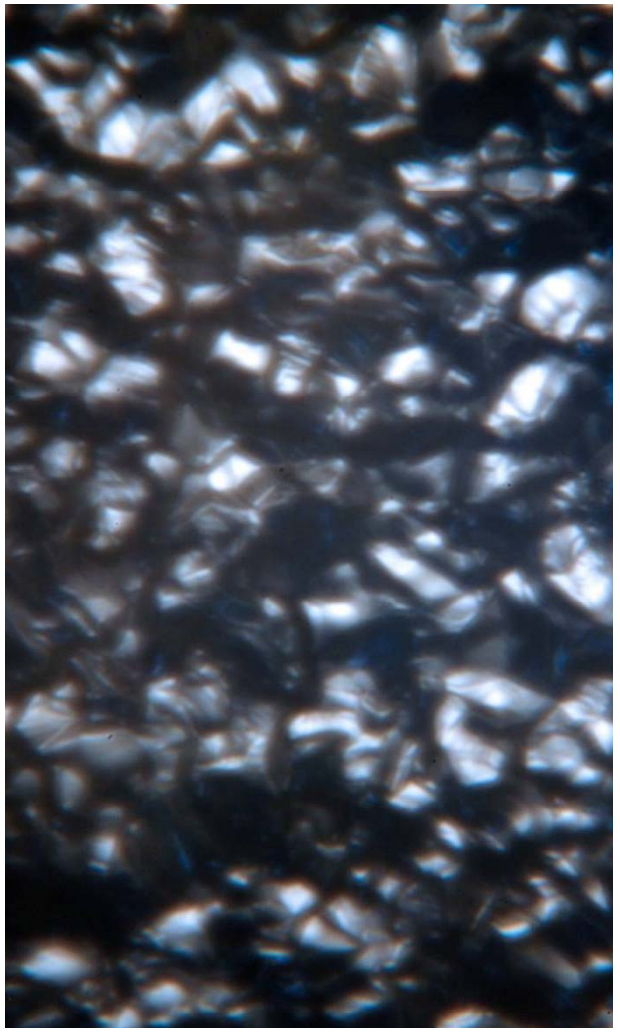




Typical RF surface of TE1AES001 (28 MV/m, BCP etched only) viewed by Questar







Jefferson Lab