

Update on S0 Work in the Americas Region

Mark Champion

22 June 2010

Overall a very positive review

- The review committee was impressed with the progress on superconducting RF cavities. In particular, they were pleased to see that the TDP-1 yield goal of 50% at 35 MV/m has been achieved .
- The committee commended the excellent processing and testing results at Jefferson Lab and the increasing throughput and quality of results at the ANL/FNAL SCSPF and the FNAL VTS.
- They were interested in the plans to optimize and qualify vertical electro-polishing and urged us to complete this work during the next year.
- Despite the progress and successes, there is concern about how we will manage to achieve the TDP-2 goal of 90% yield by the end of 2012. We proposed one pathway towards this goal is the development of nine-cell hydro-forming. The response was positive, and I think they will endorse this proposal in their report, which is due in about one month.

The review agenda and presentations can be obtained here:

- <http://ilcagenda.linearcollider.org/conferenceOtherViews.py?view=standard&confId=4571>



Americas Region Cavity Inventory update



Fermilab

Tesla-shape nine-cell cavities		
Description	No. Cavities	Status
AES 1-4	4	tested
AES 5-10	6	tested
AES 11-16	6	due June 2010
→ AES 17-36	20	Planned deliveries: 10 in Apr-Jun 2011, 10 in Mar-May 2012
Accel 6-9	4	tested
Accel 10-17	8	tested
Accel 18-29	12	testing in progress
Jlab fine-grain 1-2	2	fabrication complete; testing in progress
Niowave-Roark 1-6	6	First two received; balance due summer 2010
→ Niowave-Roark 7-16	10	Planned deliveries: 3 in Jun 2011, 3 in Mar 2012; 4 in Dec 2012
→ Pavac 1-10	10	Planned deliveries: 3 in Jun 2011, 3 in Mar 2012; 4 in Dec 2012
Total	88	
Already Received	38	
Tesla-shape single-cell cavities		
Description	No. Cavities	Status
AES 1-6	6	tested for vendor qualification; currently used for R&D
Accel 1-6	6	tested for vendor qualification; currently used for R&D
Niowave-Roark 1-6	6	tested for vendor qualification; currently used for R&D
Pavac 1-6	6	First three received; balance due summer 2010
Total	24	
Already Received	21	

Proceeding with purchase of 40 cavities using ARRA (economic stimulus) funds.

2010 Summary Data

- **24 cavity test preparations completed January-May 2010**
 - 10 one-cell preps
 - 9 nine-cell vertical preps
 - 5 horizontal test preps
- 6 bulk EP
- 11 light EP
- 68 HPR cycles

Presented at ART review

Resultant Test Highlights

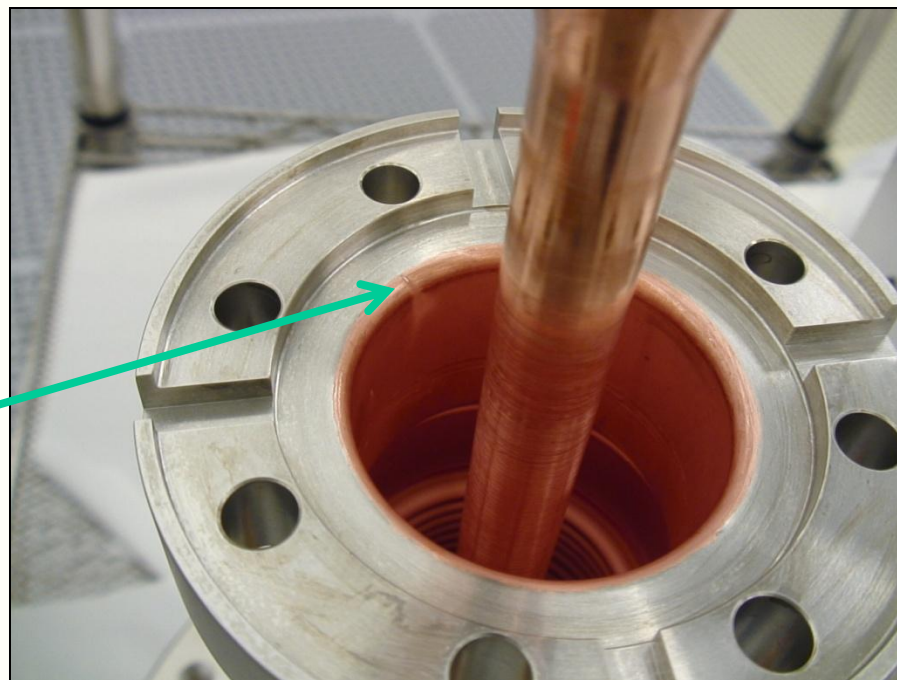
- **Highest Gradient 9-cell (rinsed and assembled only): TB9AES007 41.8 MV/m (processed/tested at JLab – test results in agreement)**
- **Highest Gradient w-ANL EP and w/o FE: TB9RI029 34.6 MV/m**
- Latest Horizontal test TB9AES009 was FE-free at 35 MV/m
 - TB9ACC008 FE-free up to 32 MV/m
- 20+ single-cell processes FE-free in a row—up to 42 MV/m
- Multiple 30+MV/m 9-cell processed through SCSPF

Cavity	Max gradient	Q_0	Field Emission	Destination
TB9AES004	31 MV/m	1.1×10^{10}	Very little	S1-Global CM
TB9ACC013	>35 MV/m	1.2×10^{10}	Heavy*	CM2
TB9AES009	35 MV/m	0.7×10^{10}	None	CM2
TB9ACC008	32 MV/m	tbd (in progress)	None	tbd

time ↓

*FE brought about by breakdown in the input coupler at ~37 MV/m --- prior to this event
 TB9ACC013 was FE-free

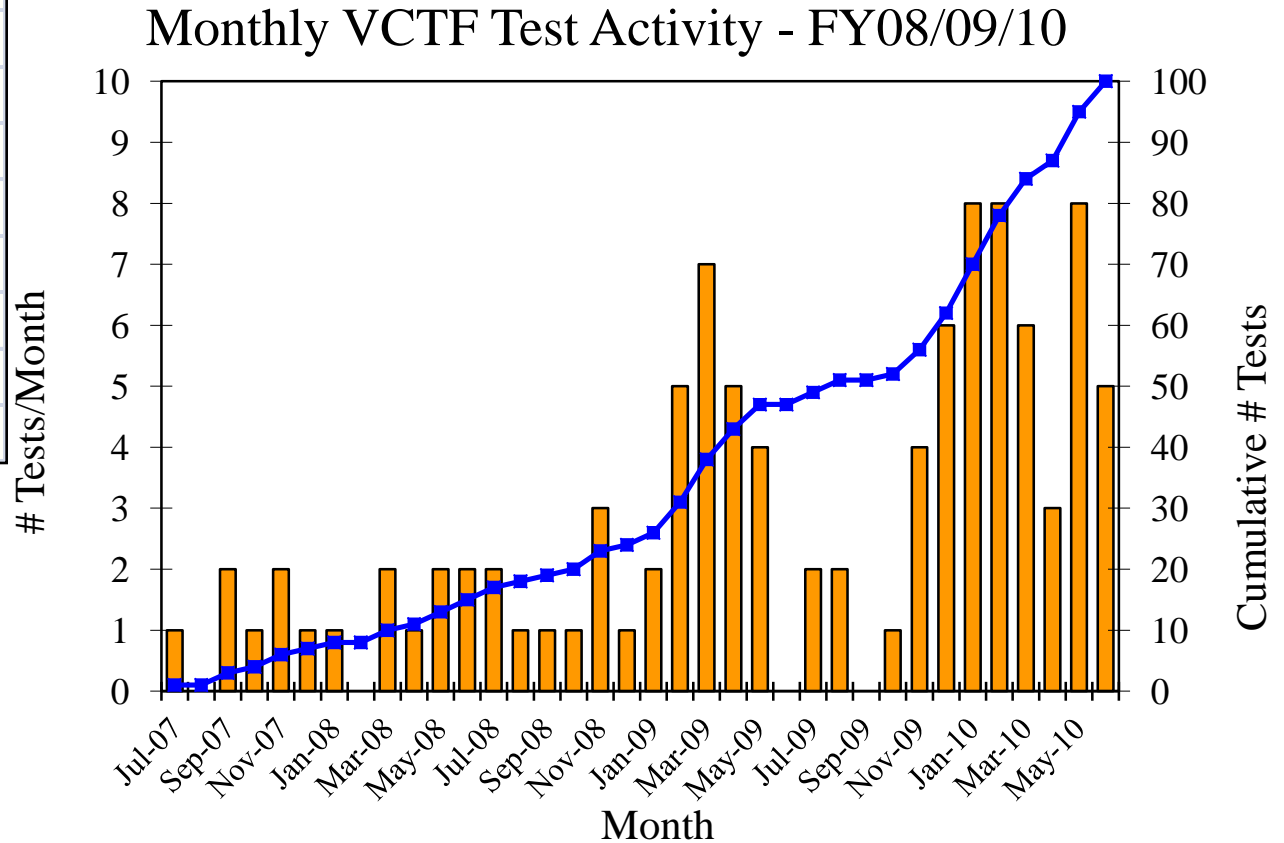
Void in Cu plating + "vapor trail"



Courtesy of Hocker

TE1CAT001	5/18/2010
TE1NR006	5/18/2010
TB9RI029	5/21/2010
TB9RI024	5/25/2010
TB9AES007	6/2/2010
TE1NR004	6/7/2010
TE1NR004	6/10/2010
TB9RI021	6/15/2010
TB9RI022	6/18/2010
TB9RI022*	6/22/2010
TB9RI021*	6/28/2010

RED = planned



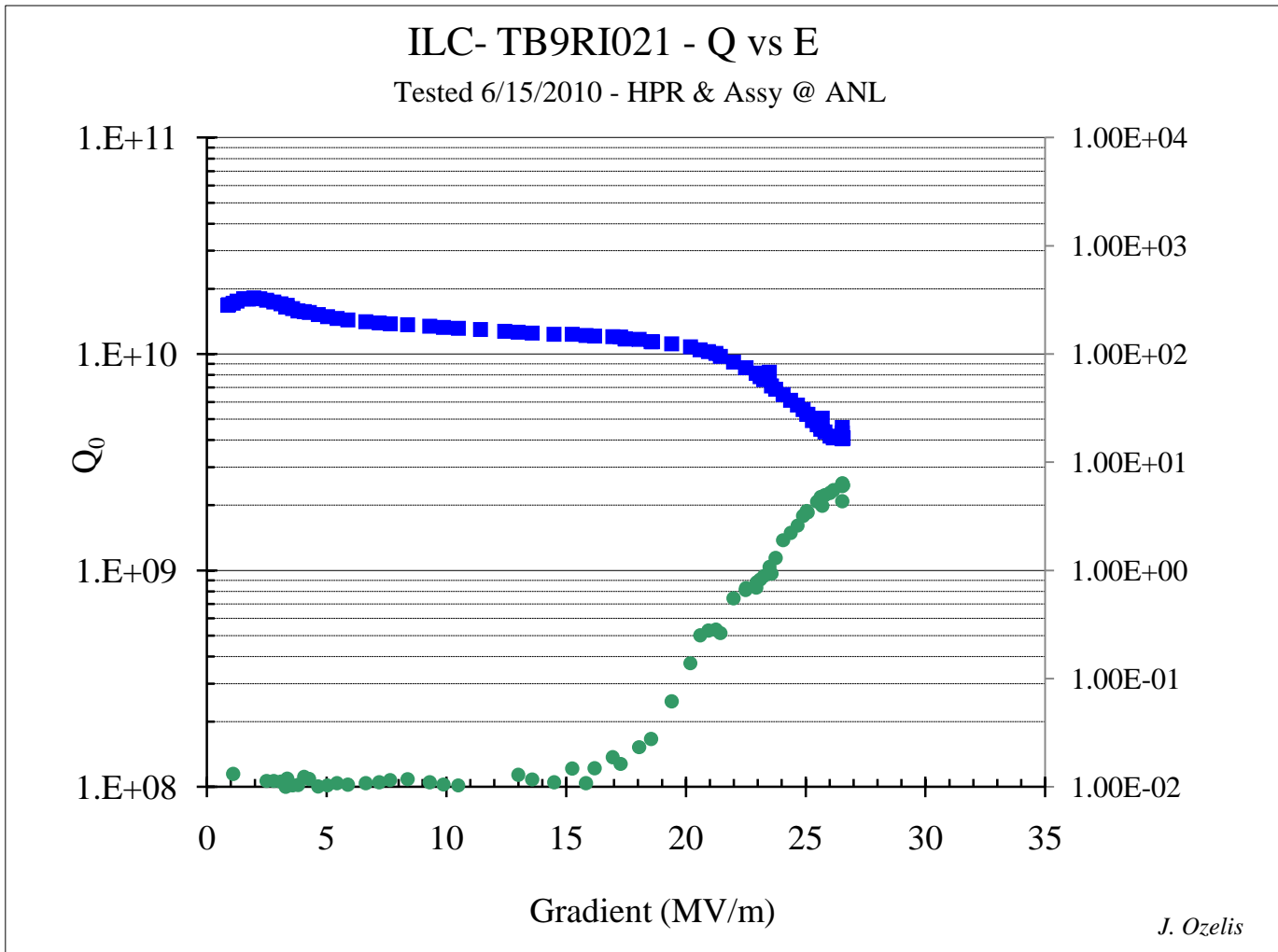
Courtesy of Ozelis

TB9RI021

- Bulk EP (133 microns) performed by RI
- Optical inspection at Fermilab
- 800 deg C de-gas at Jefferson Lab
- Light EP (25 microns) at Argonne
- Test at Fermilab

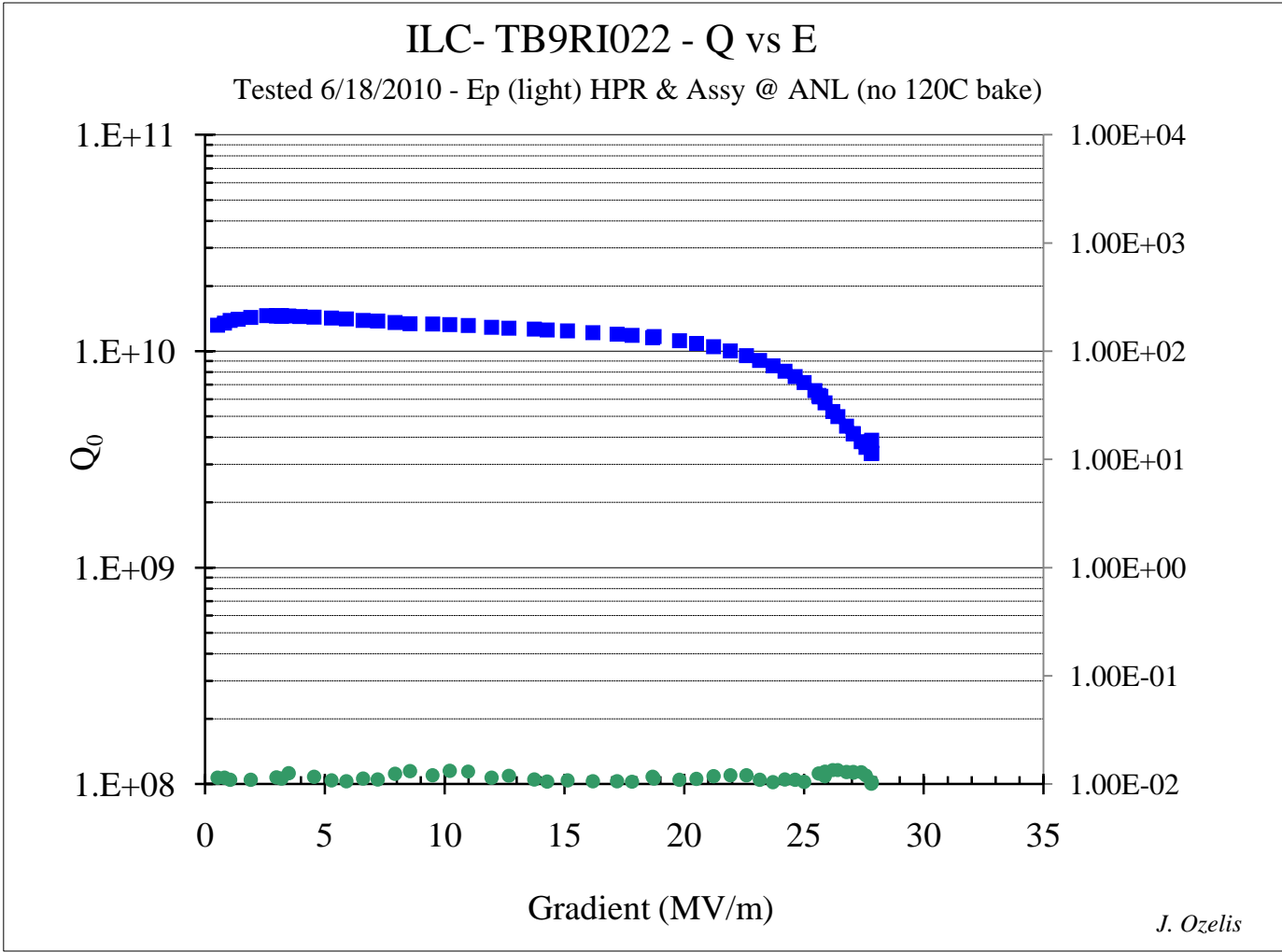
TB9RI022

- Bulk EP (153 microns) performed by RI
- Optical inspection at Fermilab
- 800 deg C de-gas at Jefferson Lab
- Light EP (22 microns) at Argonne
- Test at Fermilab



Limited by FE (RF power). $E_{\max} = 26.6$ MV/m, Q_0 (@ E_{\max}) = 4×10^9

- Did not open vacuum valve on vertical test stand.
- Next step: open valve and verify cavity performance.
- If no FE, then perform 120 deg C bake and repeat test.

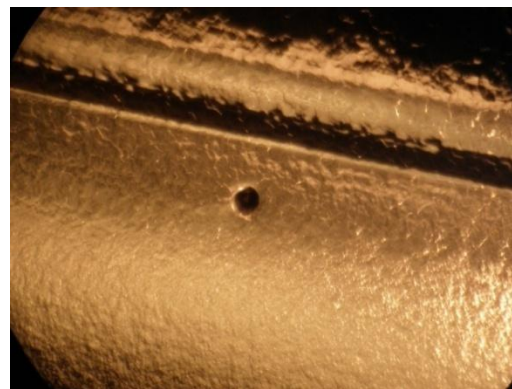


Limited by Q-drop (RF power). $E_{\max} = 27.8 \text{ MV/m}$, $Q_0 (@ E_{\max}) = 3.4 \times 10^9$

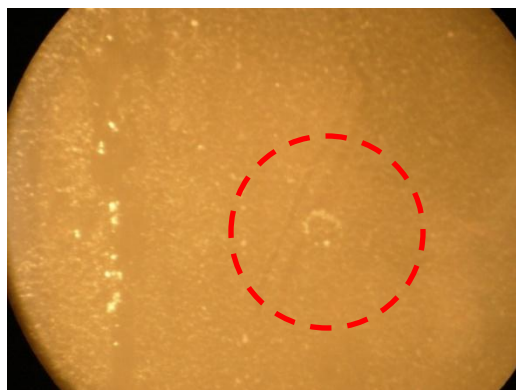
Cornell SRF Cavity Tumbler Rev I



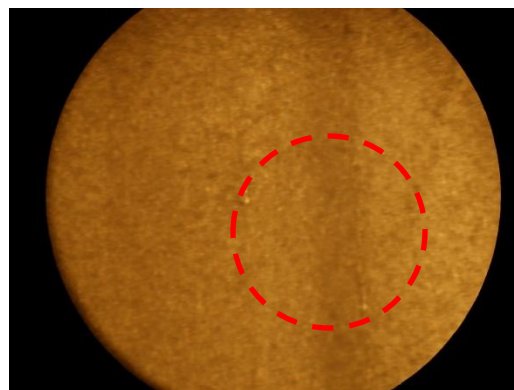
Strengthened machine. Approximate removal rate when one cell is tumbled is $15 \mu\text{m}$ per day.



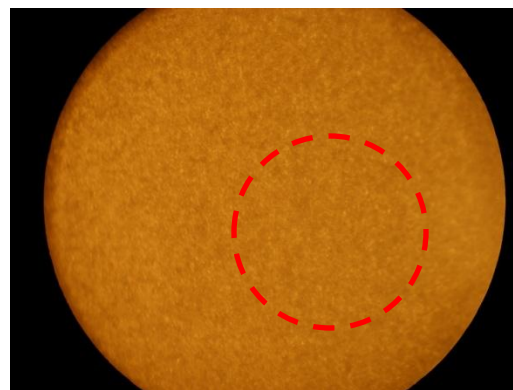
AES5 Cell#3 pit defect after Jlab Electropolish. This is the only cell to be tumbled.



After first tumbling ($-44 \mu\text{m}$)



After second tumbling ($-34 \mu\text{m}$)



After third tumbling ($-44 \mu\text{m}$)

Notes: 1. Total removal by tumbling: $122 \mu\text{m}$ 2. Only ultrasonic cleaning before photos were taken / no etching

Cornell SRF ILC Cavity VEP Plan (jun10 –sep10)

- AES5 (Pit defect in equator weld heat affected zone of cell #3)
 - Tumble cell #3
 - VEP
 - Cold electrolyte / No HNO3 / Minimize disturbance to dielectric layer
- A9 (26 MV/m E_{acc} quench in cell #1, no visible defect)
 - Tumble cell # 1
 - VEP
 - Cold electrolyte / No HNO3 / Minimize disturbance to dielectric layer
- A10 (Low initial Q_0 , Low onset of FE, Damage to iris from HPR spray head?)
 - Tumble whole cavity
 - VEP
 - Cold electrolyte / No HNO3 / Minimize disturbance to dielectric layer
- VEP treatment of two new AES cavities. Expected availability jul2010

JLab Update

Rongli Geng

ILC Cavity Group Meeting

June 22, 2010

Two New RI Cavities Qualified

$E_{acc} > 35 \text{ MV/m}$ @ $Q_0 > 8E8$

- RI18 reached 39 MV/m @ Q_0 8.2E9 after second light EP
 - Cavity reached 33 MV/m after first light EP, limited by Q-slope (electrolyte contaminated by water)
 - Cavity will be shipped back to FNAL for CM2
- RI19 reached 38 MV/m @ Q_0 8.8E9 after first light EP
 - Cavity appeared to be limited by quench
 - But lots of X-rays at highest field
 - Cavity has been re-HPR'ed and re-test this week
- Report by Grigory Ereemeev later

ICHIRO7 Testing in Collaboration with KEK

First EP successfully done at JLab June 18, 2010

