

# US Cavities Status and Plan

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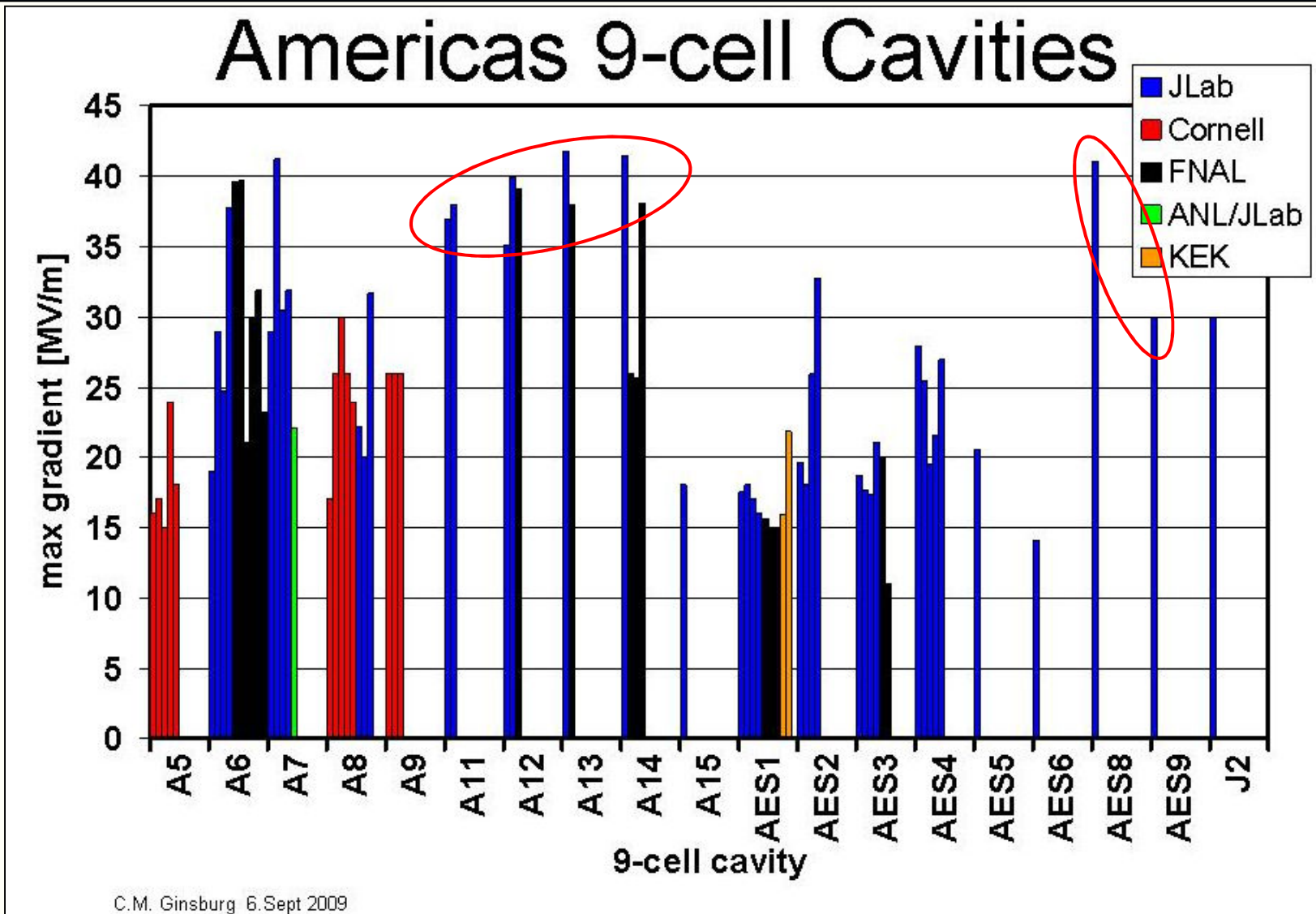
**01 October 2009**



- **Process and test new nine-cell cavities as they arrive from vendors**
  - Increase yield data set
  - Increase experience and throughput at ANL/FNAL
  - Gain new insights regarding performance limitations
- **Increase our understanding of performance limitations and develop manufacturing and processing improvements via:**
  - Nine-cell processing and testing
  - Single-cell R&D
  - R&D on materials and processes
- **Continue to develop cavity manufacturing in North America**
  - Purchase more cavities
  - Provide feedback on performance and limitations
  - Work with vendors to improve understanding of limitations and mitigation techniques
- **Provide high-performance cavities for cryomodule fabrication**
  - FNAL CM2, CM3, ..., and S1-Global

## Secondary Goals

- Perform cavity repairs via local grinding, tumbling, e-beam or laser melting, and cell replacement
- Develop improved materials and processes
  - Seamless tubes for hydroforming
  - Tumbling and chemical-mechanical polishing
  - Vertical EP
  - Rinsing optimization
- Develop alternative cavity technologies
  - Large grain
  - Hydroforming
  - Alternate shapes
- Develop instrumentation and diagnostics
  - T-mapping, 2<sup>nd</sup>-sound
  - Radiation monitoring / mapping
- Carry out the collaborative R&D programs funded through DOE (Bill Weng)
- Implement infrastructure improvements
- Reduce costs



- **Successfully commissioned single-cell cavity processing in Q2 FY09**
- **Commissioning of nine-cell cavity processing was progressing, but halted end of May due to water contamination problems (see talk by Allan Rowe)**
- **Cavity A14 damaged in early August resulting in cavity handling stand-down for ~2 months**
- **Fermilab VTS2-3 civil construction started early September**
  - **Expect to resume operation of VTS1 end of October**
- **These events have significantly delayed processing and testing of cavities at Argonne & Fermilab (~5 months)**
- **Will focus on ramping up throughput to ~1 process and test cycle per week**
- **Staff increases at ANL facility are proceeding**
  - **2 ANL engineering associates ( 1 filled, 1 pending)**
  - **2 FNAL technicians (1 filled, 1 open)**

- **ART budget for processing & testing at Argonne & Fermilab:**

<b>Argonne</b>	<b># cycles</b>	<b>cost k\$</b>
9-cell EP	23.0	345.0
Single-cell EP	10.0	60.0
Processing facility maintenance		46.0
<b>Total</b>		<b>451.0</b>
<b>Fermilab</b>		
9-cell test cycles	20.0	300.0
Single-cell test cycles	10.0	150.0
<b>Total</b>		<b>450.0</b>

- **Stimulus funding of ~\$890k will go to Argonne via Fermilab to fund labor at the Argonne facility**
- **Additional processing & testing cycles will be funded via FNAL SRF budget**

# Status and Plan at Jefferson Lab

- ~60% of budget allocated to processing and testing of nine-cell cavities → 30 cycles
- Remainder distributed as follows:

<b>Jefferson Lab</b>	<b>cost k\$</b>
Cavity Coordination & Management	100.0
Cavity Fabrication	
- new cavity fabrication (PK)	125.0
Cavity Processing & Vertical Testing	
- 30 EP cycles + cabinet maint. (RG)	1000.0
Cavity Gradient R&D	
- cleaning and surface prep R&D (CR)	200.0
- off-line EP development (RG)	100.0
- large grain studies (PK)	100.0
Cavity & Cryomodule Component R&D	
- Alt. cavity fab. (BR)	100.0
<b>Total</b>	<b>1725.0</b>

- **Additionally, stimulus funding of ~\$900k will go to Jefferson Lab via Fermilab for infrastructure improvements**
  - EP system improvements (heat exchanger, cavity cooling, spares)
  - Upgraded HPR system
  - Ultrapure water system capacity improvement
  - VTA capability improvements (buffer dewar, controls, RF improvements)
  - Next generation EP infrastructure development - stepping stone to ICP



# Status and Plan at Cornell

- **Cornell is presently installing a cryogenic plant using NSF funds**
  - **Plan to commission in Q2 FY10**
  - **Will greatly enhance testing capabilities due to helium recovery**
- **Plans for FY10 include the following items:**

<b>Cornell</b>			
Management & travel		50.0	
9-cell T-Mapping studies	5.0	153.3	
9-cell cavity repair	5.0	150.0	
2nd sound detection on dressed cavities	2.0	80.0	
Single-cell process & test	8.0	70.4	
Vertical EP development		146.3	
<b>Total</b>		<b>650.0</b>	

# Summary of FY10 ART Budget for Cavities

Argonne	# cycles	cost k\$	Jefferson Lab	cost k\$
9-cell EP	23.0	345.0	Cavity Coordination & Management	100.0
Single-cell EP	10.0	60.0	Cavity Fabrication	
Processing facility maintenance		46.0	- new cavity fabrication (PK)	125.0
<b>Total</b>		<b>451.0</b>	Cavity Processing & Vertical Testing	
			- 30 EP cycles + cabinet maint. (RG)	1000.0
<b>Fermilab</b>			Cavity Gradient R&D	
9-cell test cycles	20.0	300.0	- cleaning and surface prep R&D (CR)	200.0
Single-cell test cycles	10.0	150.0	- off-line EP development (RG)	100.0
<b>Total</b>		<b>450.0</b>	- large grain studies (PK)	100.0
			Cavity & Cryomodule Component R&D	
<b>Cornell</b>			- Alt. cavity fab. (BR)	100.0
Management & travel		50.0	<b>Total</b>	<b>1725.0</b>
9-cell T-Mapping studies	5.0	153.3		
9-cell cavity repair	5.0	150.0	<b>Grand Total</b>	<b>3276.0</b>
2nd sound detection on dressed cavities	2.0	80.0		
Single-cell process & test	8.0	70.4		
Vertical EP development		146.3		
<b>Total</b>		<b>650.0</b>		

- **FY10 budget planning assumed no increase in ART budget**
- **Distributions to Labs same as in FY09**

# Cavity Inventory and Procurement Plan

<b>Tesla-shape nine-cell cavities</b>		
<b>Description</b>	<b>No. Cavities</b>	<b>Status</b>
AES 1-4	4	tested
AES 5-10	6	received; testing in progress
AES 11-16	6	due Dec 2009
Accel 6-9	4	tested
Accel 10-17	8	received Mar 2008; testing in progress
Accel 18-29	12	at Accel for installation of Ti rings / due late CY09
Jlab fine-grain 1-2	2	fabrication complete; testing in progress
Niowave-Roark 1-6	6	2 due Jan 2009 / 4 due May-June 2010
Stimulus Procurement	40	order in progress / expect ~12 cavities in Q1 FY11
<b>Total</b>	<b>88</b>	
Already Received	24	
<b>Tesla-shape single-cell cavities</b>		
<b>Description</b>	<b>No. Cavities</b>	<b>Status</b>
AES 1-6	6	tested at Cornell; further testing in progress
Accel 1-6	6	received Dec 2008; testing in progress
Niowave-Roark 1-6	6	tested at Cornell; further testing in progress
PAVAC	6	due Q2 FY10
<b>Total</b>	<b>24</b>	
Already Received	18	

## Cavity Proposal for CM2/S1G

- Identify and prepare 10 cavities + backups for dressing for CM2 and S1G cryomodules
  - For S1G, prefer long-short cavity design
- Timescale:
  - CM2: dressed cavities March 2010
  - S1G: dressed cavities ASAP or latest end of Dec.2009
  - Working backwards, subtract
    - A minimum of 2 weeks for dressing, and
    - 1 month if horizontally testing
- Favor cavities which have gradient performance  $>31.5$  MV/m in vertical test
- Assume all 9-cell process/assembly through mid-November must be done at JLab
  - After FNAL VTS shutdown ends mid-Nov., must focus on qualifying FNAL/ANL processing facility for 9-cell cavities – facility not useful for CM cavity preparation until that happens

## Proposed Prioritization for JLab Request

1. TB9AES008: send clean/sealed to Fermilab immediately
2. A8\*: tuning, USR&HPR, test
3. TB9AES009: optical inspection, tuning, “final” process, test
4. TB9ACC016: full treatment/test of fresh cavity
5. TB9AES010: full treatment/test of fresh cavity
6. TB9AES007: full treatment/test of fresh cavity; some risk from HOM void

- Out of 10 cavities plus backups for CM2 and S1G
  - 3 cavities are ready for dressing: AES002\*, TB9ACC011, TB9ACC013
  - 6 additional cavities reasonably likely to make 31.5 MV/m could be available for dressing by end of Dec. 2009
  - 2 of the 9 are the long-short design preferred for S1G
- Additional one primary and ~five backup cavities required, including at least one more long-short design

\* Means long-short cavity design

2.Sep.2009

CMGinsburg CM2/S1G Cryomodule Cavity Plan

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## Summary

See Camille for more information

- S1G and CM2 cavity schedules appear to be achievable, with substantial risk, provided
  - Clear management-directed prioritization
  - Well-coordinated effort across facilities and Labs
  - No system failures
- This effort is largely compatible with S0 production yield data accumulation: 3 of 5 requested-to-be-done cavities in primary batch add data points to production yield plot
  - For last primary cavity and backups, S0 compatibility depends largely on R1 cavity delivery schedule, but we might expect a comparable ~3 or 4 fresh cavities out of 6
- Note: All cavities sent from JLab to Fermilab must be clean/sealed in cleanroom condition

- **We are planning to have RI (Accel) perform bulk electro-polishing on six (of twelve) new cavities because**
  - **saves time and wear-and-tear on equipment at laboratories**
  - **is consistent with our plans to perform bulk EP in industry**
  - **has been successfully demonstrated at DESY**
  - **reasonable cost and schedule proposal**
- **However, there is some concern that this introduces yet another variable into the S0 program**
- **AES would like to establish bulk EP capabilities with assistance from the ART program (Cornell)**
  - **Should it be vertical or horizontal EP?**
- **There are many related activities that are being supported through economic stimulus (ARRA) funds and/or FNAL SRF funds**
  - **e.g., hydrogen degassing furnace at FNAL, industrial EP development, cavity procurements, chemical-mechanical polishing, ...**

- **FY10 ART budget and plan exists – will no doubt evolve as the year progresses**
- **Stimulus funding provides additional support at Argonne, Fermilab, and Jefferson Lab**
- **SRF funding at Fermilab will also be utilized to some extent on these activities**
- **Planning includes provision of cavities for cryomodules at Fermilab and S1-Global at KEK**
- **Plan to process and test up to ~20 new cavities by middle of calendar year 2010**