Fermilab 1.3 GHz Superconducting RF Cavity and Cryomodule Program for Future Linacs

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U.S. DEPARTMENT OF ENERGY

Fermilab

Fermilab 1.3 GHz SRF Overview

- International Linear Collider motivated substantial infrastructure development and progress
- Project X builds on this
  - 3 GeV CW linac requires high Q0 at gradients $15<E_{acc}<20$ MV/m; studies use 1.3 GHz cavities
  - 3-8 GeV pulsed section is 1.3 GHz, ILC cavities at E_{acc}~25 MV/m
- Cavity preparation and qualification
  - Cavity inspection, surface processing, clean assembly, low-power bare cavity tests and pulsed high-power dressed cavity tests
  - Peripheral hardware, e.g., tuners and couplers, under development
- Cryomodule assembly
  - Well performing cavities assembled into cryomodules for pulsed high-power tests, and will be tested with beam.
- Status, accomplishments and plans

ANL/Fermilab 1.3 GHz cavity proc'ing infrastructure

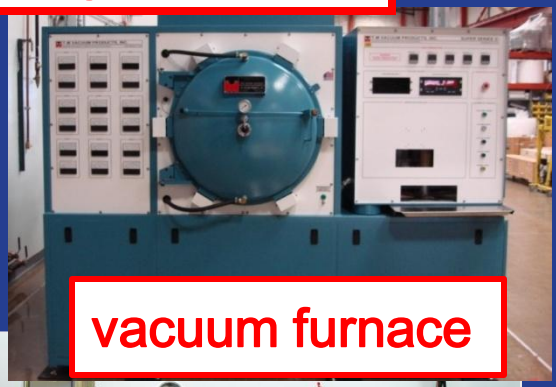
electropolishing

clean assembly

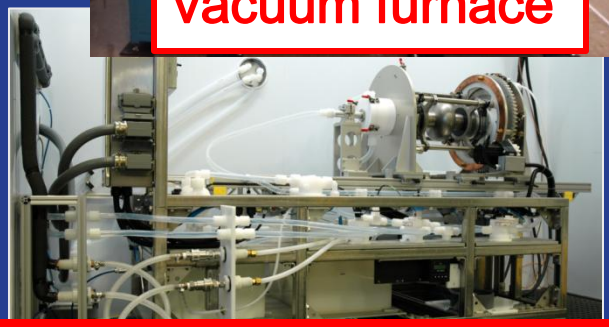
tumbling machine

high-pressure rinse

ultrasonic rinse

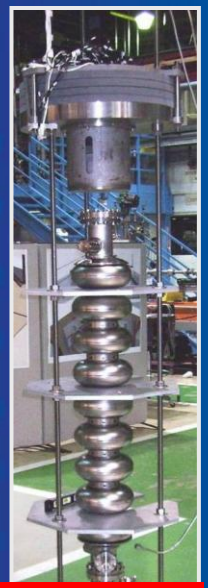


vacuum furnace



new R&D EP tool at FNAL

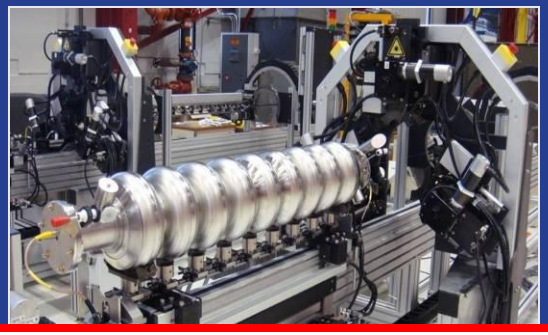
Fermilab test and assembly infrastructure



vertical test

VTS1

VTS2 Dewar (=VTS3)



cavity tuning machine

cavity inspection (Kyoto/KEK)

HTS

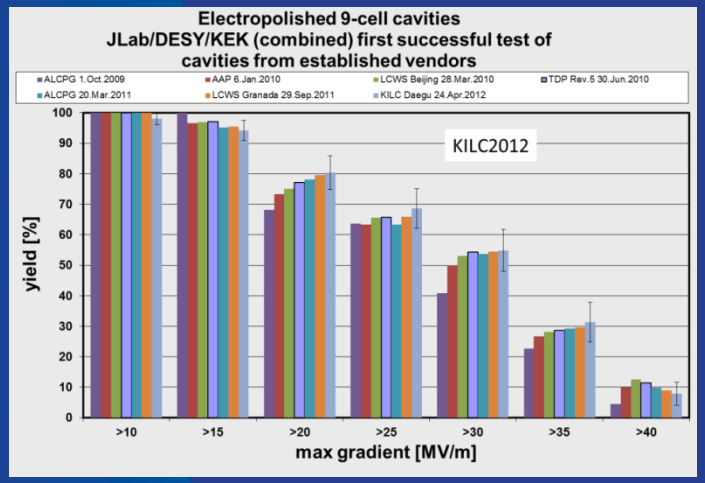
Class-10 string assembly

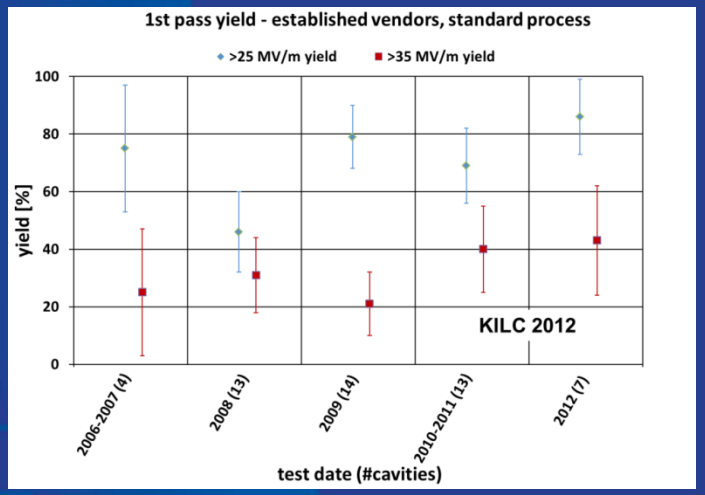
cold mass assembly

final cryomodule assembly

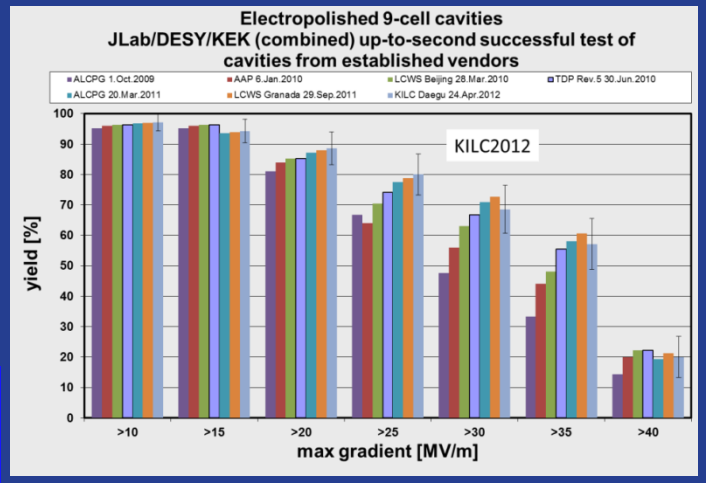
ILC 1.3 GHz Cavity Performance Benchmark

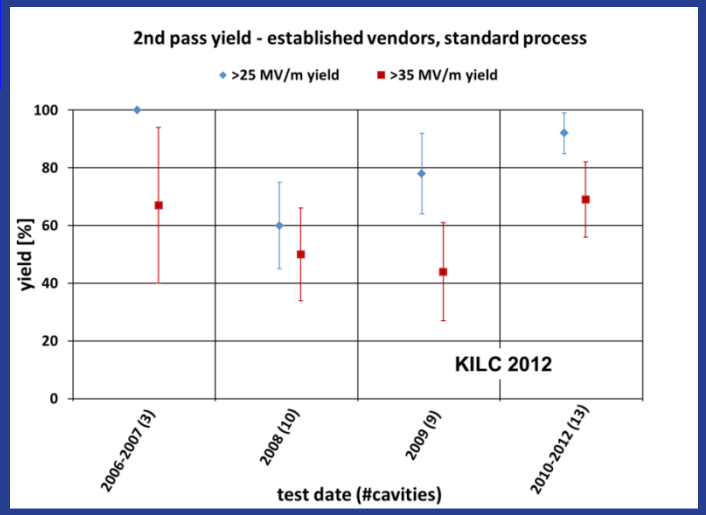
1st pass





2nd pass





International cavities from established vendors using established processes

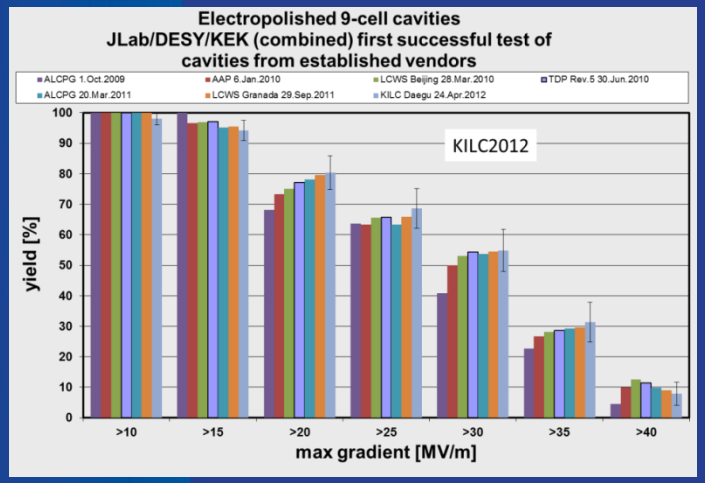
2nd pass yield for **>35 MV/m** for integrated sample is (57 +- 8)%

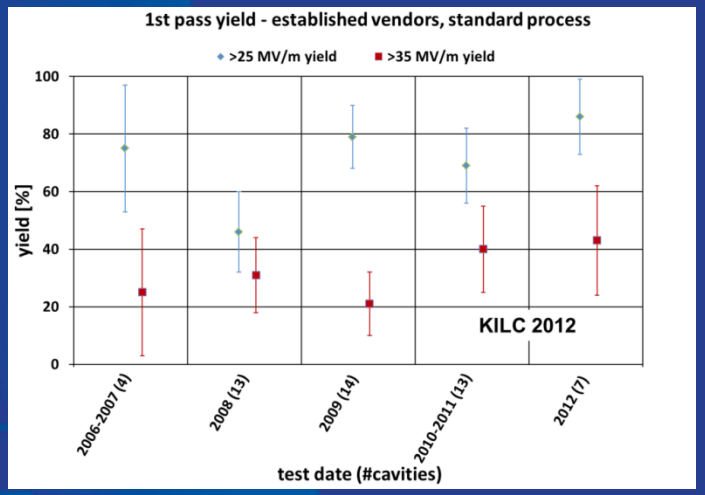
for 2010-2012 alone is (69 +- 13)%

C.M. GInsburg et al., KILC12, Daegu, S. Korea
http://ilcagenda.linearcollider.org/contributionDisplay.py?contribId=85&sessionId=36&confId=5414

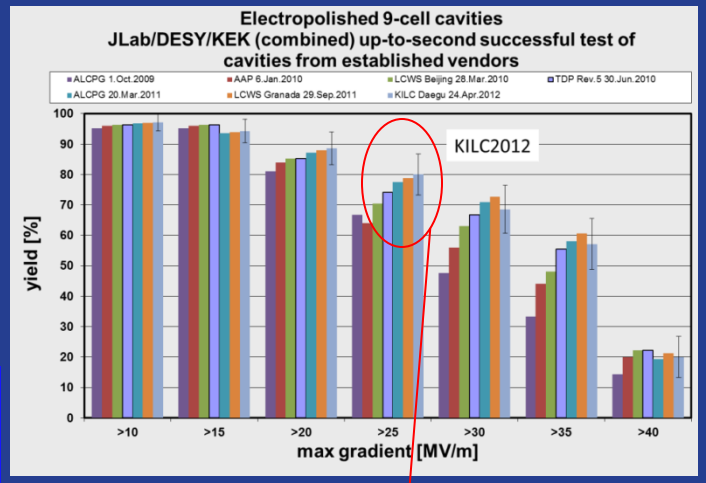
ILC 1.3 GHz Cavity Performance Benchmark

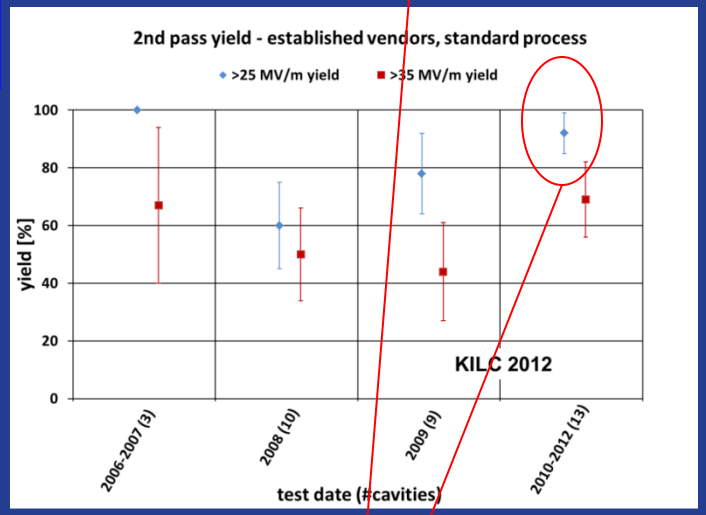
1st pass





2nd pass





International cavities from established vendors using established processes

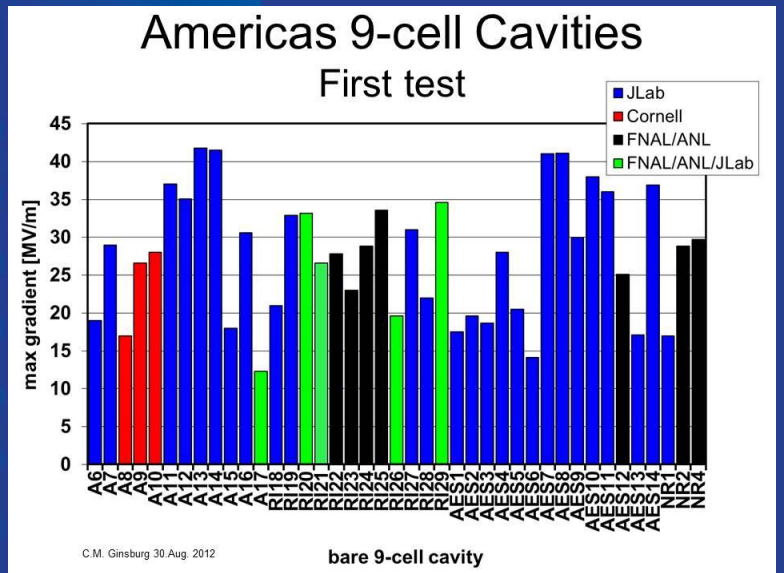
2nd pass yield for **>25 MV/m** for integrated sample is (80+- 7)%

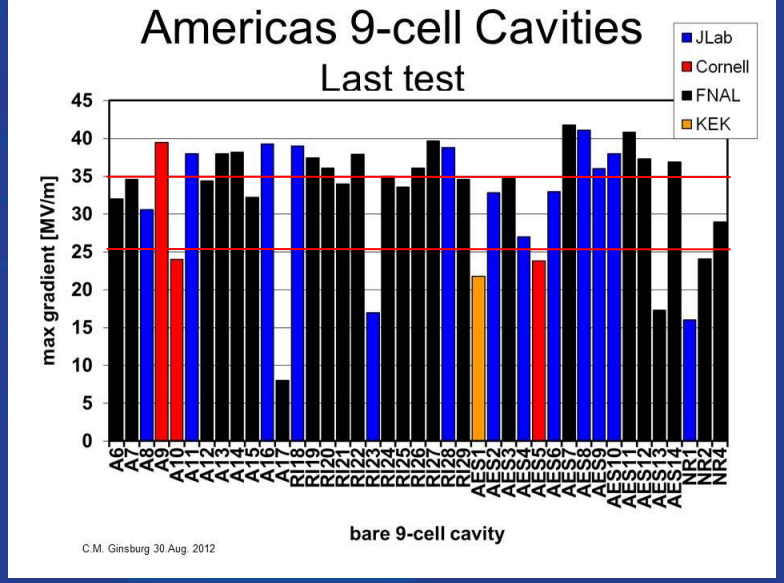
for 2010-2012 alone is (92 +- 7)%

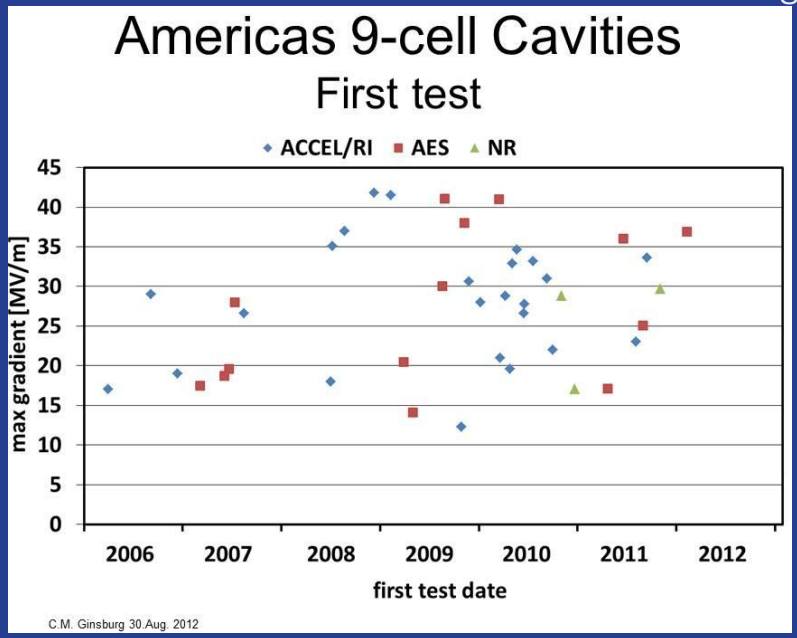
C.M. Ginsburg et al., KILC12, Daegu, S. Korea
http://ilcagenda.linearcollider.org/contributionDisplay.py?contribId=85&sessionId=36&confId=5414

Americas 1.3 GHz Cavity Performance

Status Aug.30, 2012



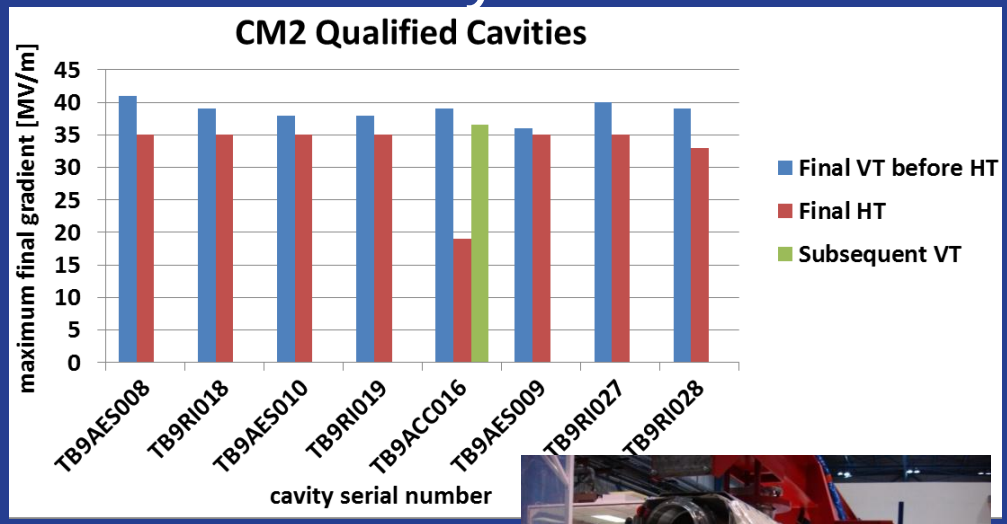




- Fermilab stewardship for 80 ILC cavities plus 1-cell prototypes
- Cavity vendor qualification
  - AES (done), Niowave-Roark, PAVAC (ongoing)
- Excellent performance achieved
  - Strong collaboration with JLab, Cornell,...
  - Infrastructure development

1.3 GHz cryomodule assembly

CM1



- CM1 (8-cavity+dummy magnet)
  - Assembled at Fermilab from a DESY "kit" which included all parts from DESY and INFN
  - Was operated at NML
- CM2 string (8-cavity + magnet)
  - Cavities were processed and vertically tested at JLab
  - Dressed and horizontally tested at FNAL
  - Assembled and leak checked at FNAL
  - Good chance for first ILC spec CM in US
- CM3 is next

CM2

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Acknowledgements and Advertisements

- Many thanks to our Fermilab, national, and international collaborators for their hard work and excellent contributions to the cavity and cryomodule development presented here

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- We are greatly indebted to the technical staff in Technical Division who make everything work.

- Please see the following related talks/posters
  - V. Yakovlev MO1A03
  - A. Grassellino MOPB078
  - S. Henderson TU1A01
  - A. Yamamoto TH3A01