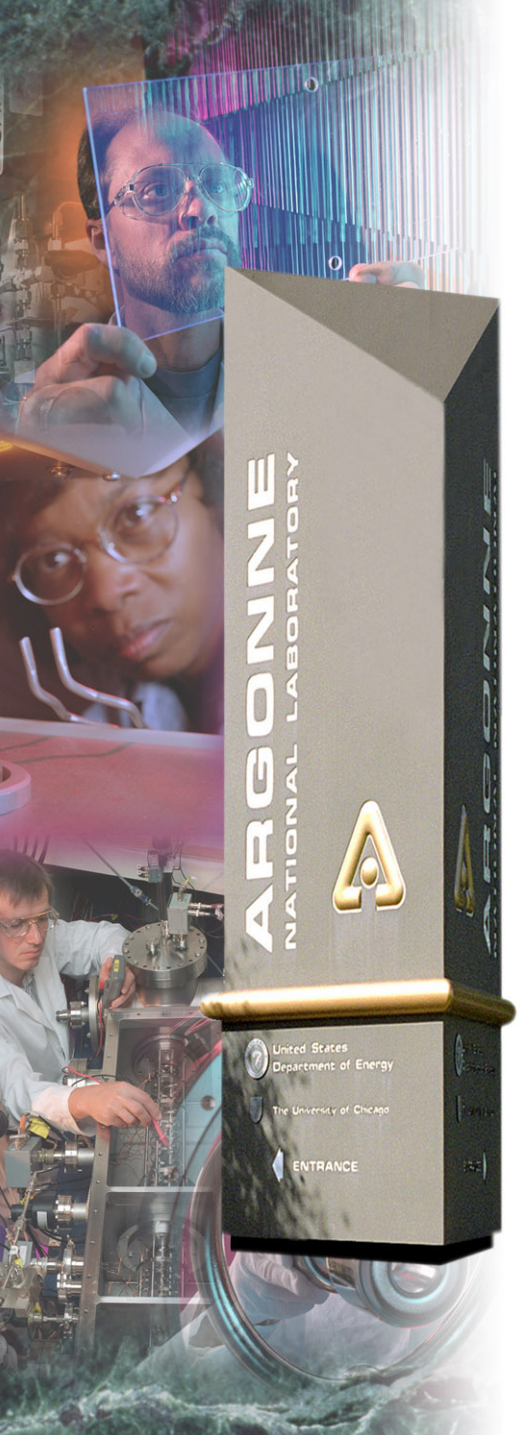

Should SMTF Include RIA?

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K.W. Shepard, Z.A. Conway

Speakers: Ken Shepard
Mike Kelly

SMTF Meeting at TJNAF ***September 30, 2004***

Argonne National Laboratory

Office of Science
U.S. Department of Energy

A U.S. Department of Energy
Office of Science Laboratory
Operated by The University of Chicago

SMTF: Focused on ILC exclusively or inclusive of ion linac needs?

- **Is the view that 'SRF development for ILC is fundamental, while other applications are peripheral and derivative' a useful and/or tenable viewpoint?**
- **If not, then what are the implications?**
  - In the area of basic SRF development work towards understanding SC RF takes into account the data and experience accumulated at lower frequencies and higher temperatures
  - For a national/international SMTF, planning will recognize that the RF, cryogenic, and other capabilities and technology required for RIA and the proton driver extend and complement that required for ILC
- **Planning to include other applications from the start will maximize the capabilities of the SMTF facility as well as maximize the base of support**

RIA will need cavity & CM test facilities

- **Within the next several years RIA, wherever sited, will require:**
  - Cavity qualification-test capability for 400 – 500 SC cavities
  - HPR and clean assembly areas for cavities, cavity strings and cryomodules
- **SRF technology for RIA (development ongoing) includes:**
  - A wide range of cavity types, frequencies, and possible operating temperatures
  - HPR to enable field-emission free performance
  - Ongoing work to minimize high-field RF losses at 2K and at 4.2K
- **Including capabilities for RIA (& the FNAL proton driver) will require:**
  - RF capability at 805 MHz, 345 MHz, and below
  - 4.2 K as well as 2 K refrigeration and distribution capability
  - Processing, assembly, and test capabilities for TEM as well as TM cavities

Talk Outline: 2 Parts

SMTF Can and Should Support Reduced Beta

- **Part I. A large new cavity processing facility to be completed in FY05 can support SMTF at Fermilab**
- **Part II. Low- and mid-beta cavity development is both similar to and complimentary to development for the ILC**

The Joint ANL/FNAL RFSC Cavity Processing Facility

Can provide a valuable support facility for SMTF at Fermilab

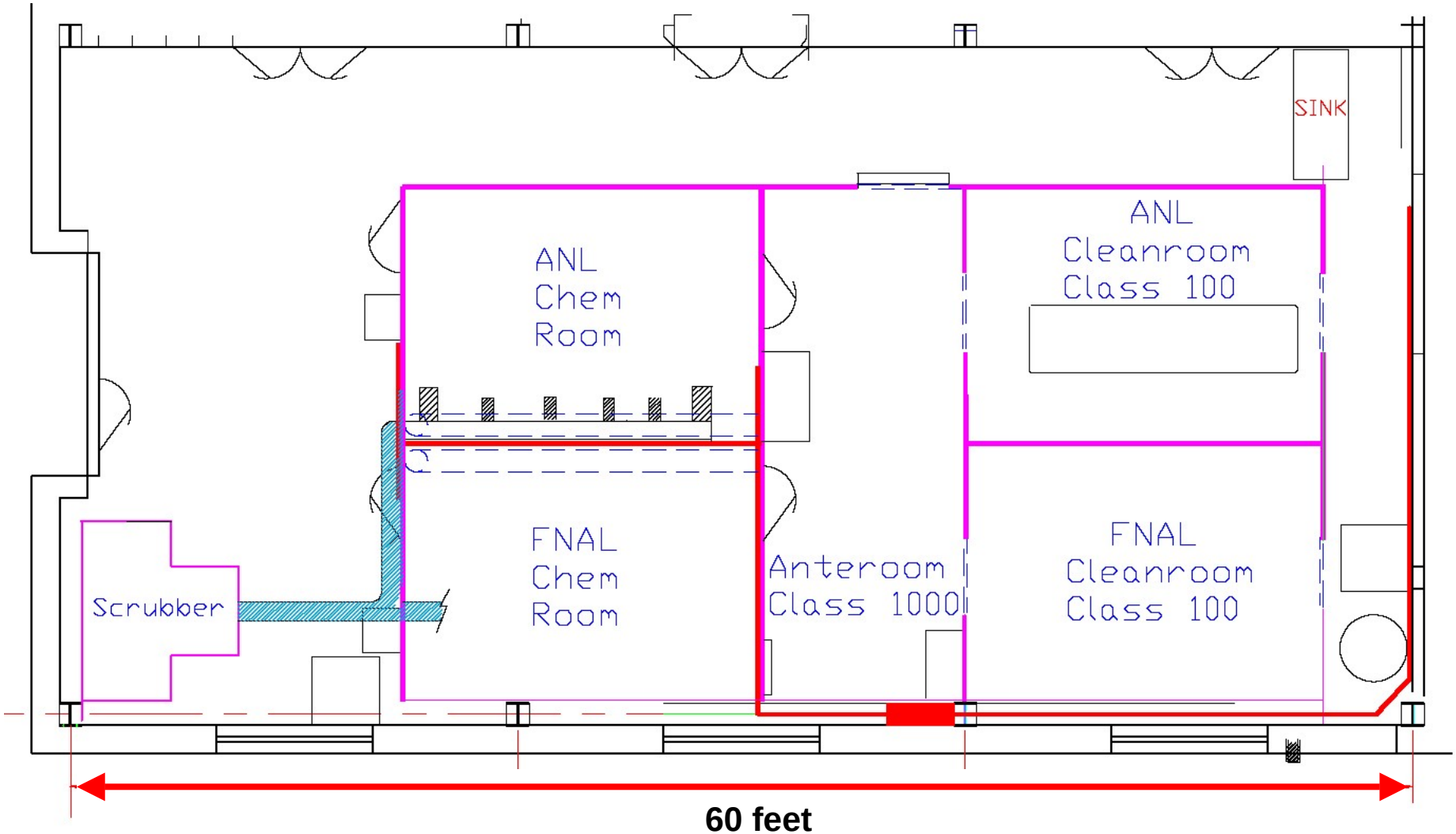
Comprehensive surface processing capability for SC devices and related hardware using:

- **Buffered Chemical Polishing (BCP)**
- **Electropolishing (EP)**
- **Ultrasonic cleaning**
- **Ultrapure high-pressure water rinsing**
- **Cleanroom assembly of rf devices (single cavities, couplers)**

Layout, design and principal areas:

- **Two large sealed chemistry areas with a large air scrubber**
- **Remotely controlled BCP and EP operations**
- **A large clean anteroom (gowning & ultrasonic cleaning of hardware)**
- **Two separate class 100 or better clean areas with a dedicated high pressure rinse capability**

The Joint ANL/FNAL RFSC Cavity Processing Facility



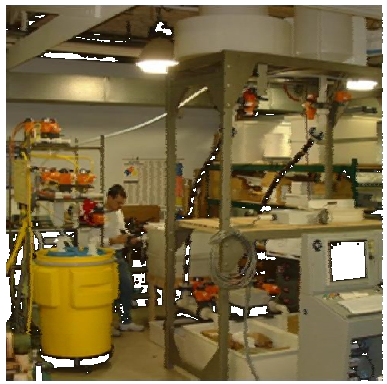
Phase I: The Joint ANL/FNAL Chemistry Facility

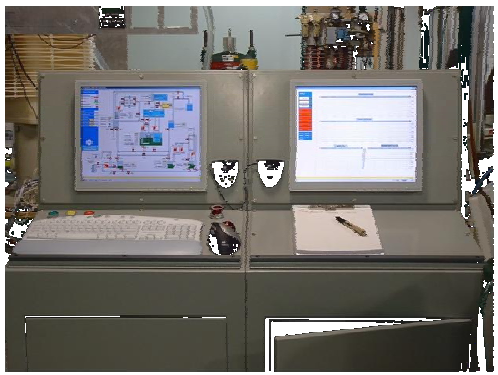
Chemical Processing Rooms

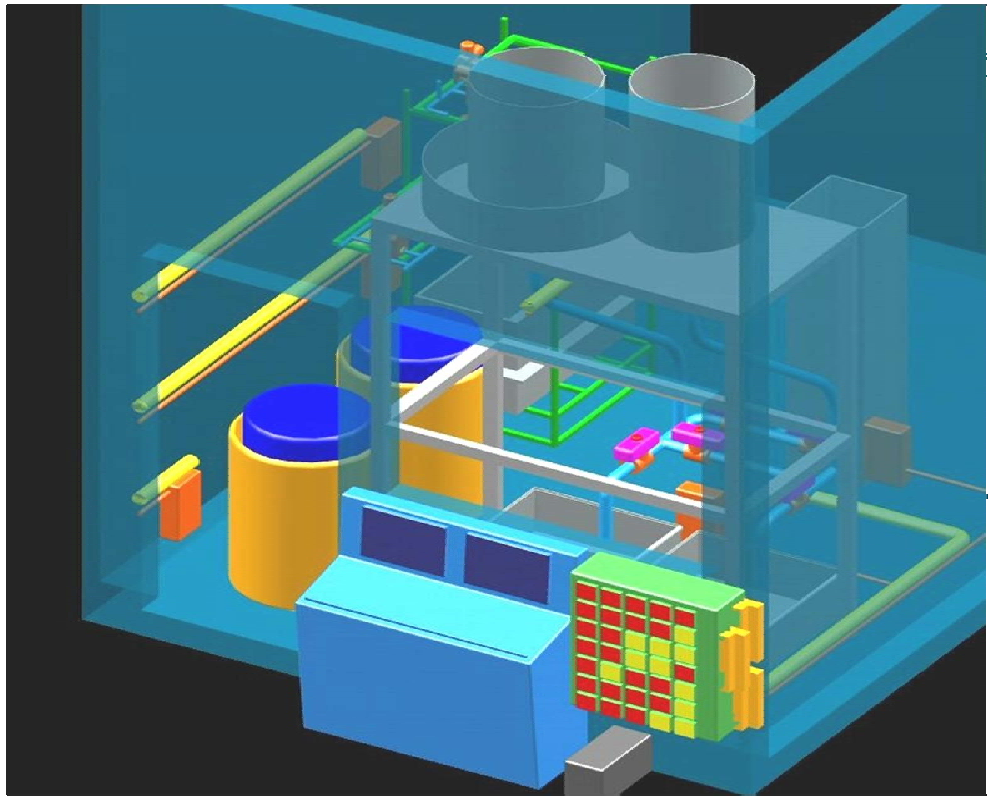
Air Scrubber

- Two sealed chemistry areas, 16 ft ceiling
- Large air scrubber suitable for RIA cavity production

FNAL Chemistry Area for Beta=1

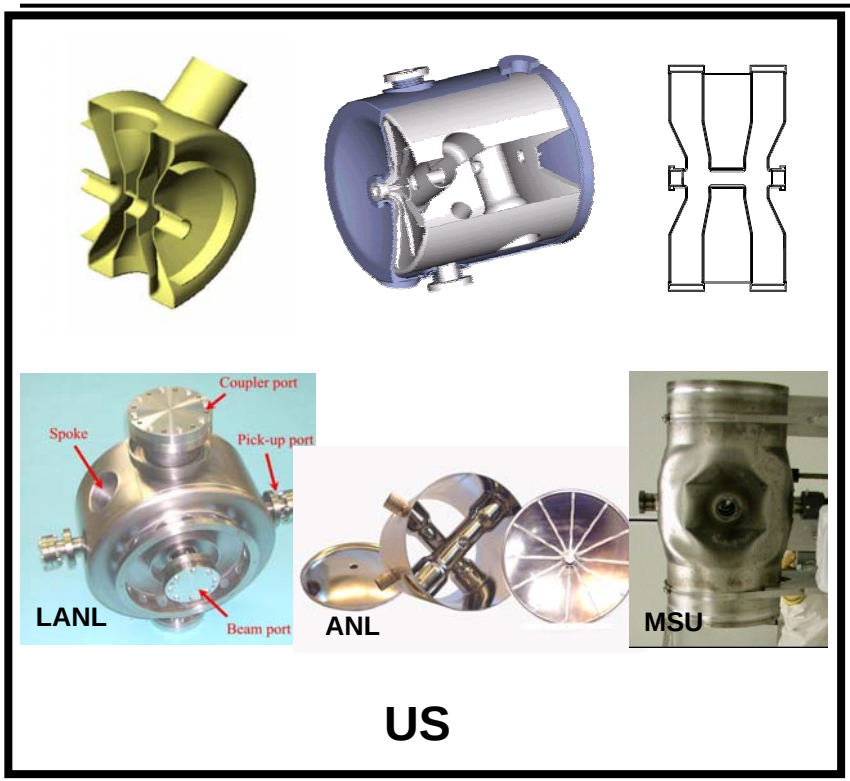




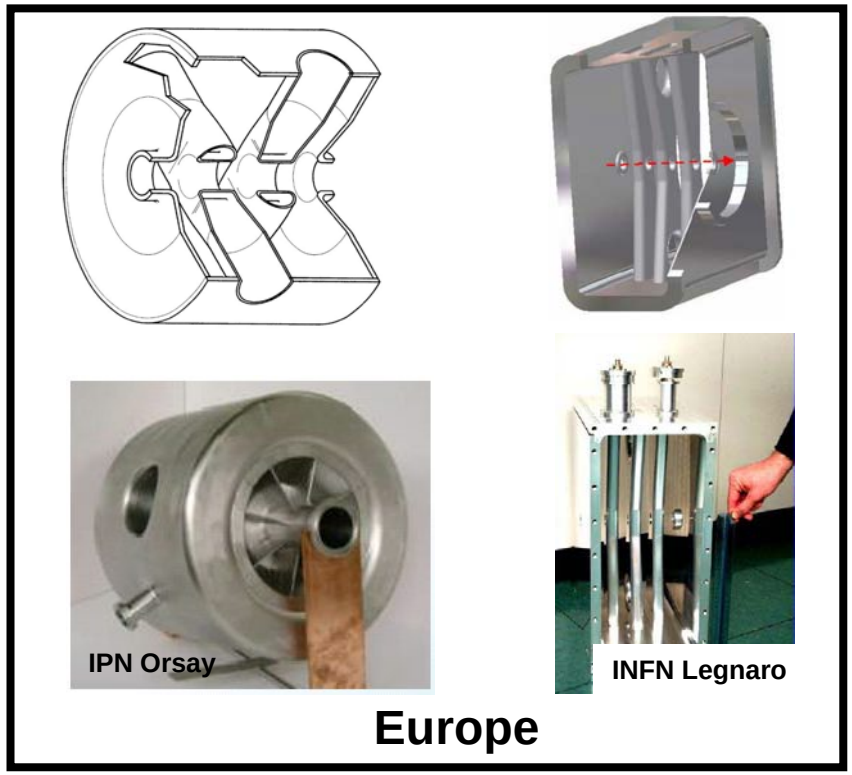


- Remotely controlled, semi-automatic operation
- Suitable to handle 9-cell 1.3 GHz cavities
- 250 liter acid handling capability
- <1 minute cavity fill/empty time

Part II.
Interest in Mid-Beta Cavity Development



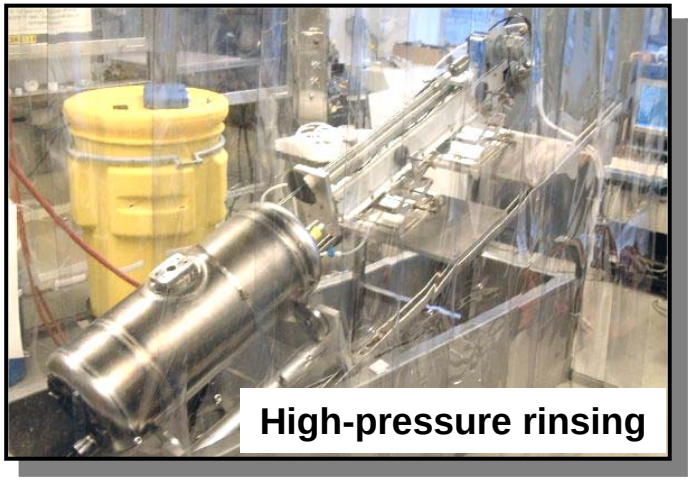
US



Europe

- Not just RIA (cw)…many applications for 300-350 MHz
- 8 GeV Upgrade at Fermilab (pulsed high-peak power)
- Accelerator driven systems at LANL (high average current)
- Spoke Workshop LANL at 2002 was attended by 11 labs and universities from US, France, Germany and Italy

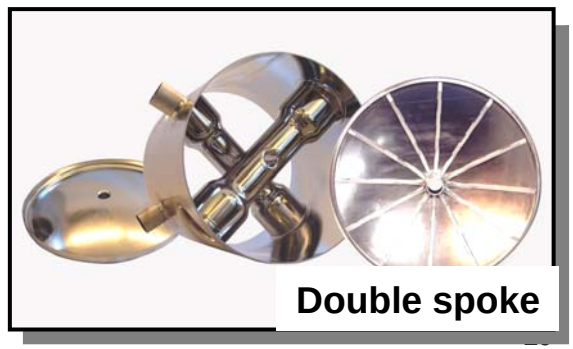
Techniques: Clean Processing for SRF Cavities


High-pressure rinsing

Clean room cavity assembly

Quarter-wave

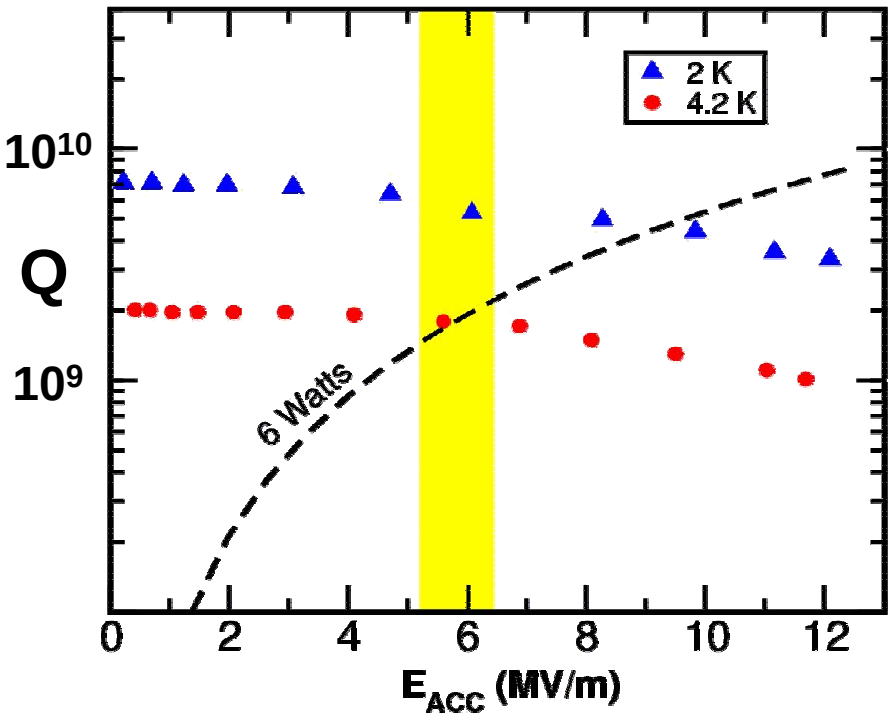
Co-axial half-wave

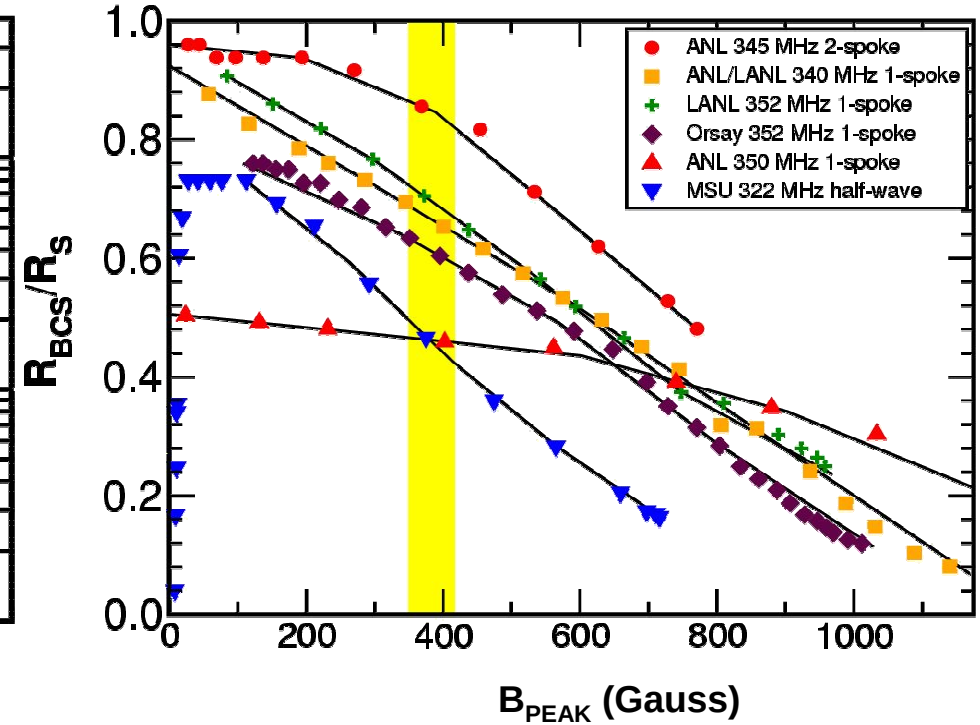

Double spoke

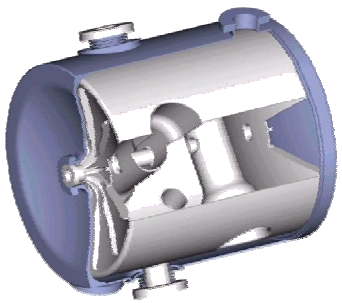
Clean techniques from DESY and Jefferson Lab are similar for low- and mid-beta cavities

- Ultrapure high-pressure water rinse in clean area
- Clean room assembly of cavity, couplers
- Electropolishing

Progress in Mid-beta Cavities







345 MHz
β=0.4

Double-spoke

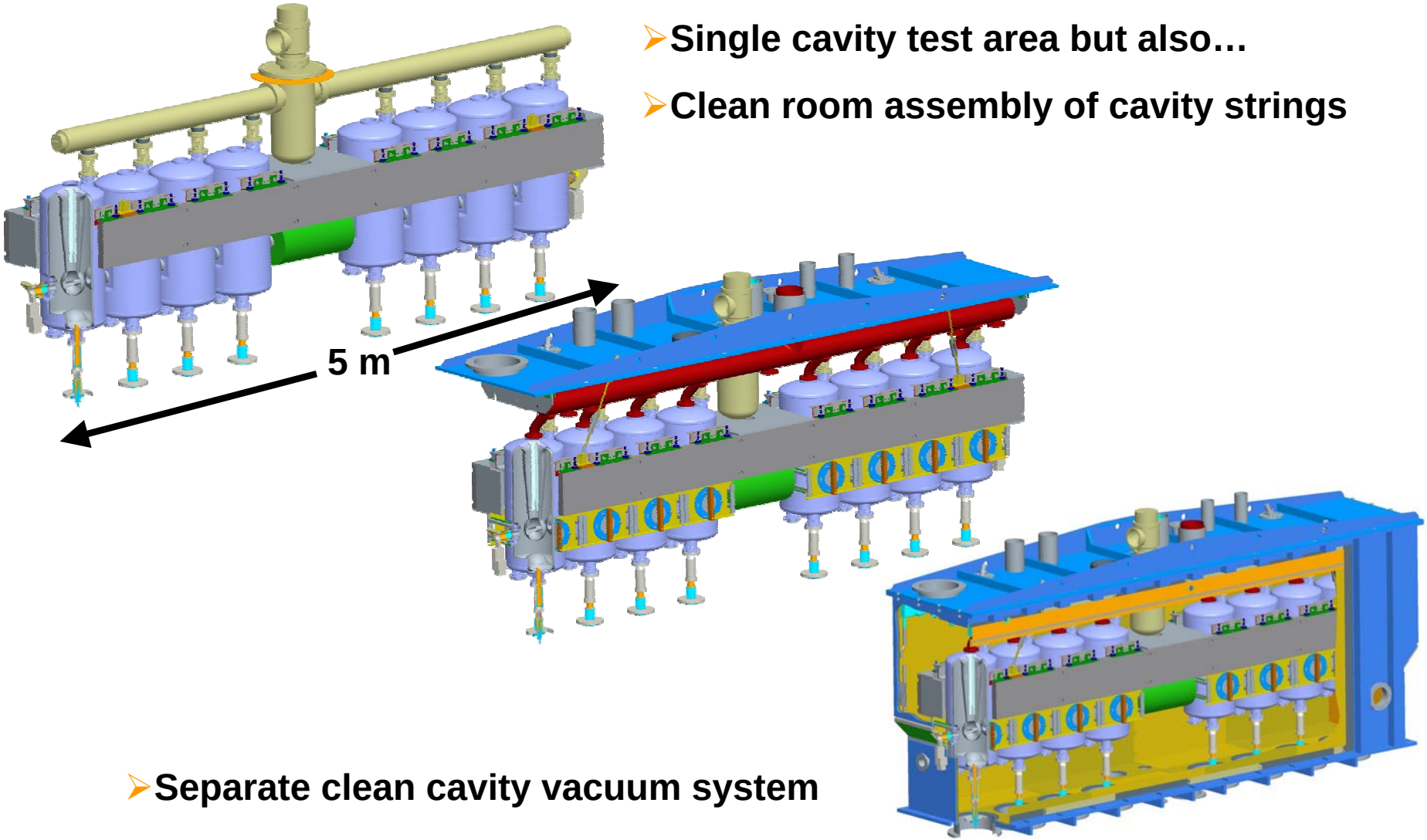
Frequency Range

322 – 352 MHz

- **Similar progress has been made at lower frequencies**

A RIA TEM-class Cavity Cryomodule

- Single cavity test area but also…
- Clean room assembly of cavity strings



- Separate clean cavity vacuum system

Straw man for RIA Requirements at SMTF

Test stations for:

- Single cavity cryostats (5)
- A 5 meter long cavity string assembly

RF power

- 10 kW @ 805 MHz, 345 MHz
- 1-2 kW @ 172 MHz, 115 MHz, 57 MHz

Refrigeration

- 100 Watts at 4 K, 2 K in single cavity tests
- 200 Watts at 4 K, 2 K in string assembly tests

RIA could bring many of these things to the table but, if included, they should be taken account of in the planning

SMTF Should Include Mid-Beta

"In the last 30+ years, the development of low and medium β superconducting cavities has been one of the richest and most imaginative areas of srf

The field has been in perpetual evolution and progress…"

-SRF 2003

SMTF can and should provide a national test facility for:

- **Many large projects requiring reduced beta cavities**
- **Advancing the state-of-the-art including for reduced beta which uses most of the same techniques and facilities**
- **A successful R&D program which will include experimental work at 4 K, reduced beta and low frequency**
- **Interchange between ILC and other development groups**