Cavity Test Stands for Project X

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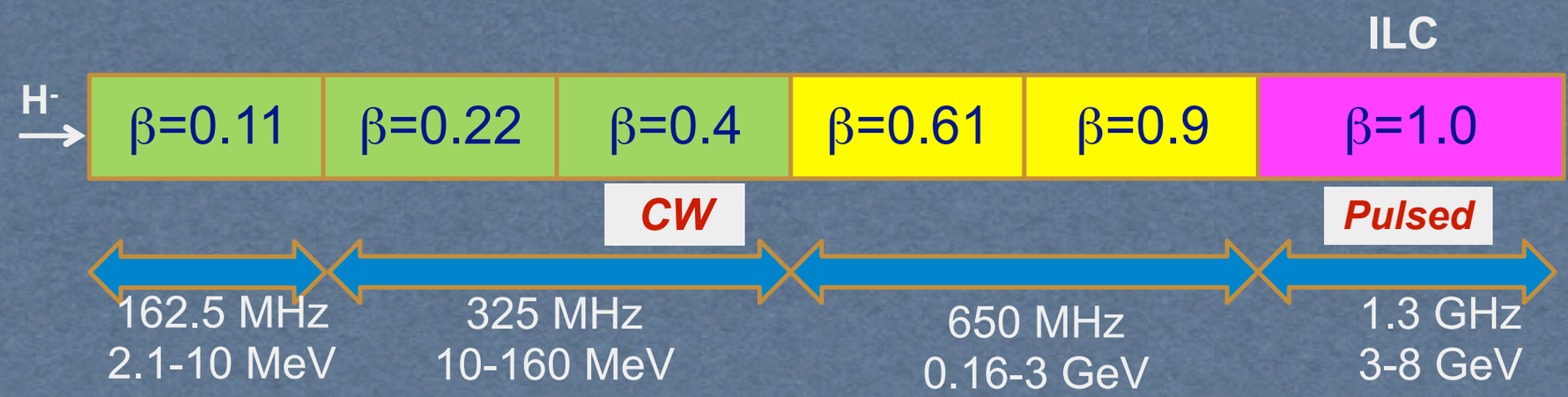
Project X PX Linac SRF Cavities



Section	Freq	Energy (MeV)	Cav/mag/CM	Type
HWR (β_G=0.11)	162.5	2.1-10	9 /6/1	Half Wave, solenoid
SSR1 (β_G=0.22)	325	10-42	16/8/ 2	Single Spoke, solenoid
SSR2 (β_G=0.47)	325	42-160	36/20/4	Single Spoke, solenoid
LB 650 (β_G=0.61)	650	160-460	42 /14/7	5-cell elliptical, doublet
HB 650 (β_G=0.9)	650	460-3000	152/19/19	5-cell elliptical, doublet
ILC 1.3 (β_G=1.0)	1300	3000-8000	224 /28 /28	9-cell elliptical, quad

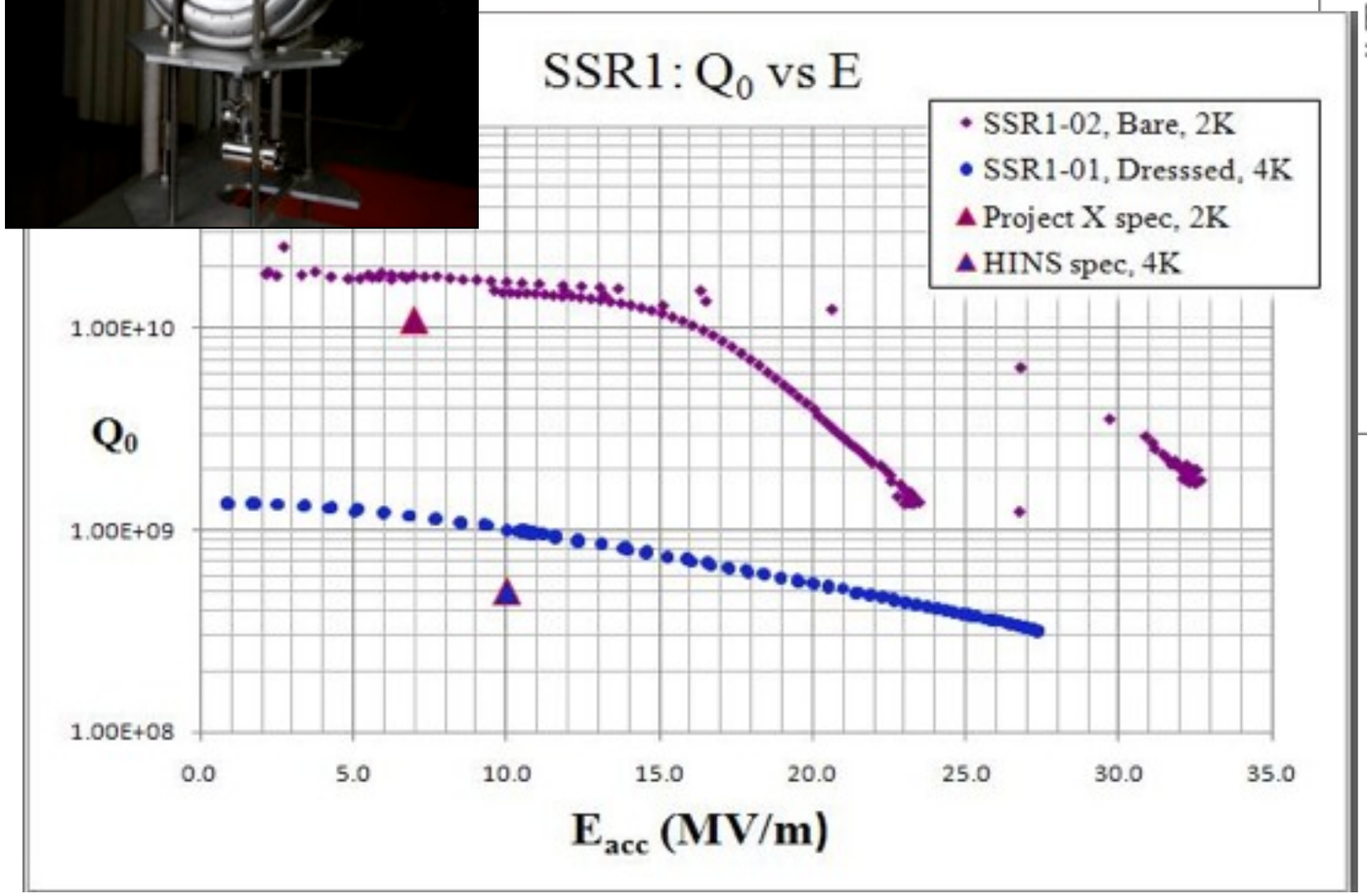
Project X Vertical Cavity Test Facility

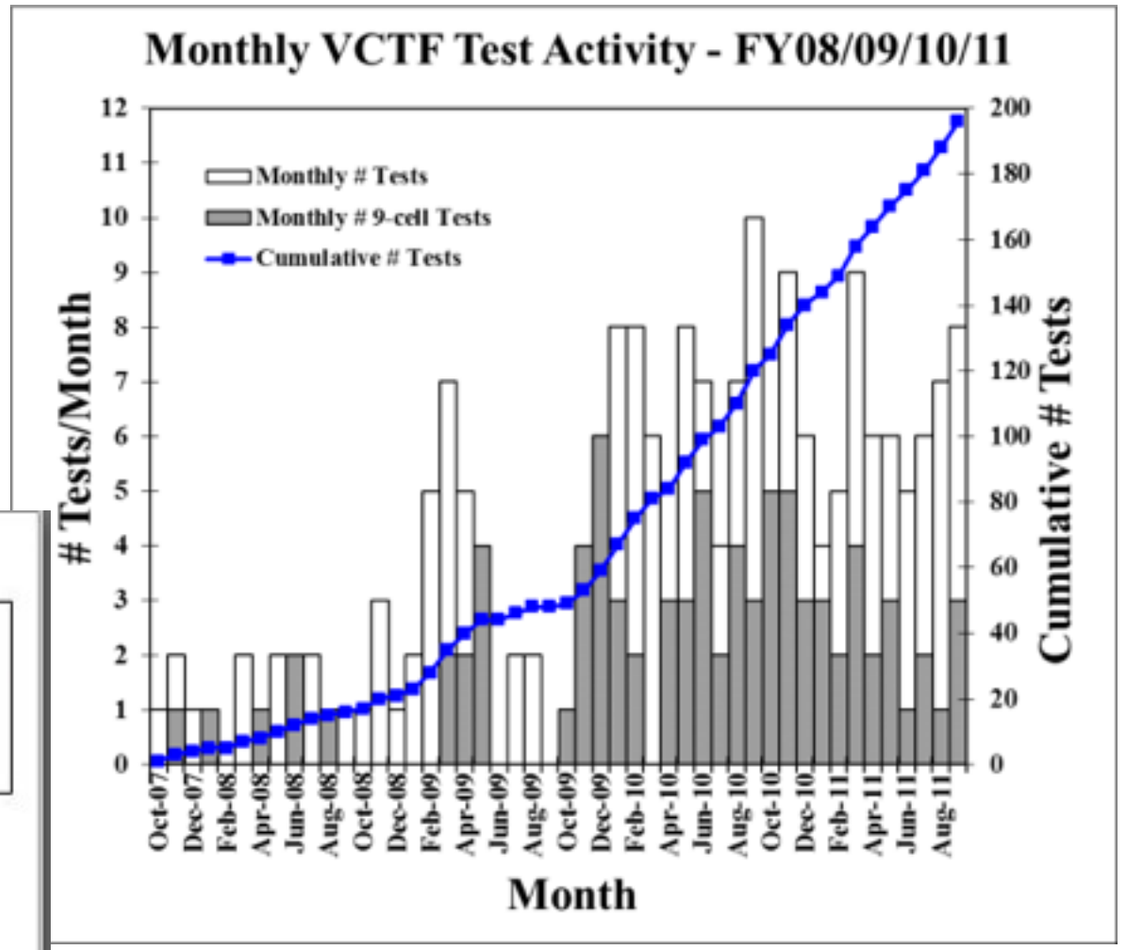
- Vertical testing purpose:
  - qualify cavities for dressing
  - fast (1-2 days) turnaround
  - tools for diagnosing bad cavities
    - e.g. thermometry/2nd sound for quench localization
- VCTF located in FNAL Industrial Building 1 (IB1)
  - VTS1: operational since 2007
    - 1.3 GHz (1- or 9-cell), 650 MHz (1- or 5-cell), SSR1
  - VTS2 & 3: installed, to be commissioned
    - all of above, plus SSR2
  - 125 W @ 2 K refrigeration capacity
  - variety of RF systems

VTS1 Cryostat

9-cell Tesla-style cavity

Project X VTS1 ops: 1.3 GHz and SSR1





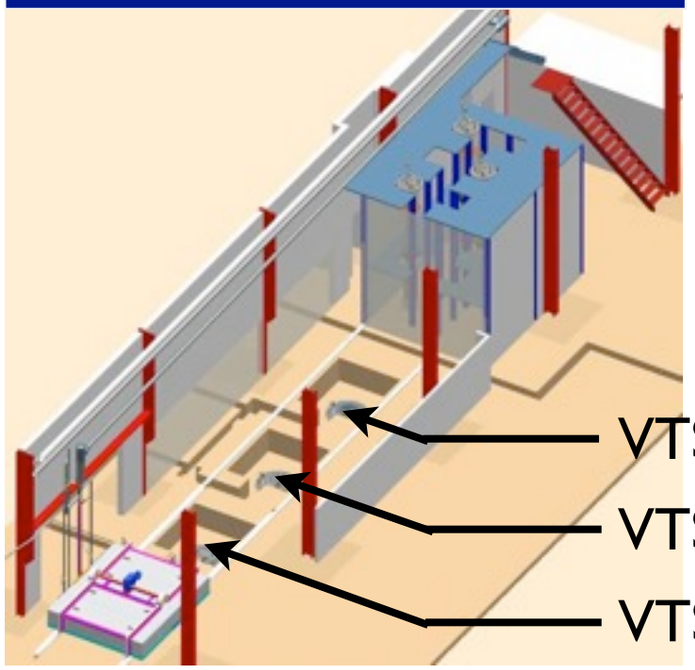
~80 cavity tests/ year (CY2010)

VTS1 ops: 650 MHz

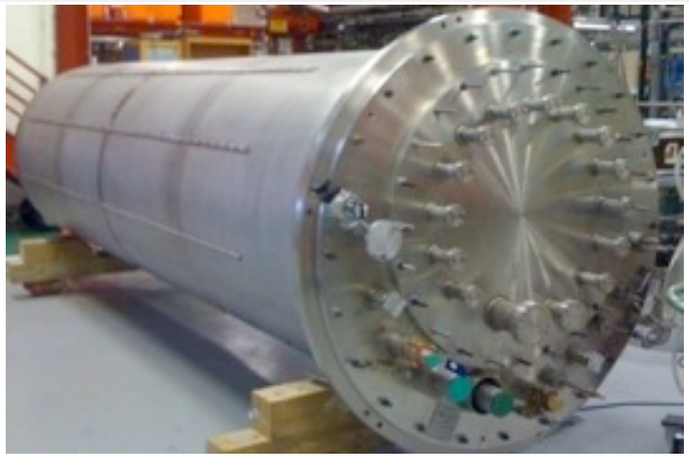
- 650 MHz beta=0.61 single-cell tested at VTS1 to commission mechanics and RF system
- Six beta=0.9 single-cells now at FNAL to be tested soon
- Two beta=0.9 five-cells on order, to be tested this year

VTS2 and VTS3

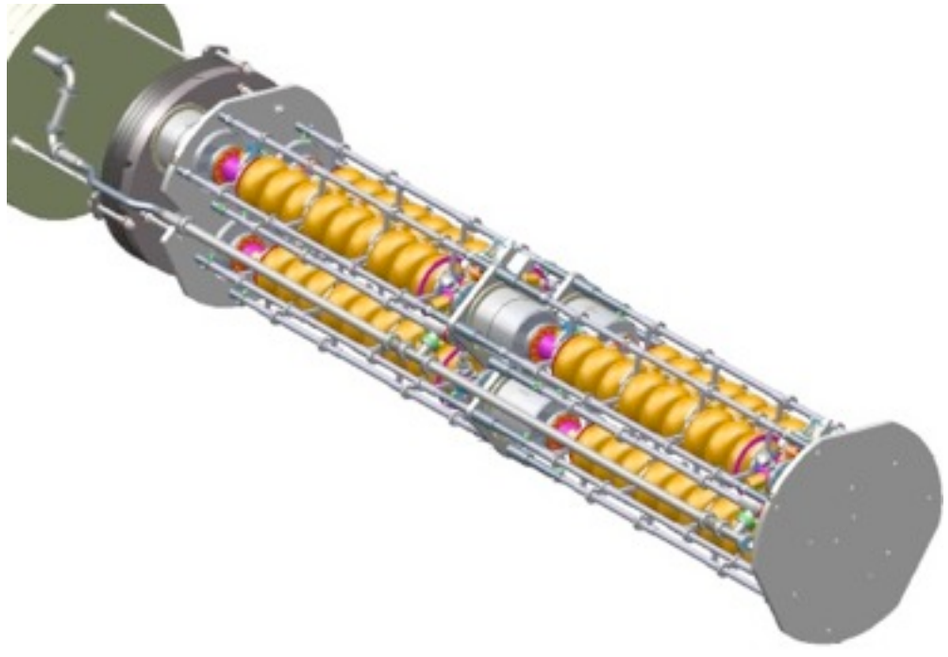
Two more VTS pits & staging area



VTS2 cryostat prior to installation



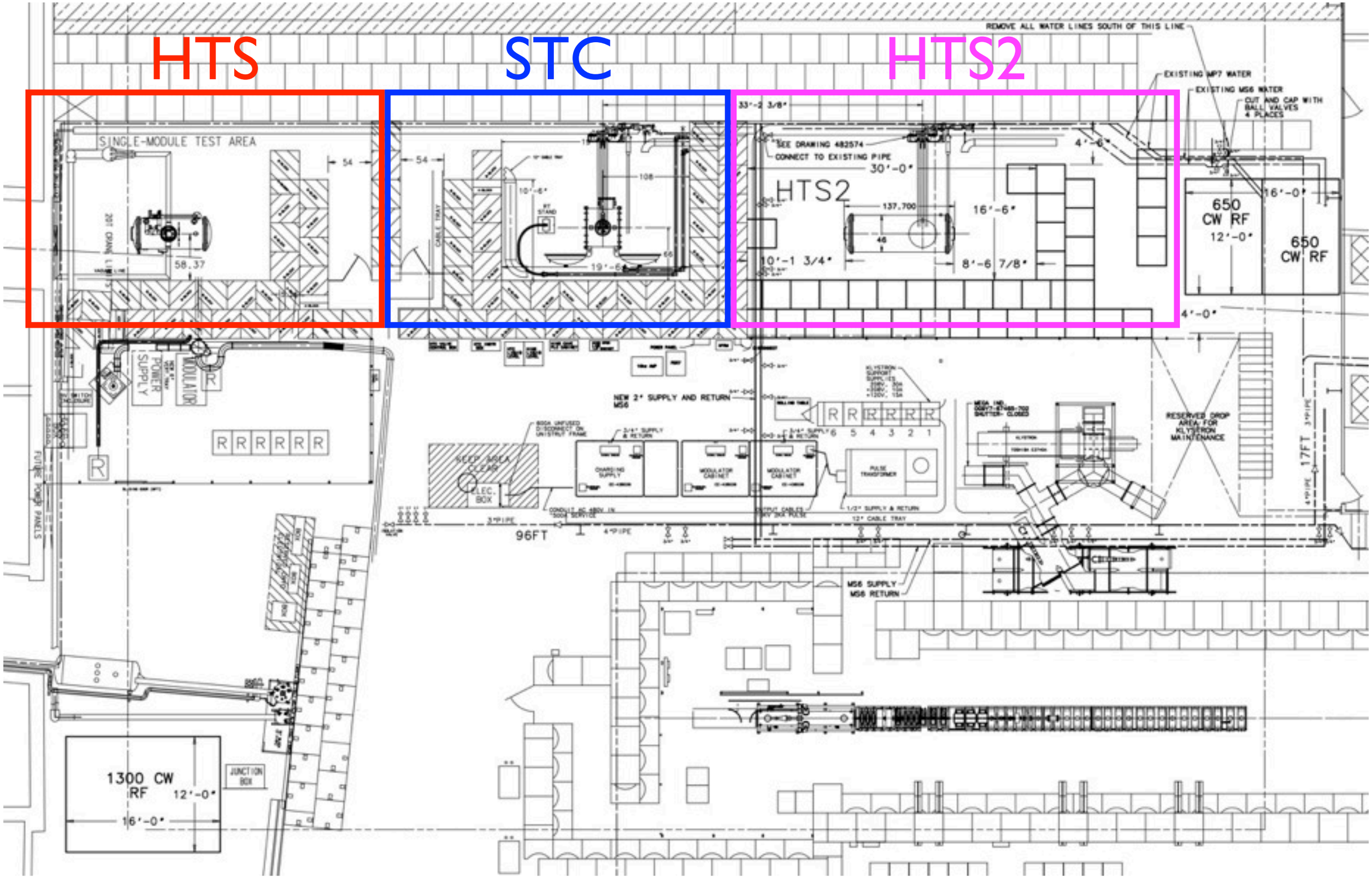
- Two new cryostats, slightly larger
  - Enables SSR2 testing
  - Enables simultaneous cooldown of up to 6 1.3 GHz cavities
- Cryostats installed, awaiting connection to infrastructure and commissioning



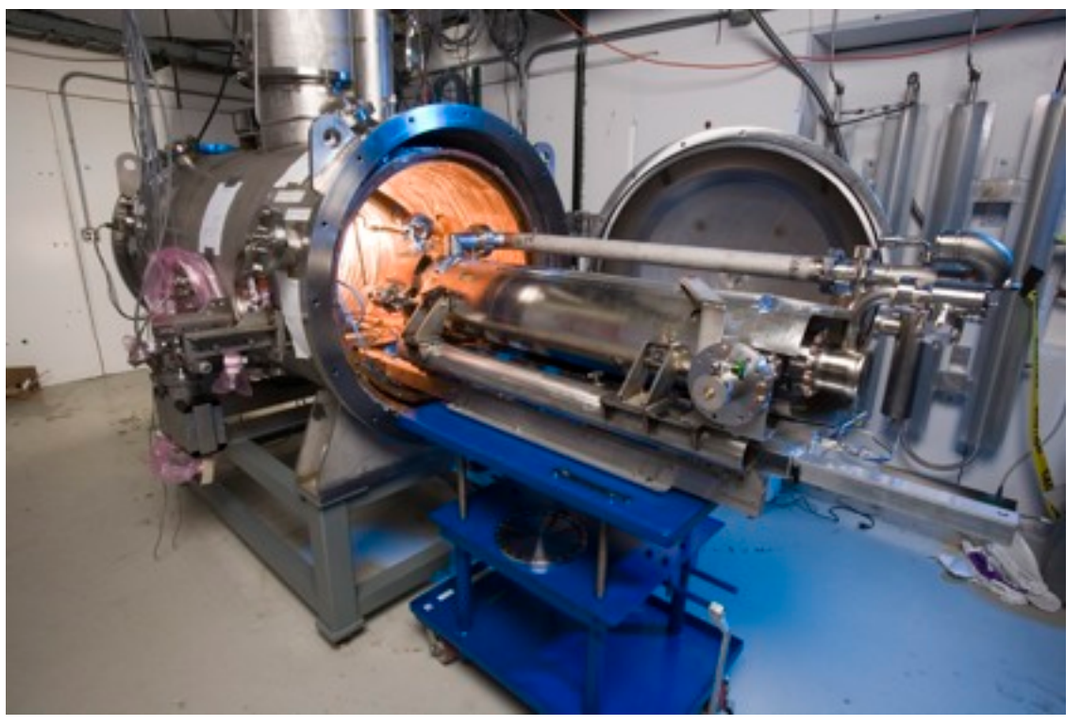
Project X Horizontal Test Stands

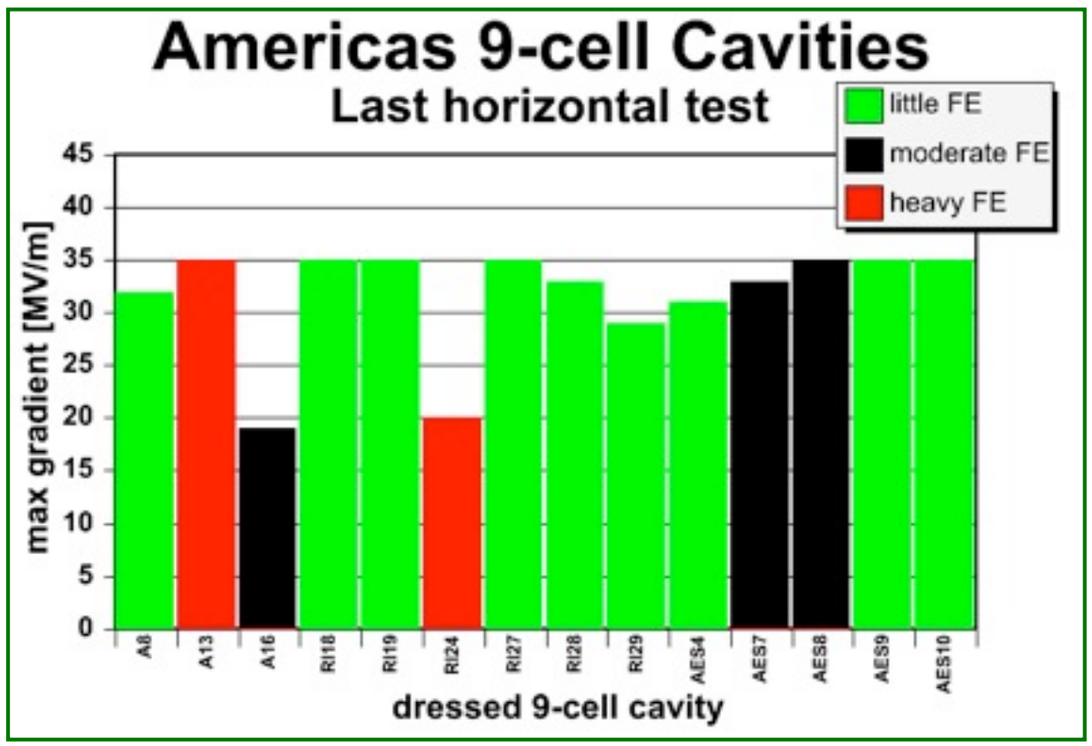
- Located in Meson Detector Building (MDB)
  - "HTS" = pulsed 1.3 GHz cavities
  - "STC" = 325 MHz spoke resonators
  - "HTS2" (2014) = CW 650 MHz, pulsed 1.3 GHz
    - 60-80 W @ 2 K refrigeration available
- Horizontal facilities serve two purposes
  - Performance validation of dressed cavities at intermediate point between VT, CM
  - R&D for cavity auxiliary components (couplers, tuners, etc.)

MDB Layout


HTS
STC
HTS2
REMOVE ALL WATER LINES SOUTH OF THIS LINE
EXISTING MP7 WATER
EXISTING MS6 WATER
CUT AND CAP WITH BALL VALVES 4 PLACES
SINGLE-MODULE TEST AREA
54
58.37
54
108
19'-6"
CABLE TRAY
33'-2 3/8"
SEE DRAWING 482574
CONNECT TO EXISTING PIPE
30'-0"
HTS2
137.700
16'-6"
10'-1 3/4"
8'-6 7/8"
4'-6"
650 CW RF
12'-0"
16'-0"
650 CW RF
4'-0"
NEW 2" SUPPLY AND RETURN MS6
RESERVED DROP AREA FOR KLYSTRON MAINTENANCE
17FT
96FT
MS6 SUPPLY
MS6 RETURN
1300 CW RF
12'-0"
16'-0"
JUNCTION BOX
POWER SUPPLY
MODULATOR

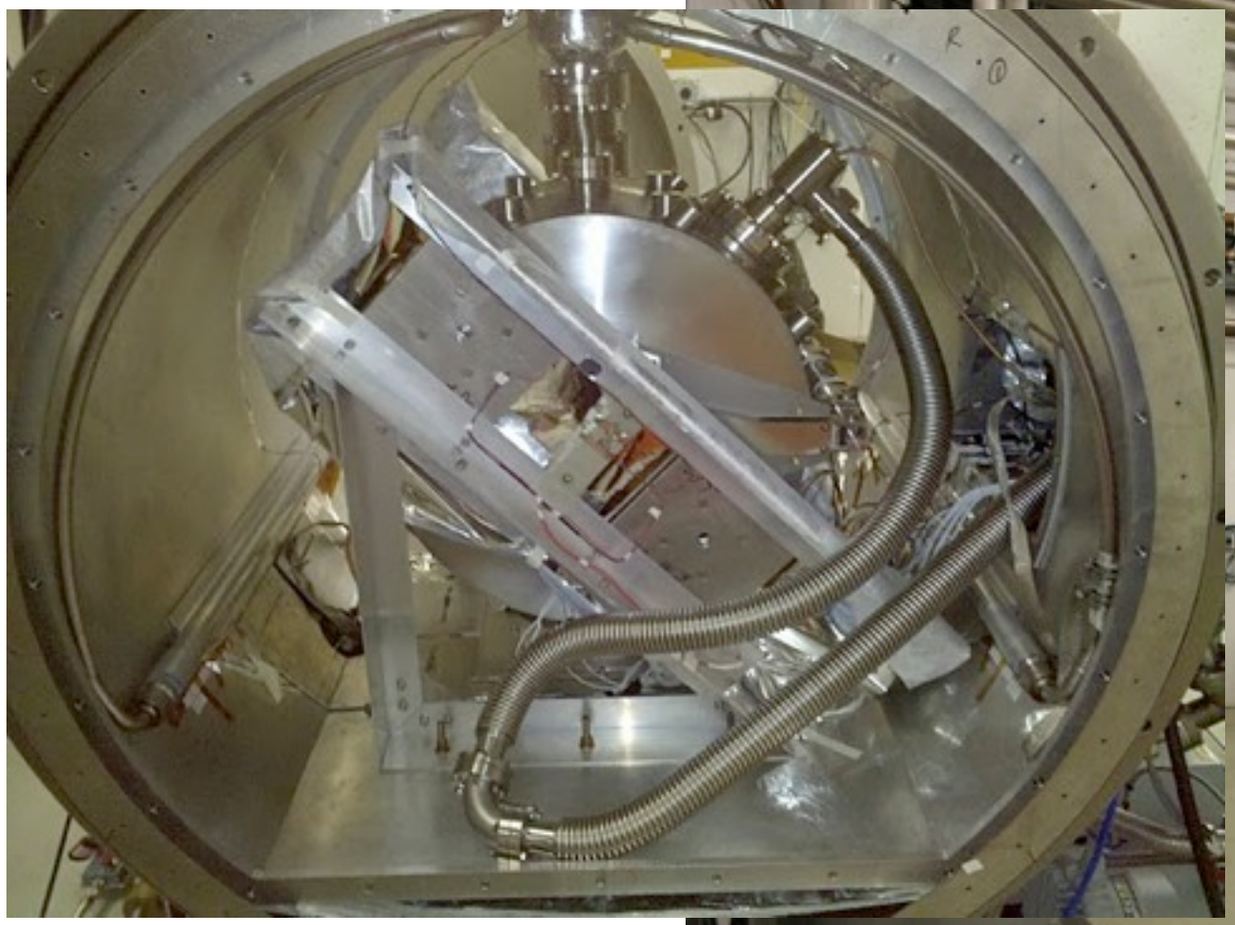
HTS(-1)





- Operational for ~4 yrs
  - 1.3 GHz and 3.9 GHz cavities, ~1.5 ms RF pulses
  - Two 1.3 GHz tests w/ long (8-9 ms) RF pulses
    - Adopt long-pulse test as part of standard cavity run plan
- ~2 cavity/month throughput

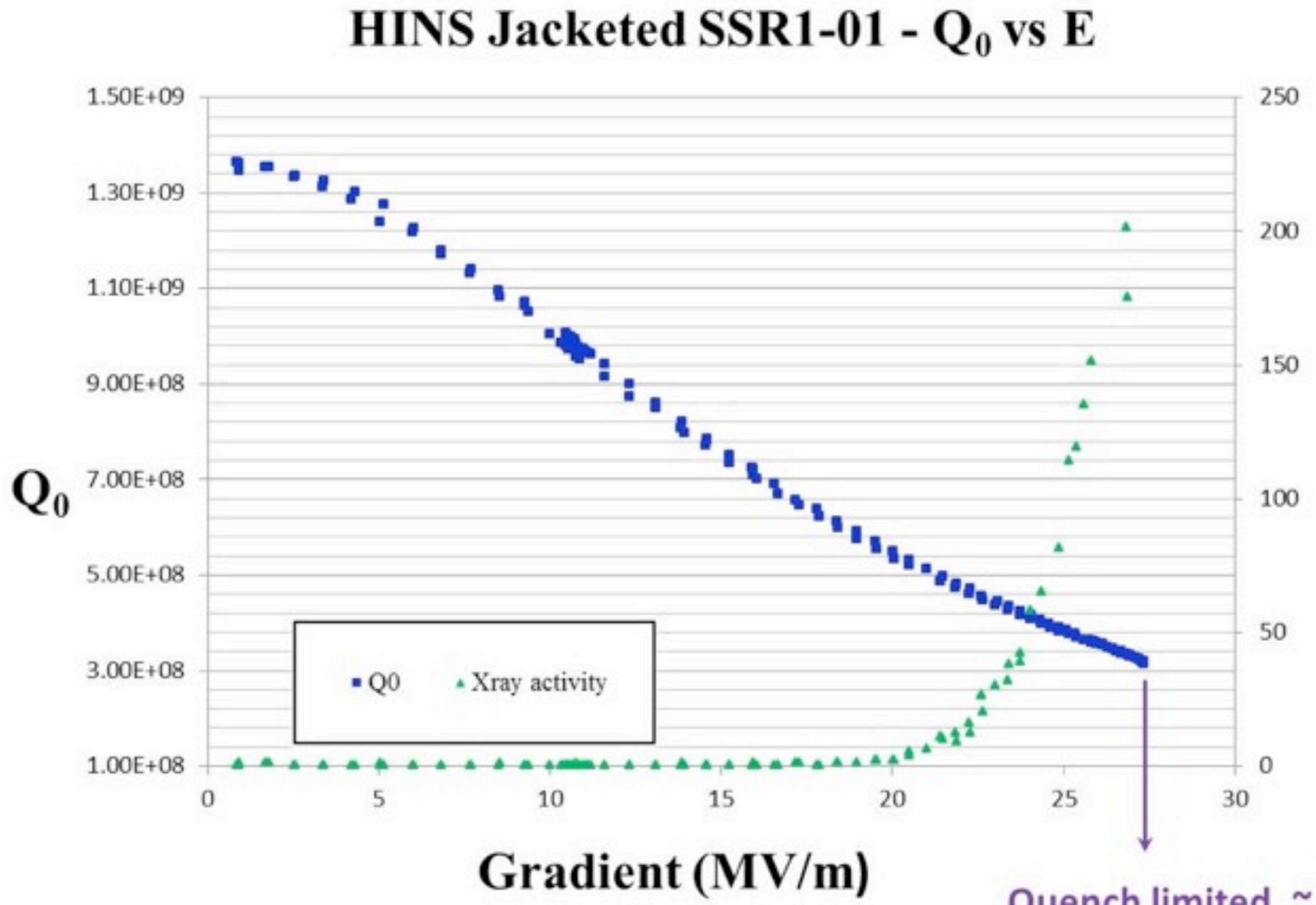
STC



- Operational for ~1.5 yrs
- One SSR1 cavity test (extensive)
  - Resonance control expts, magnet cooling expts
  - 4.5 K operation --- upgrade for 2 K capability to begin soon

Project X SSR1 results from STC

Critically coupled

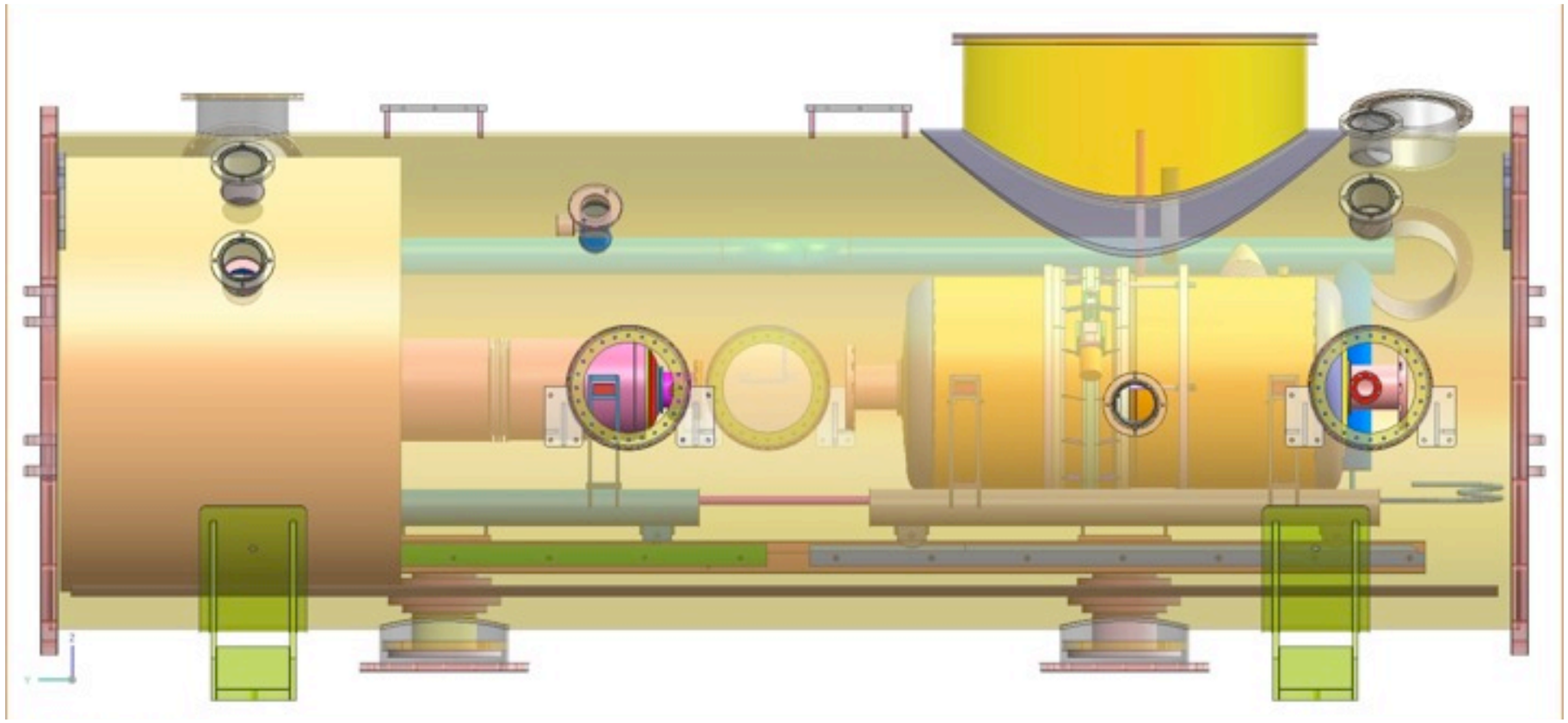


Measured by chipmunks, outside of cryostat, ~1m from cavity

Quench limited, ~ 27 MV/m
T = 4.7 K

Design: Q_0 at 10 MV/m = 5e8

HTS-2



- Under design at RRCAT in India
  - Finish this FY, deliver to FNAL in mid-FY14
- 650 MHz CW, 1.3 GHz pulsed
- Two cavities cooled simultaneously for better throughput

Conclusions

- FNAL has (or will have) infrastructure for testing all flavors of PX cavities (excluding HWR)
  - Both bare and dressed
- Future upgrades
  - Increased facility throughput
  - 2K capability for dressed spoke resonators
  - New cavity capabilities
    - Dressed 650 MHz
    - Bare SSR2