Status and Plans of STF

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outline

- **Completion of STF 1.0**

  1 TESLA-shape cavity cool-down test

  1 LL-shape cavity cool-down test

  4 TESLA-shape cavities cryomodule experiment

  STF cavity process and test facility construction

- **Preparation of S1-Global**

  8 cavities cryomodule test with 31.5MV/m operation (S1-task)

  2 DESY + 2 FNAL + 4 KEK cavities

- **Start-up of STF 2.0**

  construction and operation of ILC cryomodule with ILC beam

  RF gun + capture cryomodule + 3 ILC cryomodules

1 TESLA-shape cavity cool-down test

Cool-down test schedule:

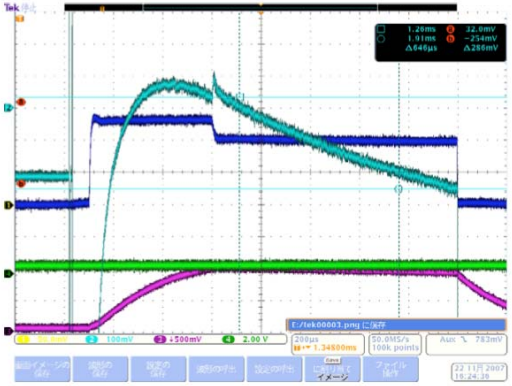
Oct. 03-12, 2007: cool down test, suspended by SRF workshop
Oct. 22 -26: re-cool down
Oct.29 - Nov. 02 : 4K Test (1 week)
Nov.05 - Nov. 09 : 2K Test(1 week)
Nov.12 - Nov 22 : 2K with HLRF on (2 weeks)

Test Items:

Cool down control
Heat load measurements
Cavity fundamentals(Q,Eacc,f0..)
Lorentz detuning
Piezo compensation
Mechanical vibration
GRP distortion by WPM
etc.

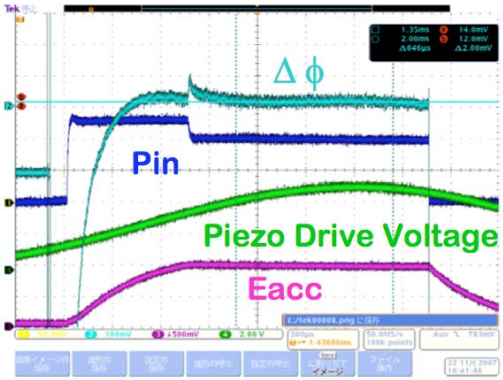
Compensation by Piezo (1) ; higher Tension

Eacc = 18. MV/m
Piezo / OFF



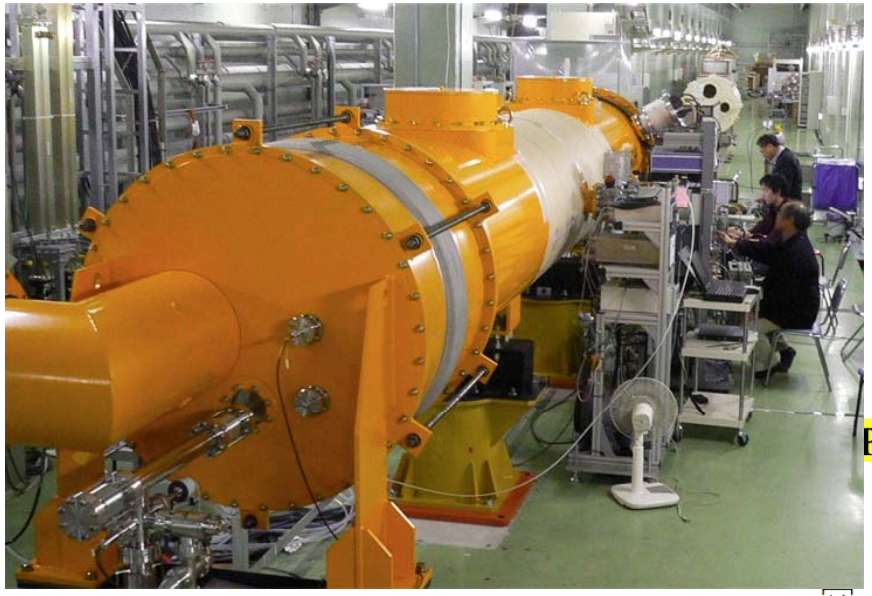
$\Delta\phi$ = - 15 °

Eacc = 18. MV/m
Piezo / ON
300 Hz, 500 V, - 700 μsec



$\Delta\phi$ = ~ 0 °

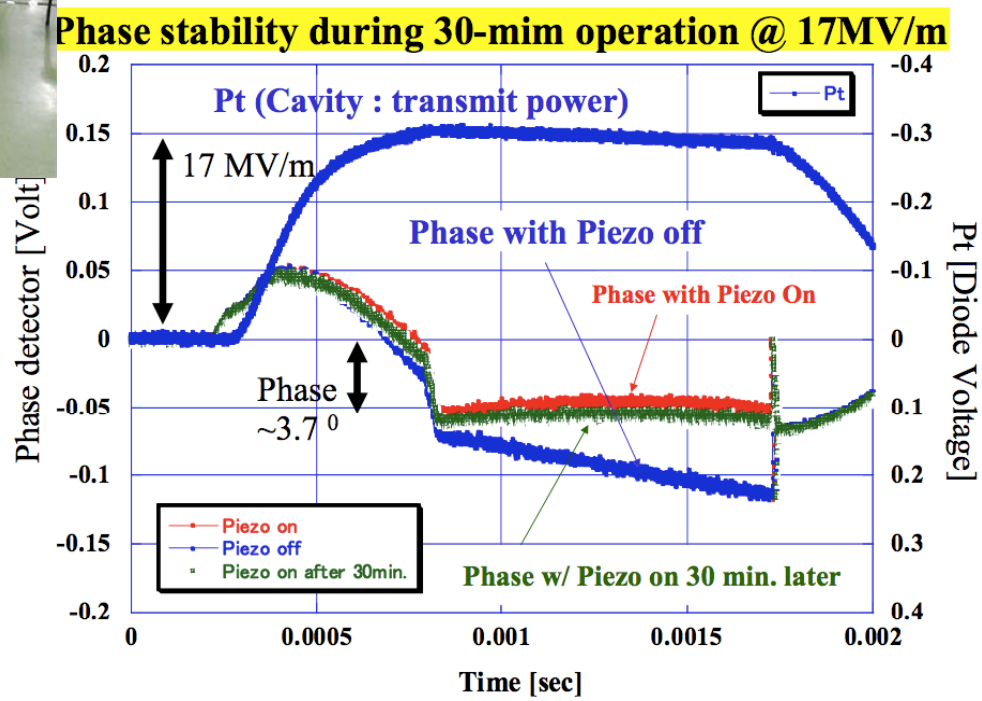
1 LL-shape cavity cool-down test



Test Items :

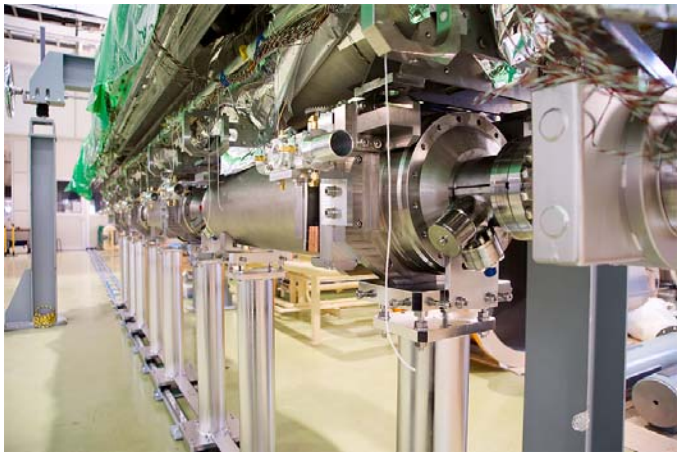
Heat load measurement,
Ball-screw tuner test,
coupler performance test,
cavity performance test
(it was 19.5MV/m in VT),
etc.

Ichiro #1
cool down test
Feb. 13 to Mar. 31, 2008



Installation of 4 TESLA-shape cavities into cryomodule

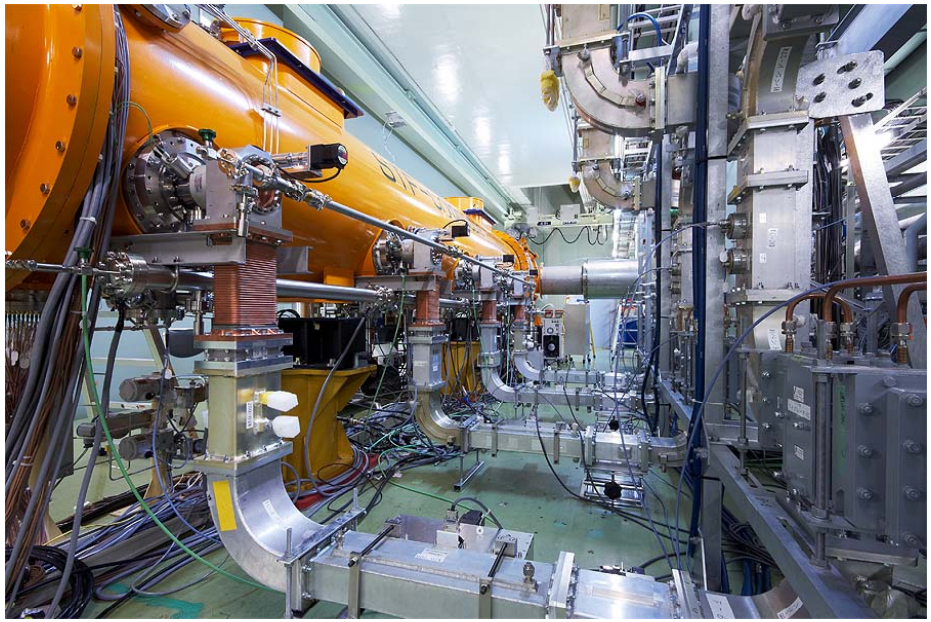
TESLA-style cavities were assembled in clean room, hung on the cold mass, and inserted into the vessel, on Feb. 29, 2008.



STF1.0 (4 TESLA-style cavities in short cryomodule)

exp. term : May 2008 – Dec. 2008
Experience of ILC cryomodule technology

module assembly,
2k cryogenics,
heat load,
cavity performance,
LLRF performance,
waveguide configuration test, Qext control

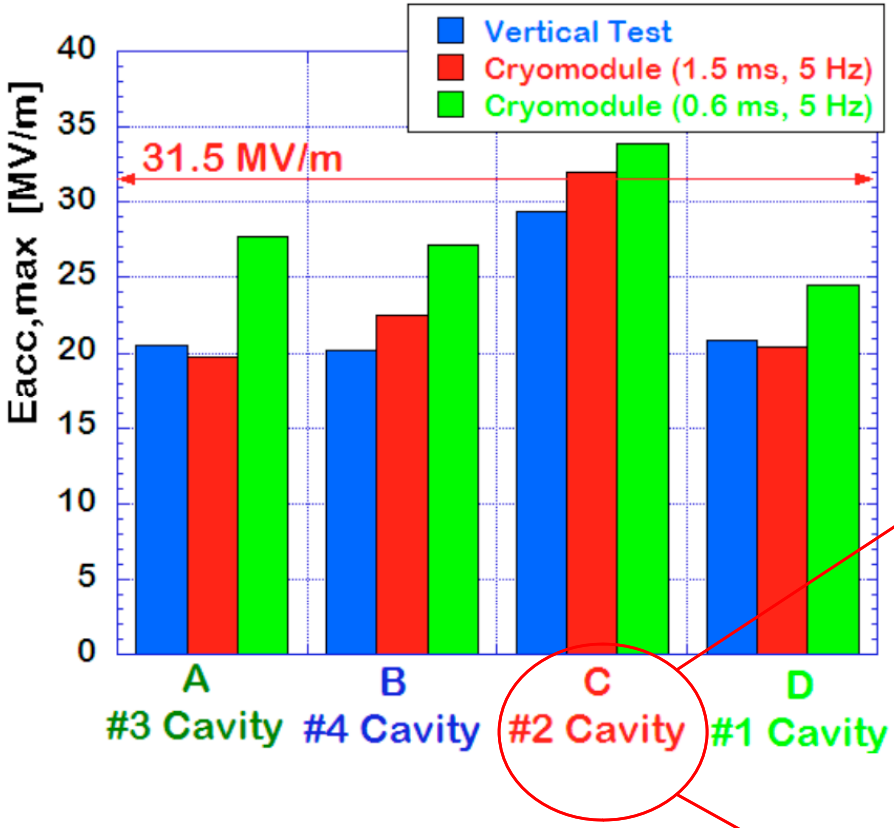


high power test, 4 cavities combined,
using external phase shifters and variable reflectors.
QL can be set +/- 15%.

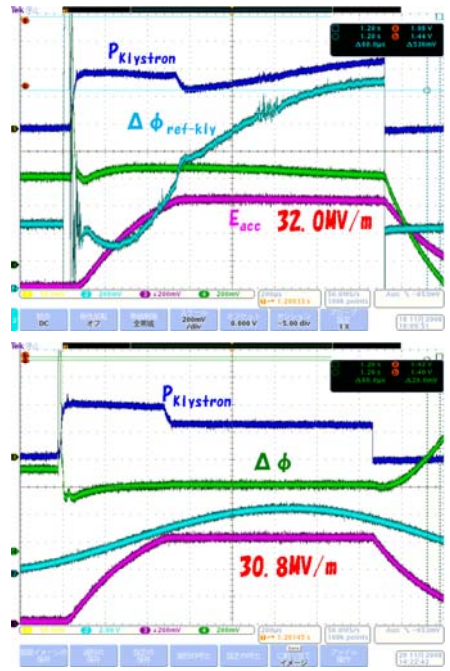
high power test, one by one.

high power test, 4 cavities combined,
using tree-type distribution.

Cavity performance in STF 1.0 cryomodule

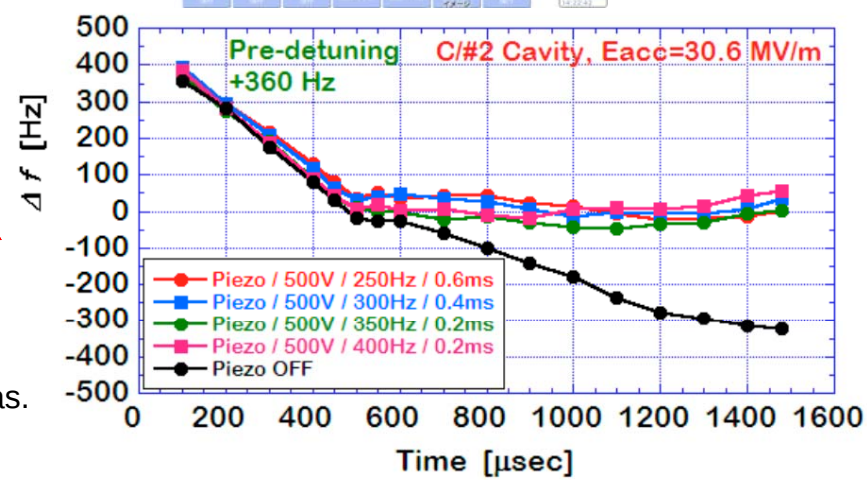


BLC #2 cavity performance



FB on
Piezo off

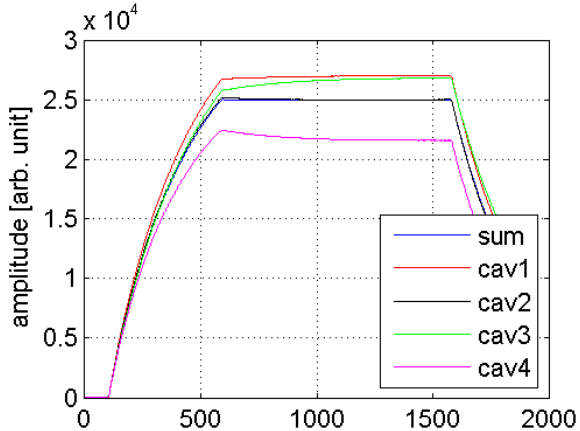
FB on
Piezo on

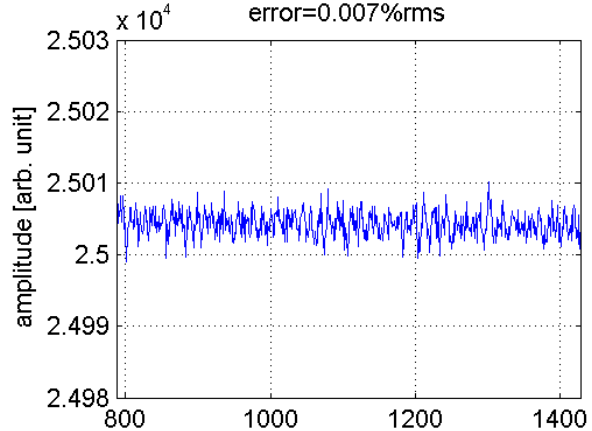


Lorentz detune meas.
(piezo on)

LLRF control for 4 cavities vector sum

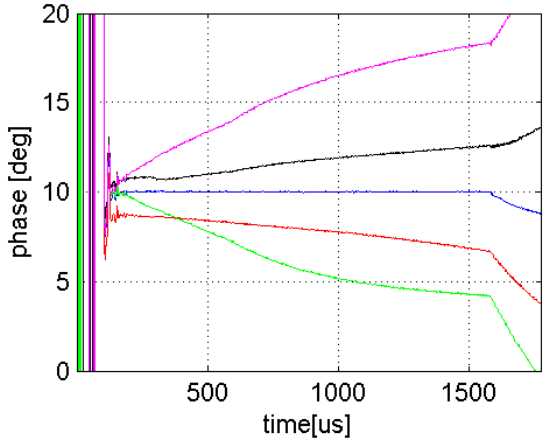
amplitude

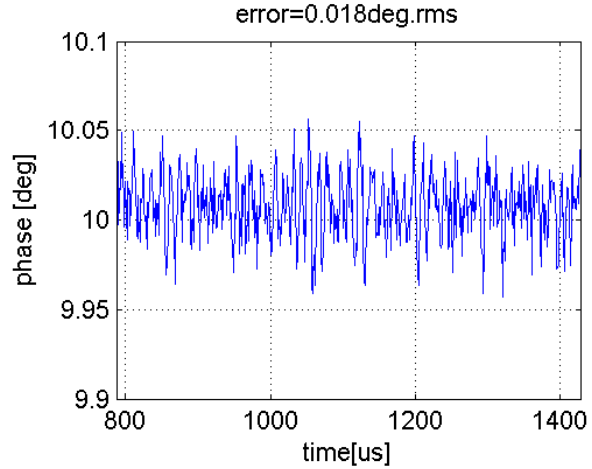




0.04%rms

phase



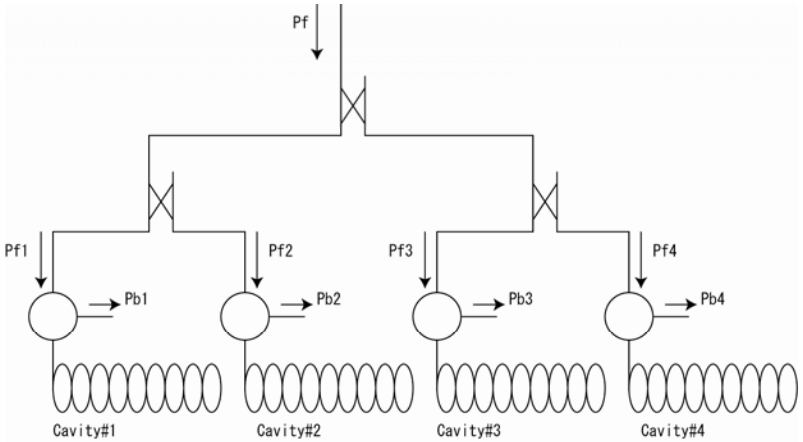


0.02deg rms

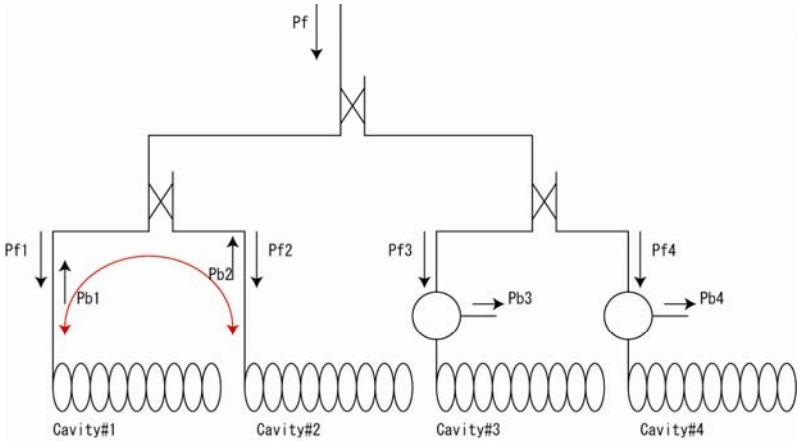
The first test of feedback (with feed-forward) using 4 cavities vector sum.
The stabilities were very good.

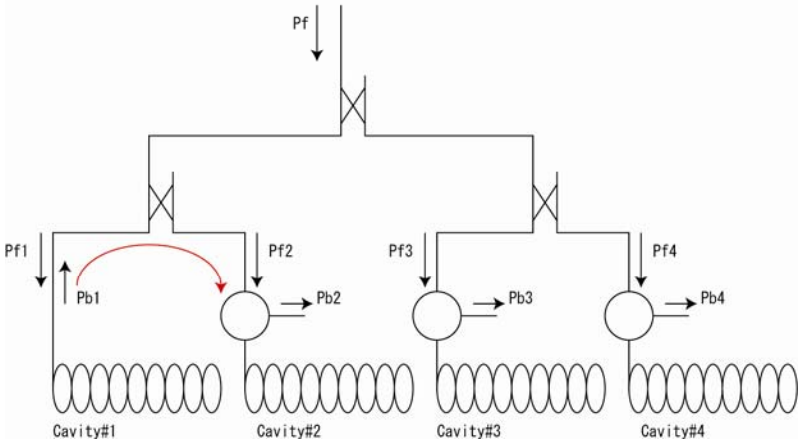
cavity circulator removal test

(a) with circulators

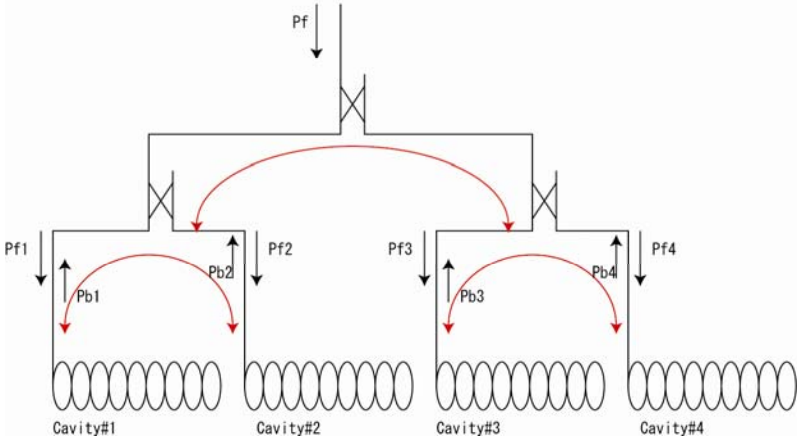


(c) 1 pair circulators removal



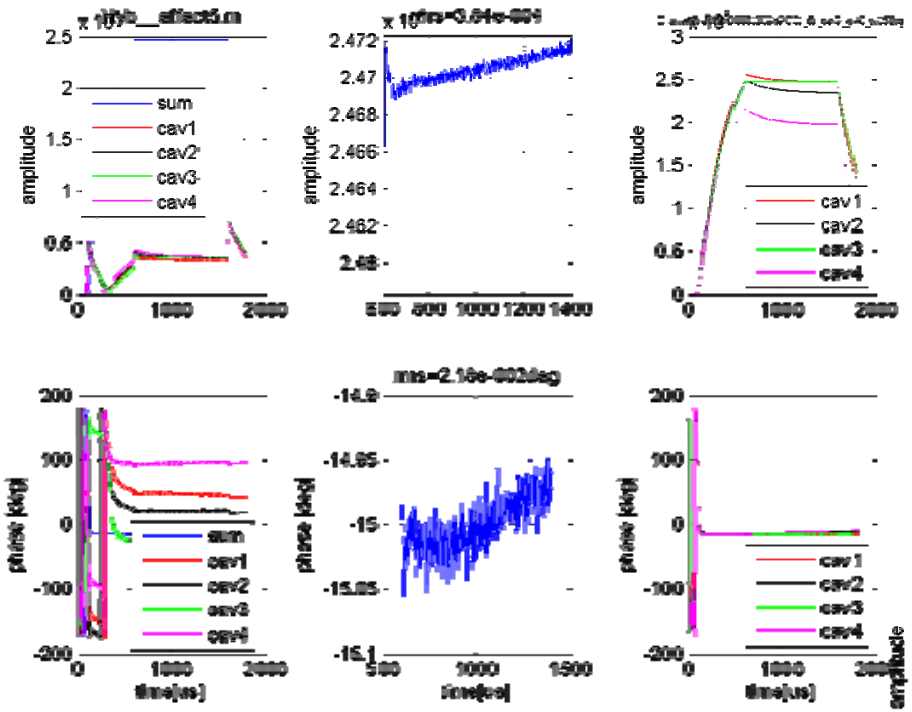


(b) 1 circulator removal

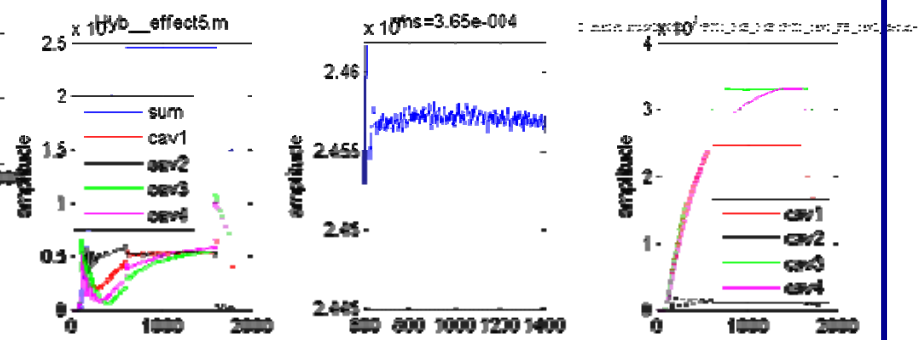


(d) whole circulators removal

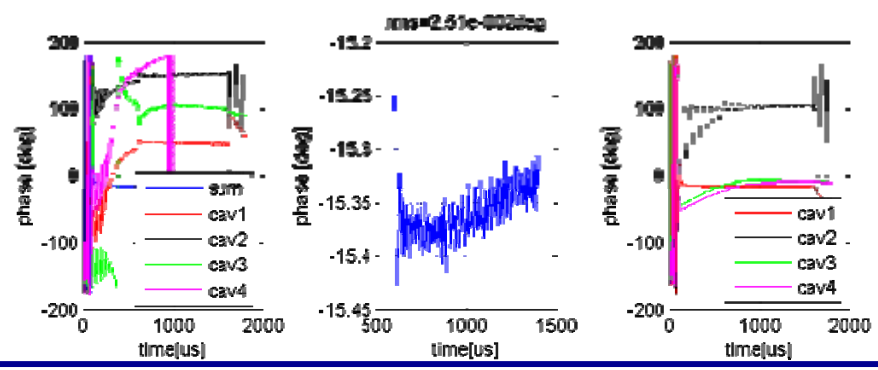
stability results of circulator removal test



with circulator in each cavity input



with circulator removed for all cavities



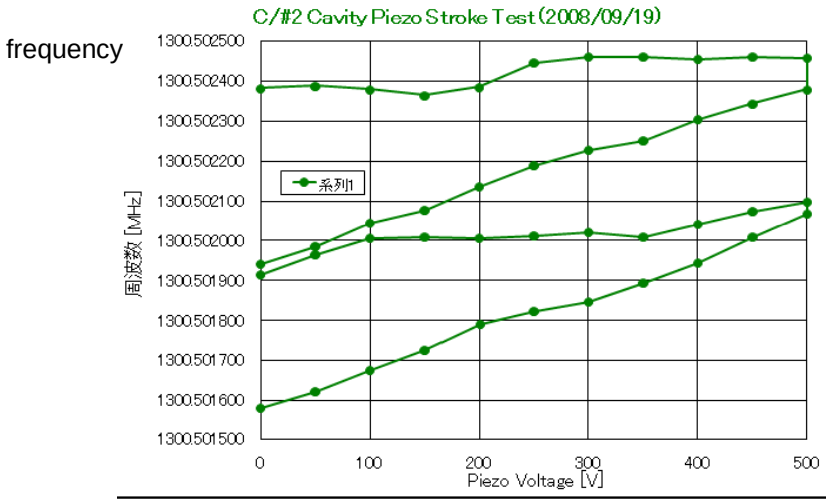
No change on the stabilities

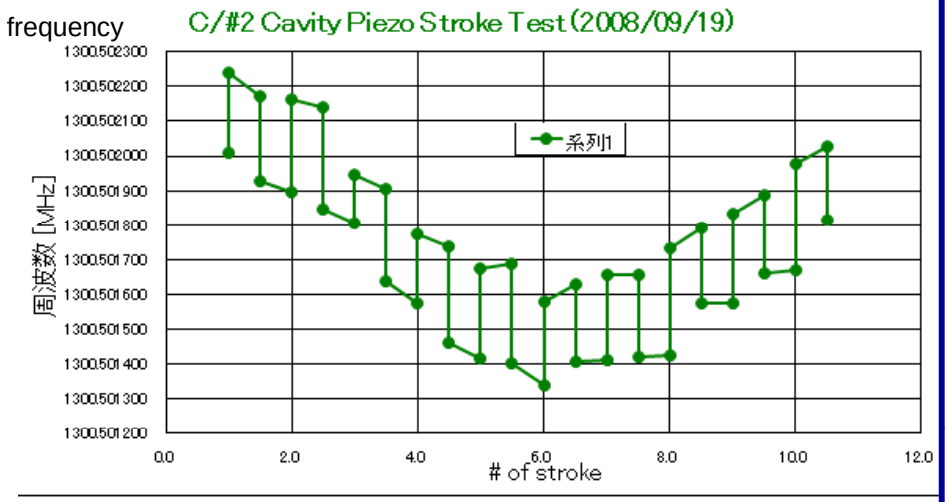
Measured QL variation in case of circulator removed

test #	date	set up condition	average QL of cavity#1 for 150 pulse meas.	Pf_flat	Pf_rf_off
(1)	Dec. 3	with circulators in each cavity input	1.28E+06	99.9%	0.206%
(2)	Dec. 4	circulator#1 removed	1.22E+06	97.6%	7.06%
(7)	Dec. 5	circulator#1+#2 removed, cavity #2 detune.	1.40E+06	97.8%	6.86%
(11)	Dec. 6	all circulators removed, cavity #2 detune.	1.47E+06	104%	5.02%
(12)	Dec. 6	all circulators removed, cavity #2, #3 detune.	1.34E+06	97.3%	6.19%
(13)	Dec. 6	all circulators removed, cavity #2, #3, #4 detune.	1.35E+06	97.7%	7.35%
(18)	Dec. 6	all circulators removed, cavity #2 detune, use bad isolation hybrid.	1.26E+06	94.2%	20.3%
(19)	Dec. 6	all circulators removed, cavity #2, #3 detune, use bad isolation hybrid.	1.23E+06	92.7%	18.0%
(20)	Dec. 6	all circulators removed, cavity #2, #3, #4 detune, use bad isolation hybrid.	1.17E+06	91.2%	24.6%

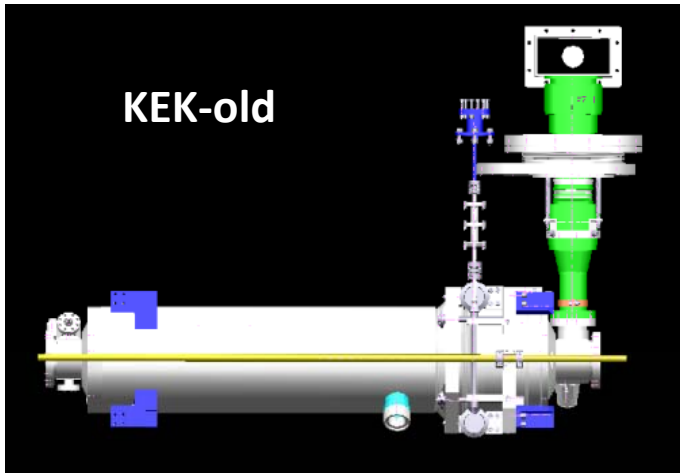
Measured QL variation in several cases are 1.17-1.47E06, with/without circulators.

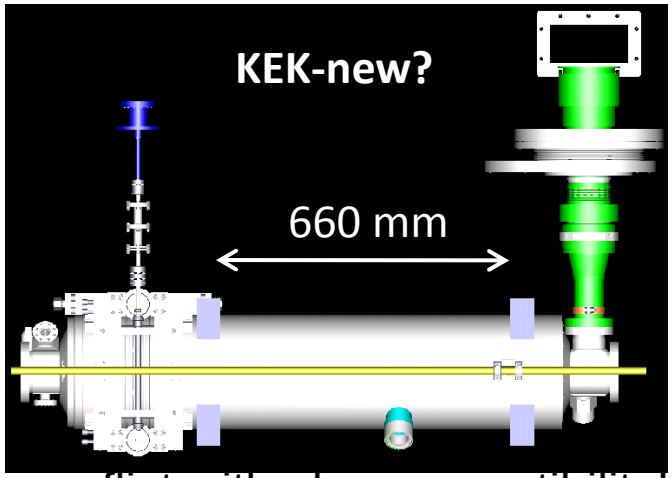
No repeatability for piezo response (STF1.0 experiment)





support tab friction for piezo drive?? → confirmation by room-temp meas.
consideration of tuner design change.



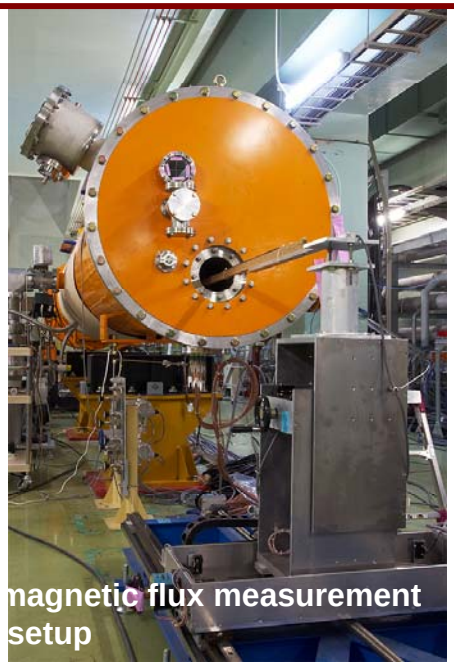


conflict with plug-compatibility!!

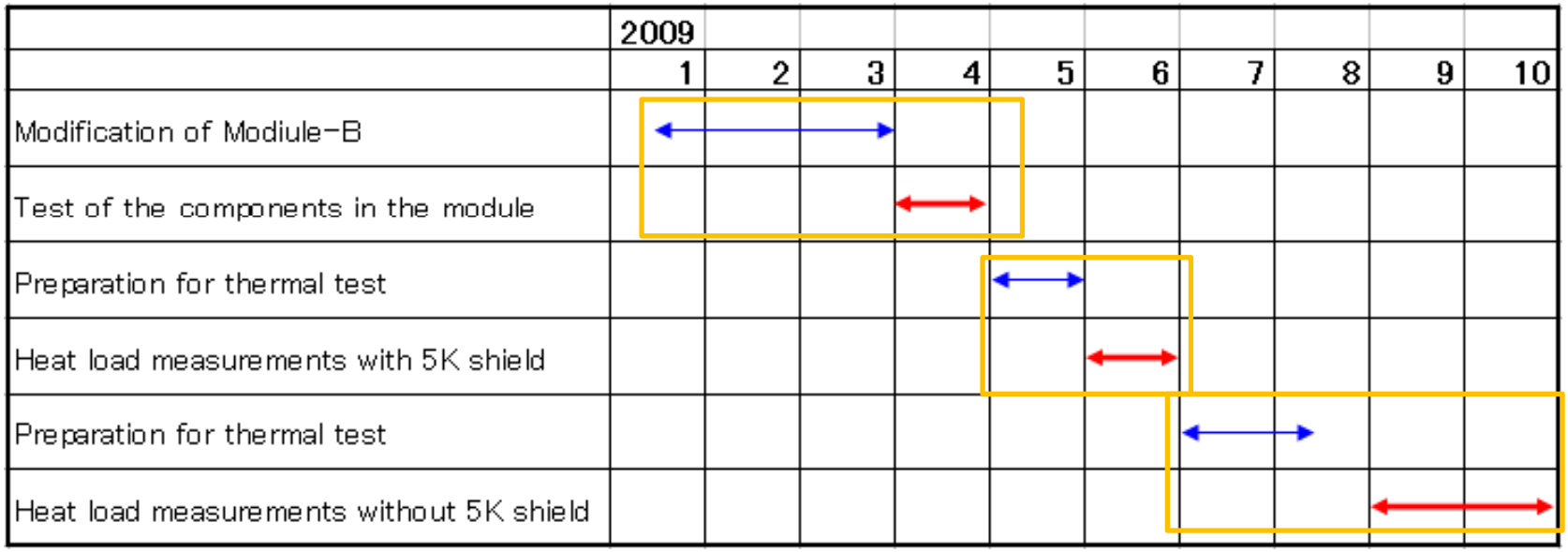
STF1.0 remains (exp. in 2009, before S1-Global)

(1) precise measurement of GRP thermal distortion
using laser distance-meter,
improved WPM monitors,
magnetic flux measurement at cavity position.

(2) Test of 5K shield removal
(thermal performance measurement)

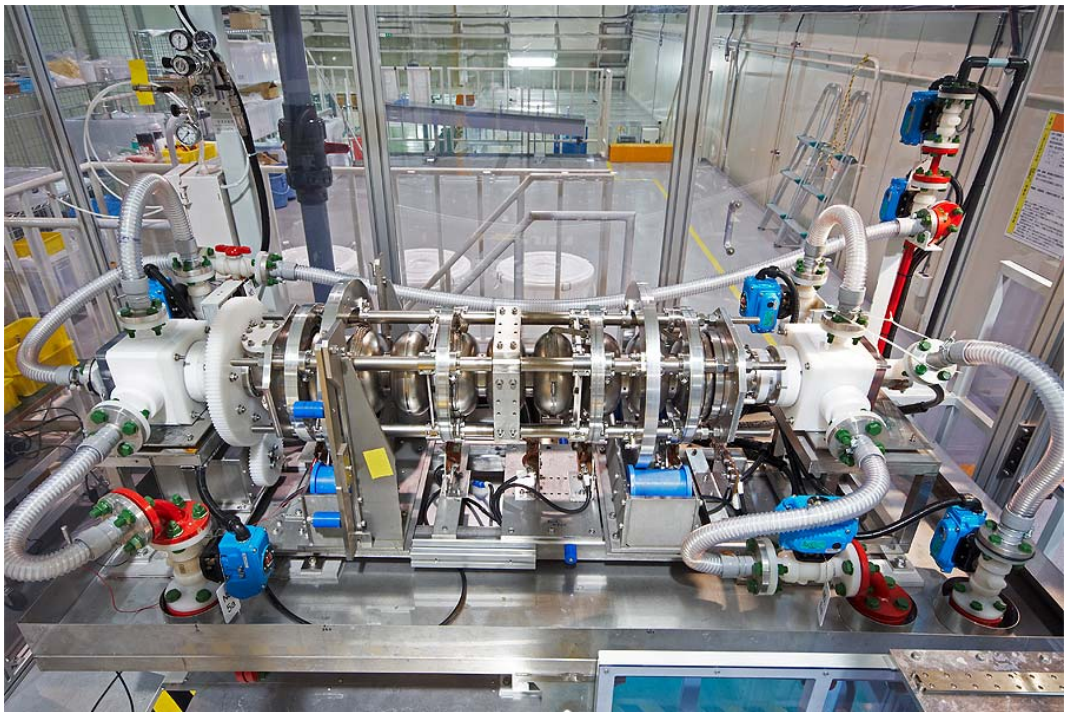


Test schedule



STF Facility Start-up: EP Facility

9-cell cavity on the EP bed

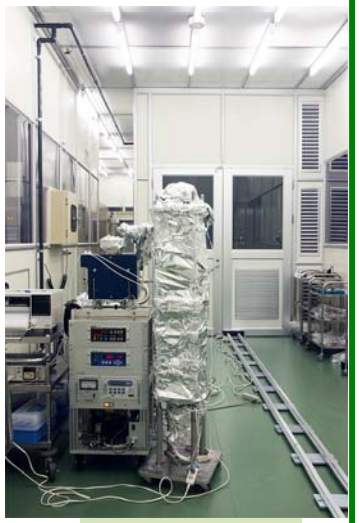


EP acid: HF + H_2SO_4
Aluminum anode,
surface removal speed: 20µm/hour,
~18V ~270A ~30degC
cavity rotation: 1 rot/min

electrode in/out in vertically

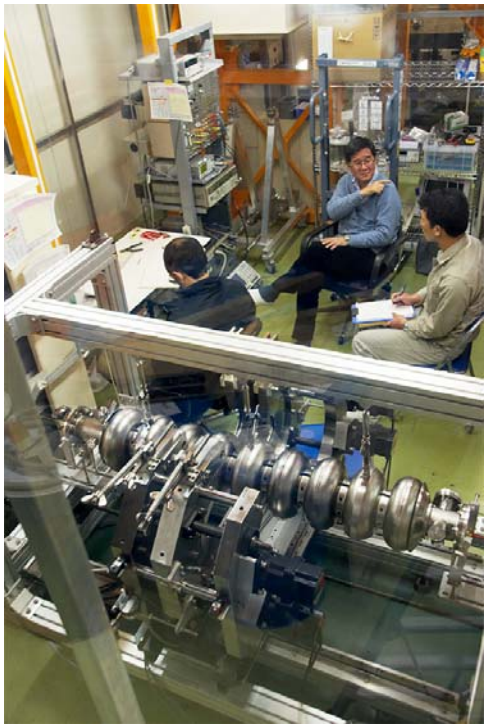
ultra-sonic cleaning

HPR installation



120C bake

STF Facility Start-up : Vertical Test Facility

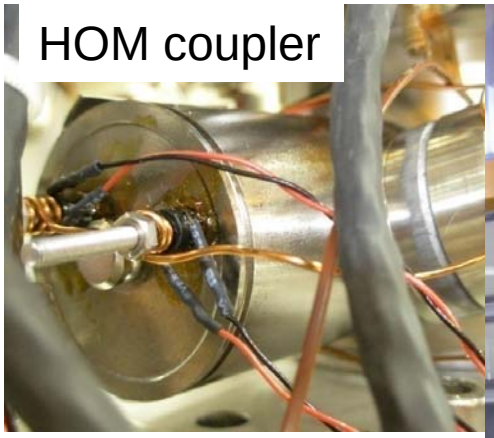


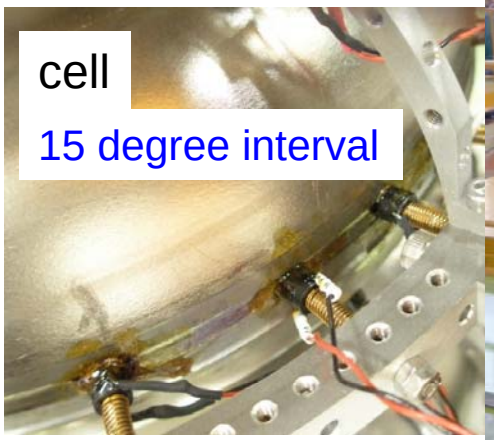
AES001 Pre-tuning tuned to 96.6% flatness.

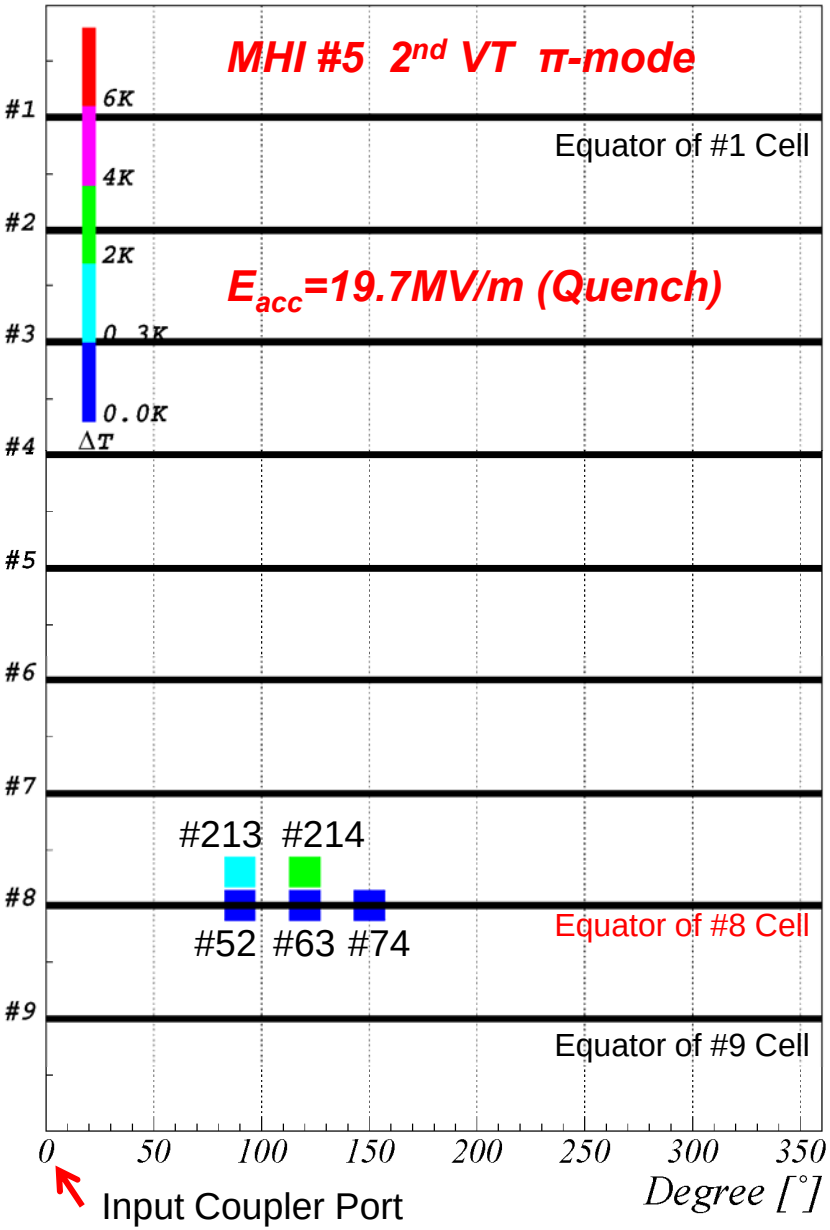
Cavity Installation test and pumping test

Installation test into cryostat

Temperature Sensors (T-map)





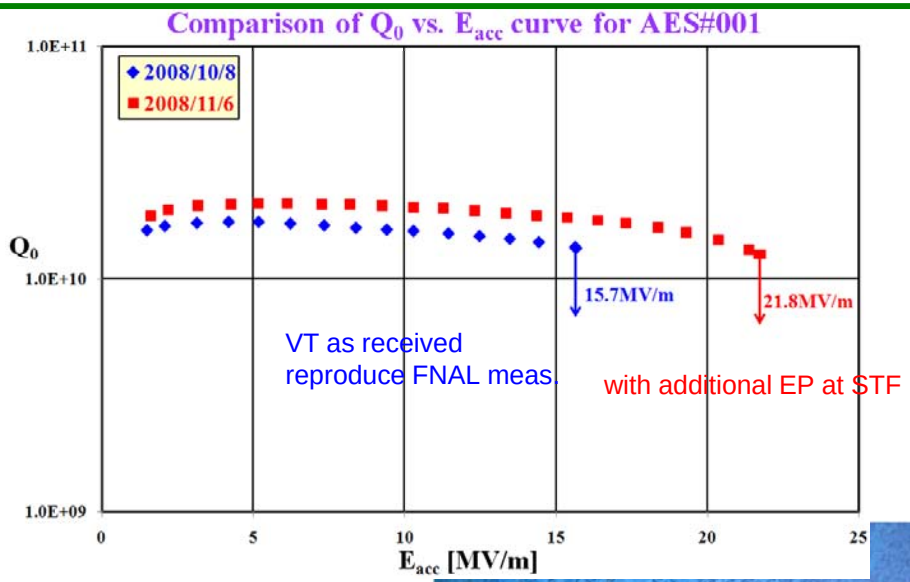


Total number of sensor:176
18 sensors/cell

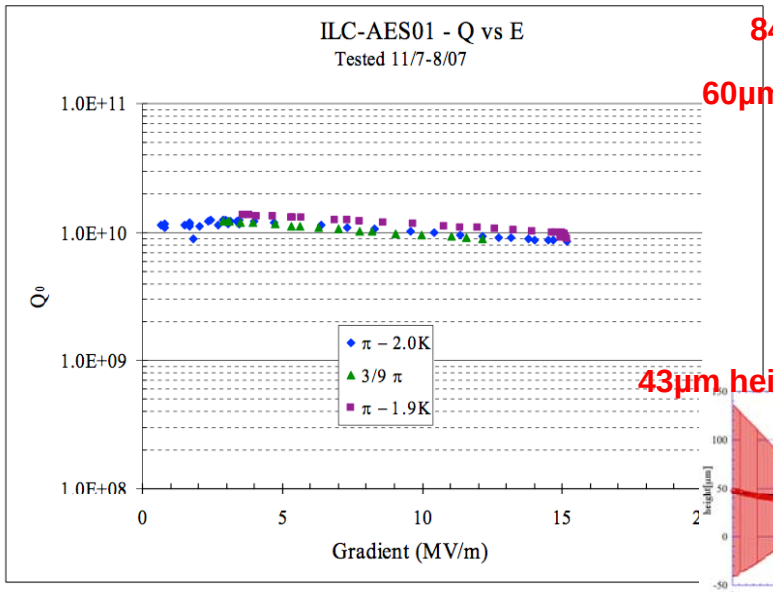
Performance of STF EP & VT

Borrowed FNAL AES001 cavity was inspected inside, Vertical test as received, and vertical tested after STF EP process.

temp. rise was observed in the same defect location.



3rd Test Results

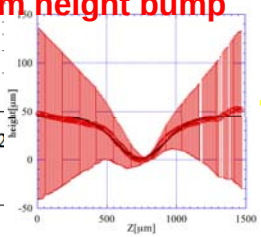


J. Ozelis 12/4/2007

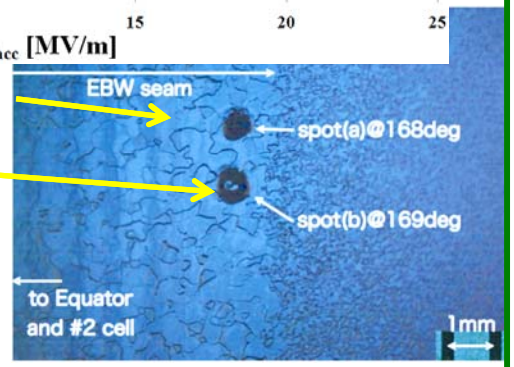
84μm height bump

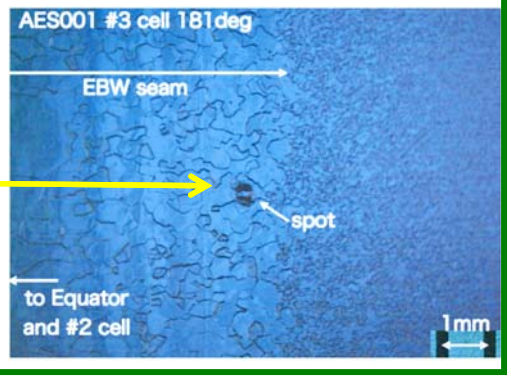
60μm height bump

43μm height bump



~21mm





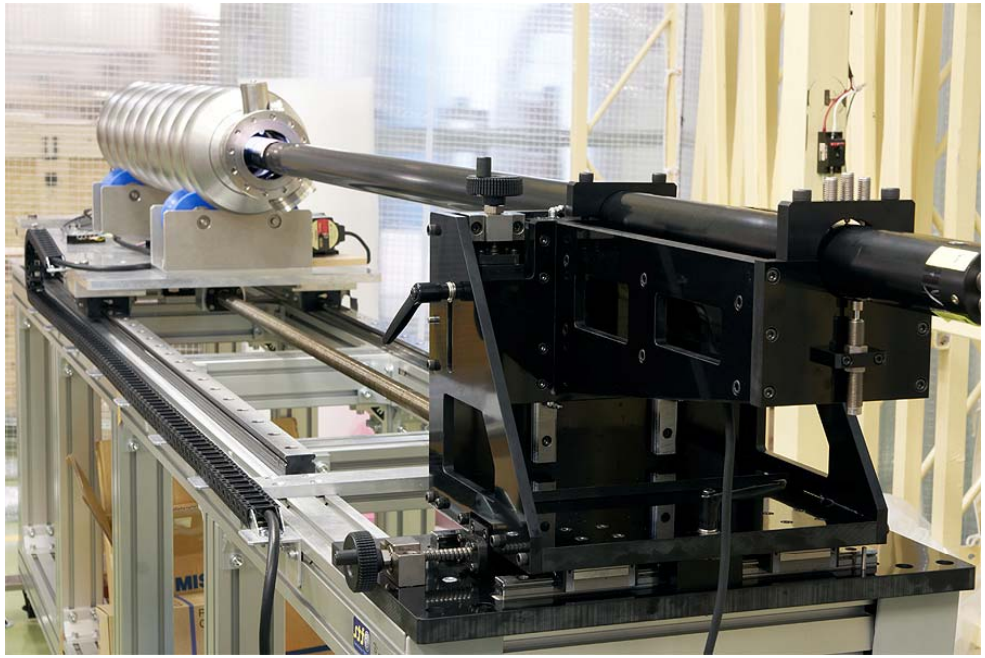
Inspection camera

Research on gradient limitation;

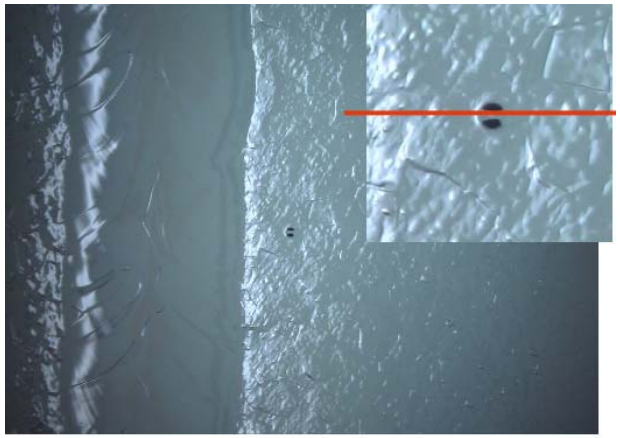
Use of Inspection Camera together with T-map for identifying the reason of quench.

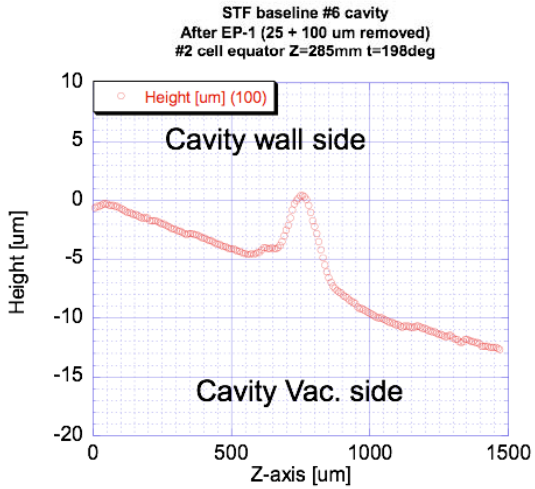
Use it for new production cavities.

upgrade : cylinder rotation instead cavity rotation,
LED illumination instead EL,
twice much high resolution,
full automated image capture,
automated defect finding, …



Inspection Camera (KEK-Kyoto)



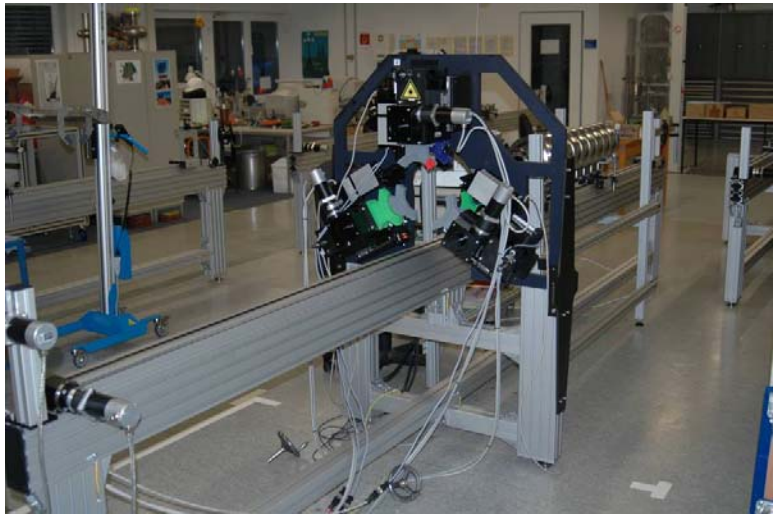


shallow defect found on MHI#6 cavity : new production

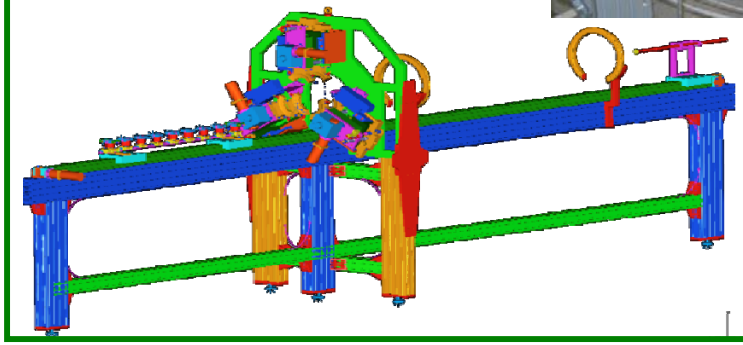
Automated pre-tuning machine

DESY-FNAL-KEK collaboration;
full automated pre-tuning machine
for speedup of pre-tuning process.

DESY: hardware development
FNAL: control development



DESY development



delivery to KEK
is scheduled in ~Nov. 2009

FNAL development

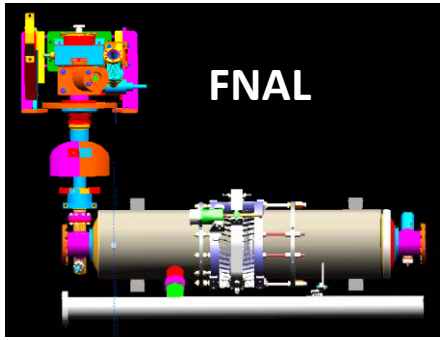
S1-Global

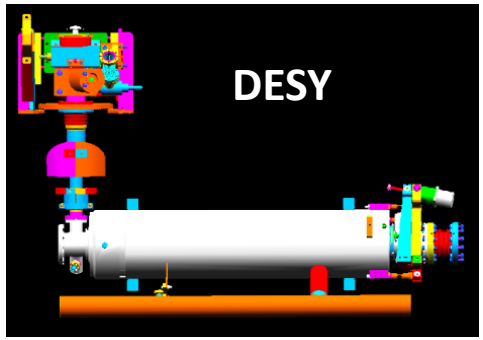
Aiming 31.5MV/m operational cryomodule, by international collaboration

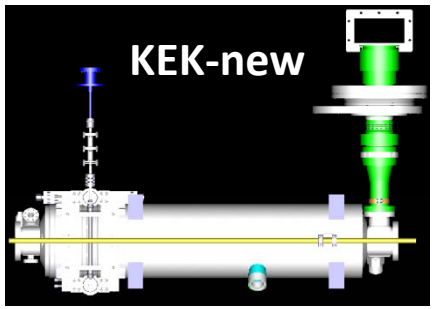
assembly : Oct 2009 - April 2010
operation : May 2010 – December 2010

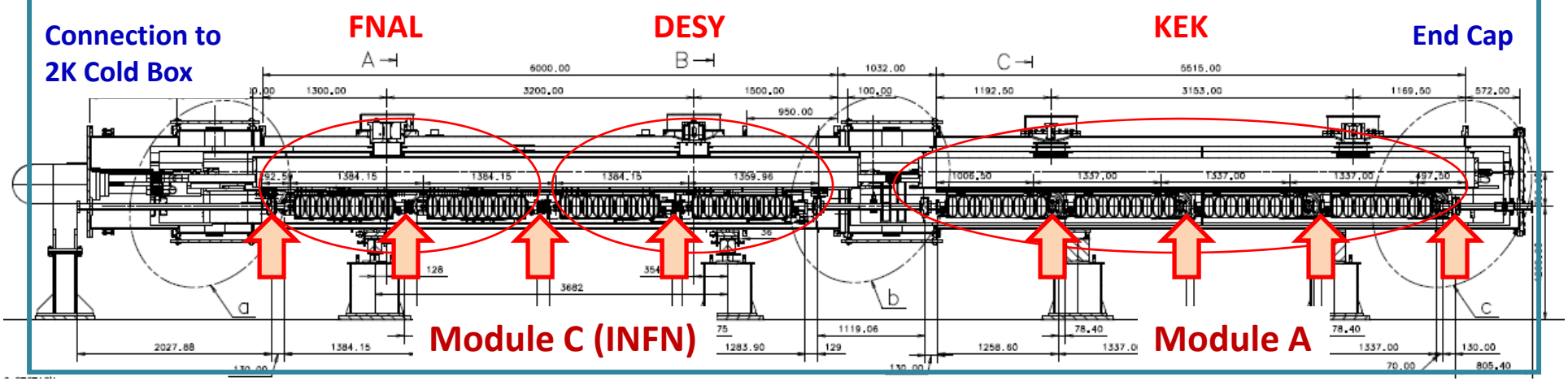
MOU between INFN and KEK : exist
MOU between DESY and KEK : first version was exchanged
MOU between FNAL and KEK : first version was exchanged
MOU between SLAC and KEK : start soon

Module-A : existing KEK cryostat + 4 new KEK cavities
Module-C : INFN cryostat + 2 DESY cavities + 2 FNAL cavities
power distribution : 2 SLAC VTO + existing KEK WG







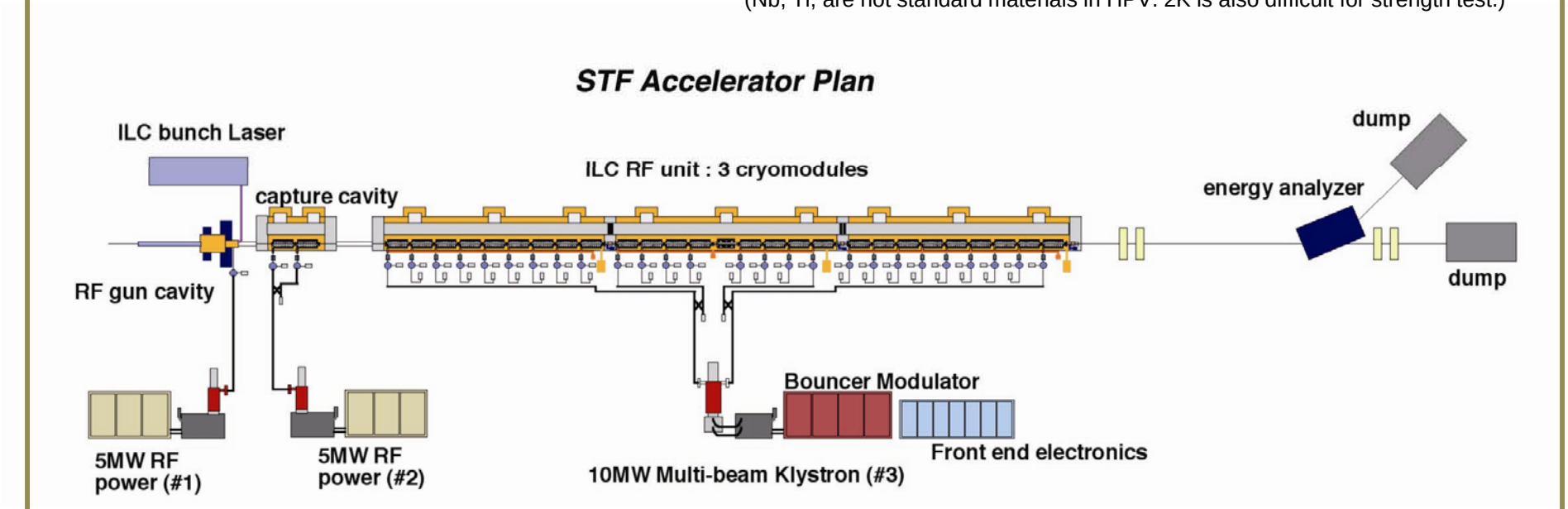


STF2.0 accelerator plan

New installation;

photocathode RFgun : FNAL gun cavity, JINR-IAP laser, ATF photocathode
capture cavity : two 9-cell SC cavities
cryomodule : 3 ILC cryomodules (1 ILC RF unit)
klystron : 10MW horizontal multi-beam klystron
modulator : bouncer modulator

HPV applications for cavity package, cryomodule, cryogenics, independently.
Material strength test are required in the applications.
(Nb, Ti, are not standard materials in HPV. 2K is also difficult for strength test.)



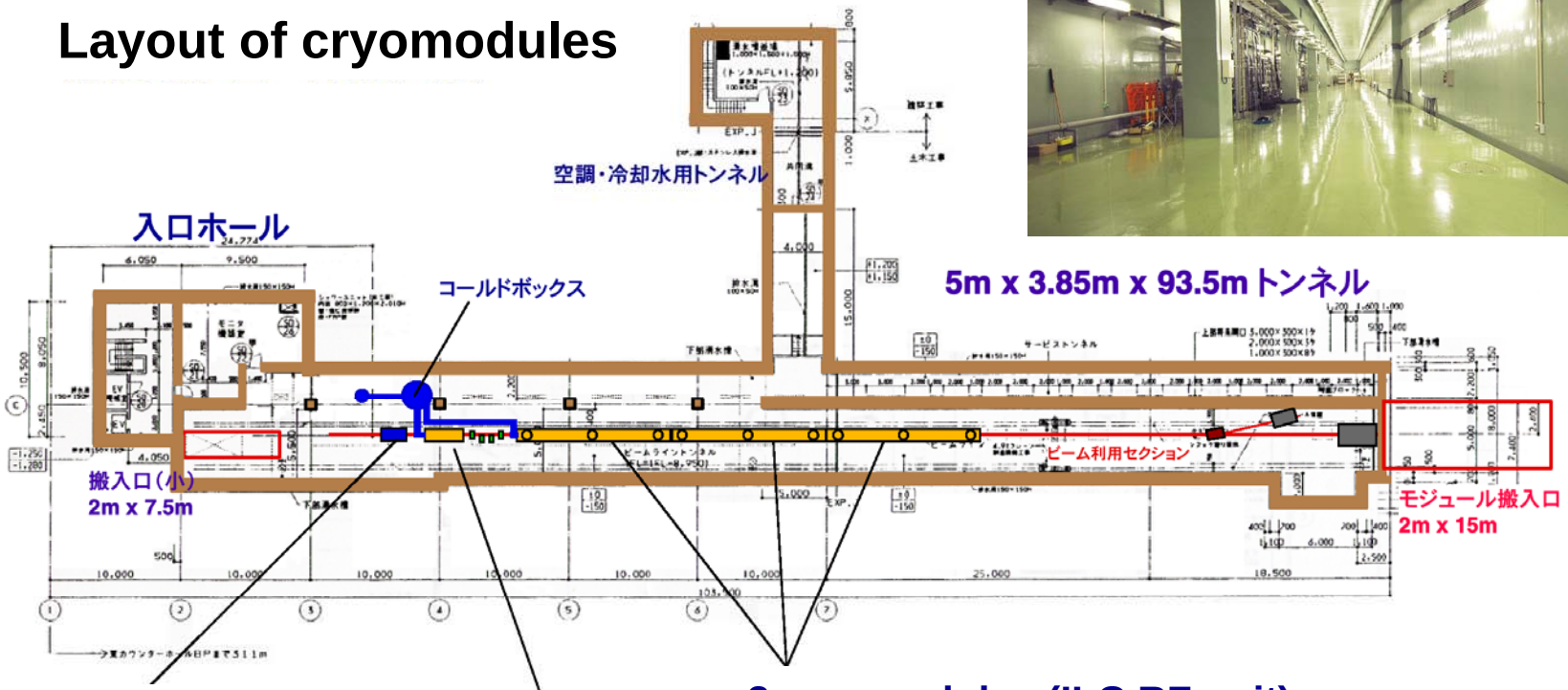
Cavities : 2+26
Klystrons : 5MW + 5MW + 10MW
Beam : 850MeV, 1ms train、9mA、 5Hz

Cryomodules installation in STF tunnel

STF

plan of next few years construction

Layout of cryomodules



RFgun

capture cavities
(2 cavities)

3 cryomodules (ILC RF unit)

V8.1 H. Hayano, 07/14/2008

STF tunnel in 2013 - 2014

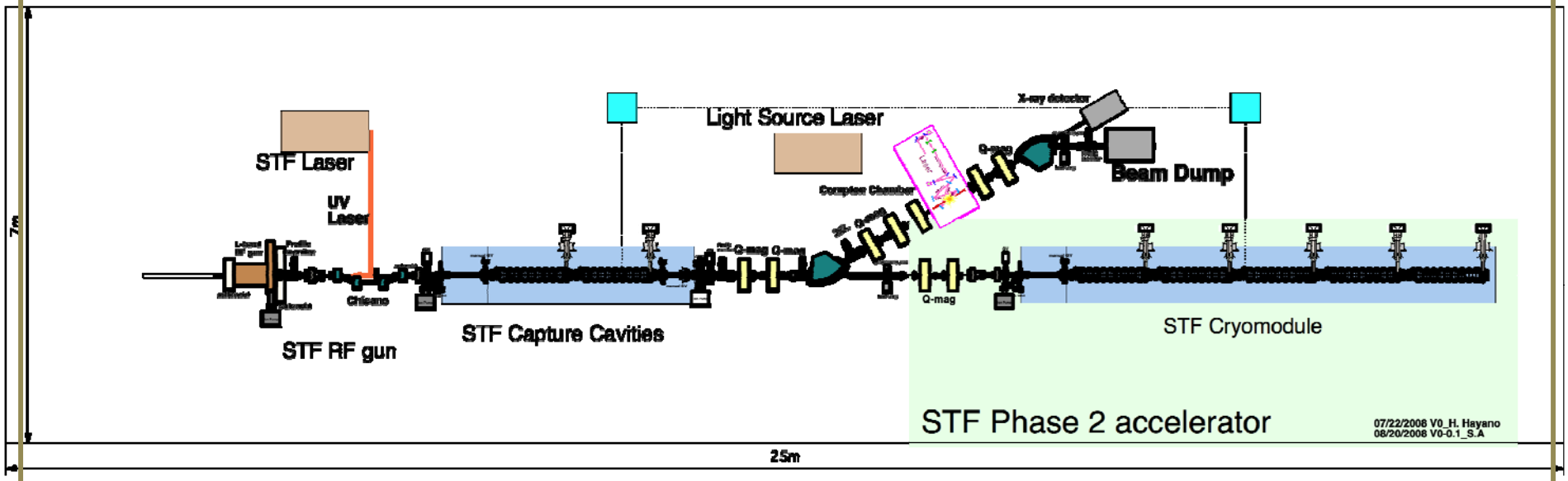
STF2.0 Pre-accelerator part

On a way to construct STF phase2.0 accelerator;

verification experiment : compact light source accelerator

use of STF RF gun and capture cavities : two 9-cell SC cavities with beam collision to stored laser in multi-mirror storage cavity.

Compact Light Source accelerator In STF Phase 2



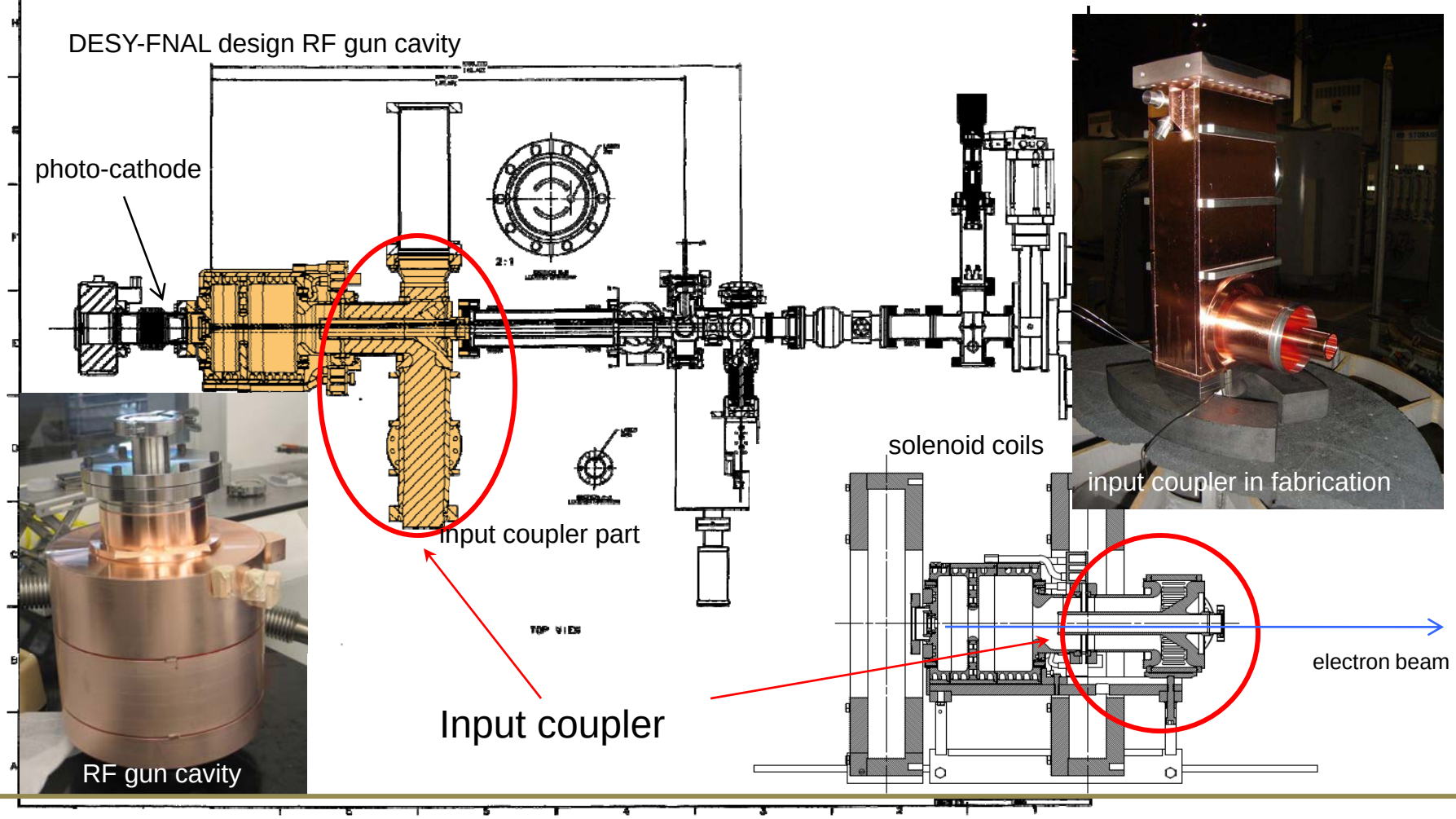
RF gun construction for STF phase 2

As a beam source of STF phase2.0 accelerator;

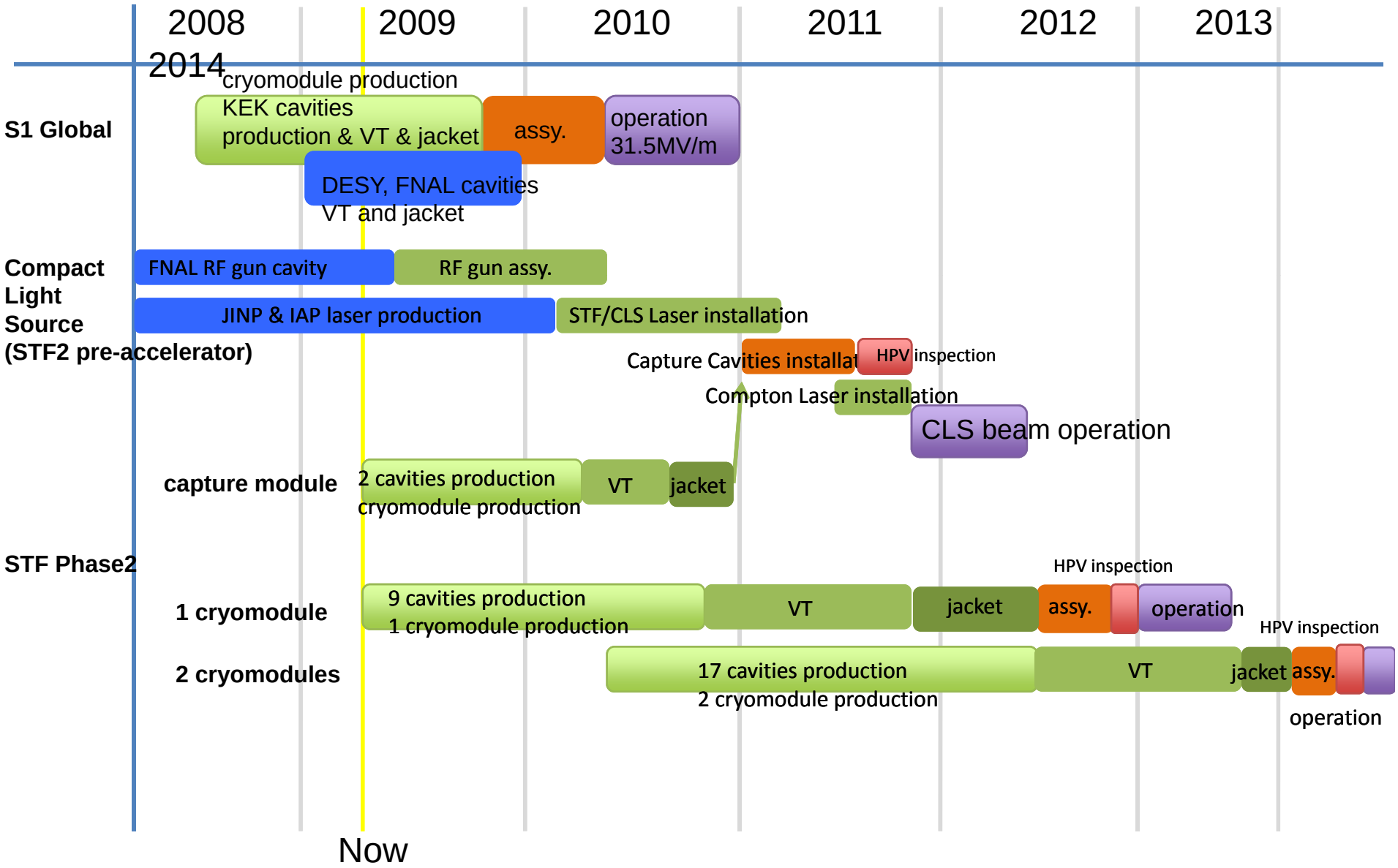
DESY-FNAL design RF gun cavities are under fabrication in FNAL.

KEK joined this program.

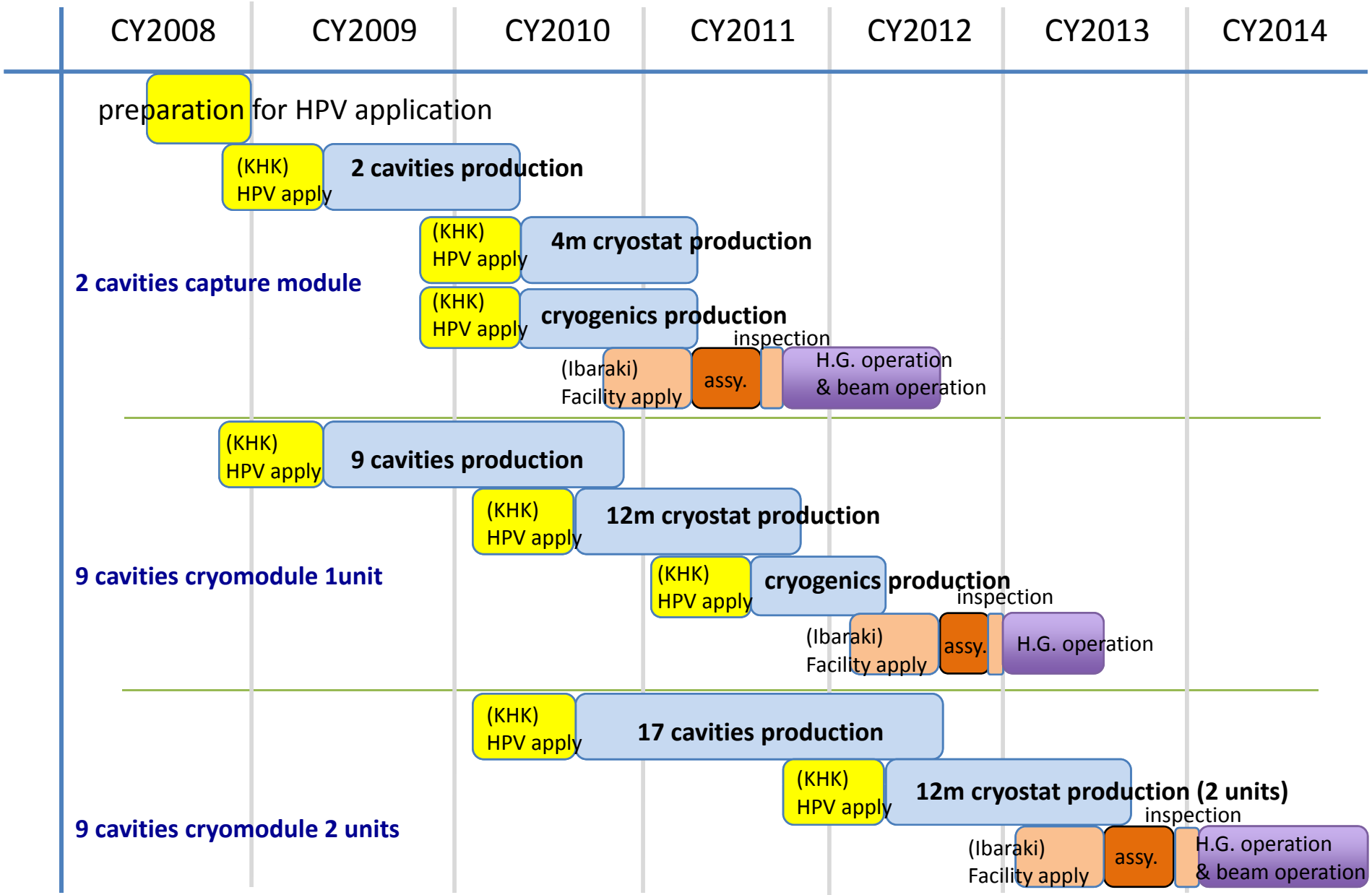
Delivery of gun cavity and input coupler is scheduled in May 2009.



Plans from S1-G to STF phase 2



STF Cryomodule production for HPV application



Summary of STF achievements and Plans

(1) Quick experience of cryomodule technologies by STF 1.0.
In parallel, infra-structures like EP and VT are in development.

’1 cavity test for both TESLA-shape and LL-shape,
4 TESLA-shape cavities cool-down test'

(2) Instrumentations like T-map and inspection camera etc
are under development and upgrade continuously.

’To ensure cavity gradient performance, to find reason of quench'

(3) Preparation of ‘S1-Global’ cryomodule test is on a way.

’KEK fabricated 5 cavities. DESY 2 and FNAL 2 are expected.
INFN module C is under fabrication'

(4) Construction of STF phase 2 cryomodules with HPV regulation passed
is started.

’Work for HPV regulation clear is on going for the first 11 cavities.'

end