Cavity production R&D in STF

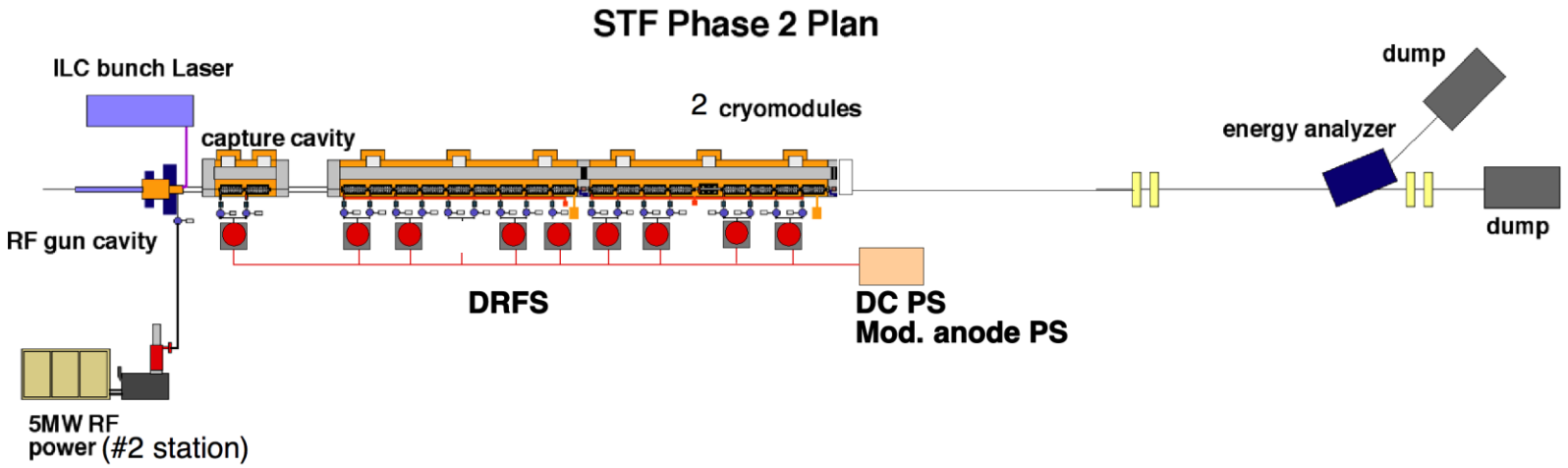
H. Hayano 09092010

STF and Cavity Fabrication Facility

KEK　つくばキャンパス（北側上空より）

STF phase 2 Accelerator Plan

DRFS base cryomodule operation with ILC-structure beam

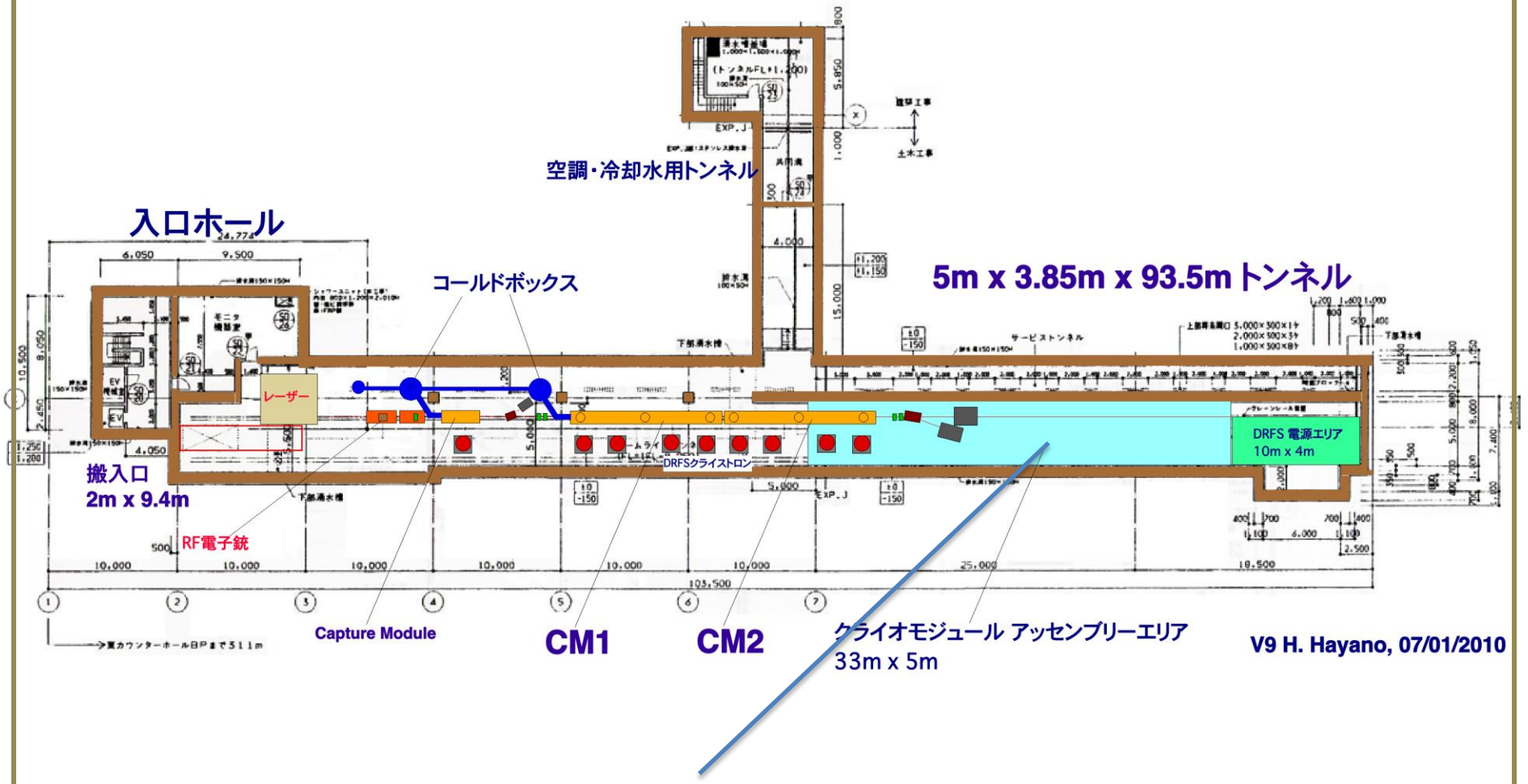


Cavity: Capture Module(2 cavities) +
CM1(9 cavities)
+CM2(8 cavities)
beam: 9mA, 5Hz
at RF-gun:4.7MeV
at Capture Module exit: 21MeV,
CM1 exit: 273MeV
CM2 exit: 525MeV

*CM-2 is still under discussion

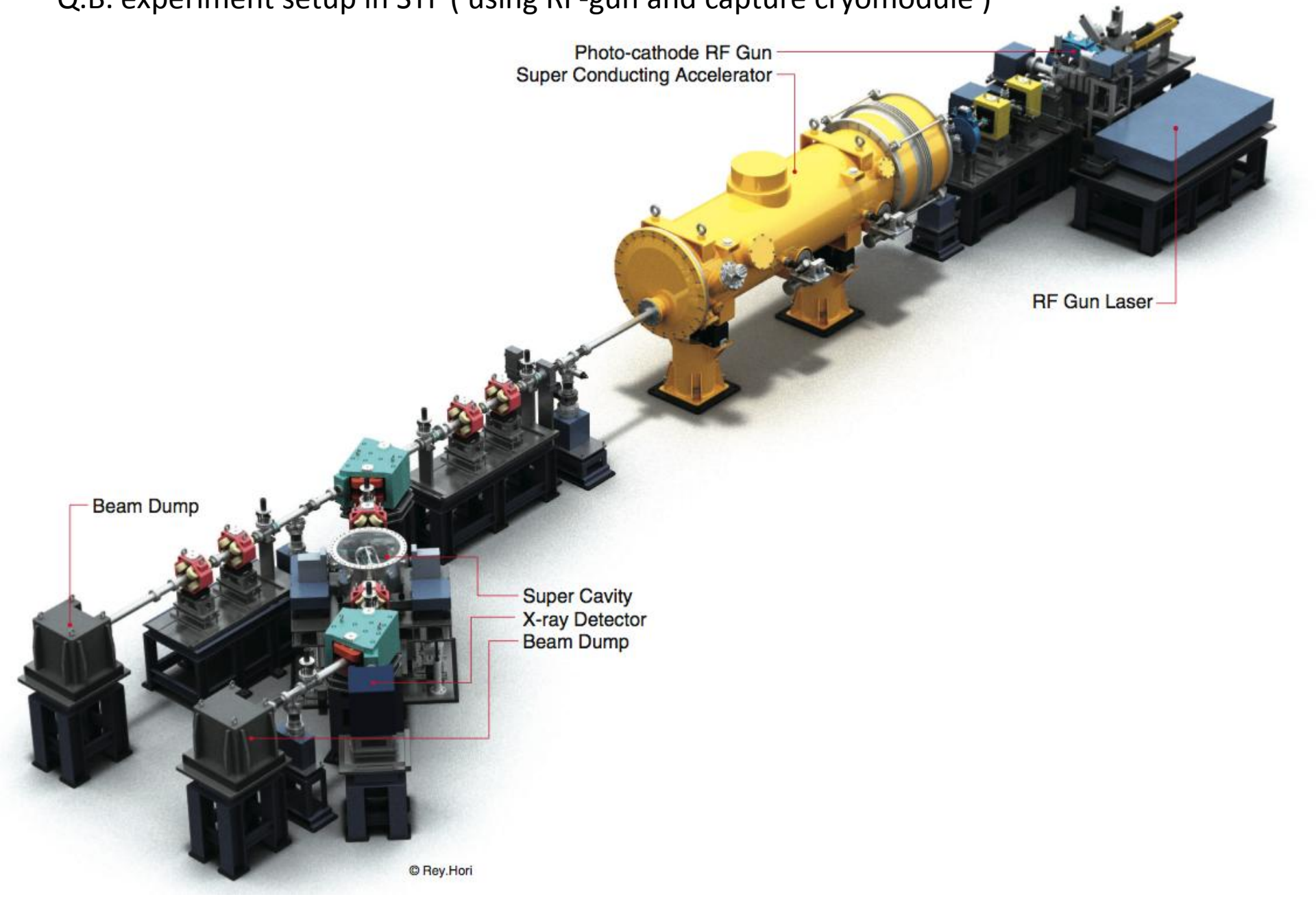
RF-gun cavity: 41.4MV/m (3.5MW input power)
Cavity gradient: Capture Module:15.2MV/m
CM1:31.5MV/m
CM2:31.5MV/m

STF phase2.0 accelerator :Tunnel Layout



Cryomodule Assembly in tunnel, because of limited length of access hatch

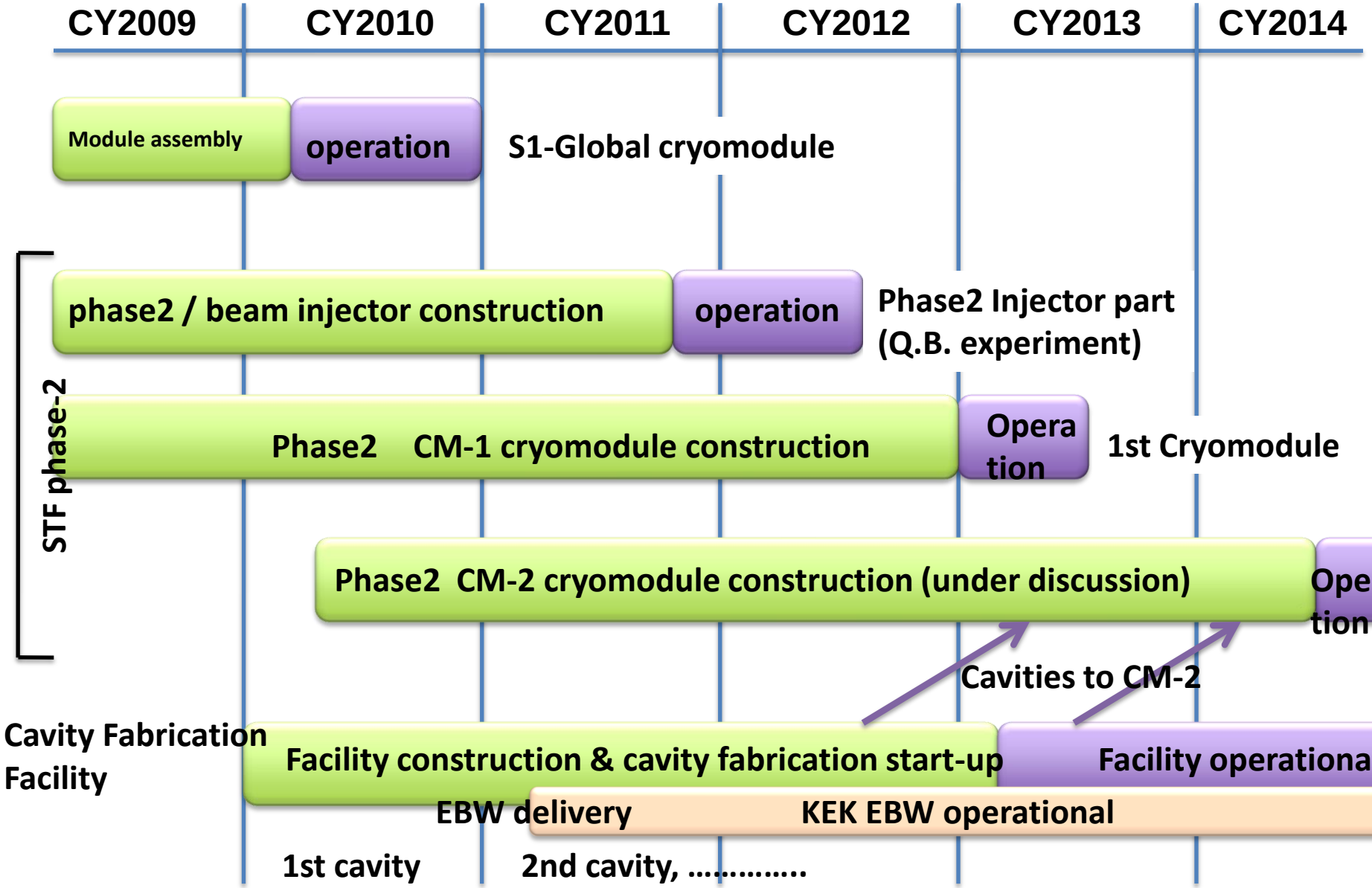
Q.B. experiment setup in STF (using RF-gun and capture cryomodule)



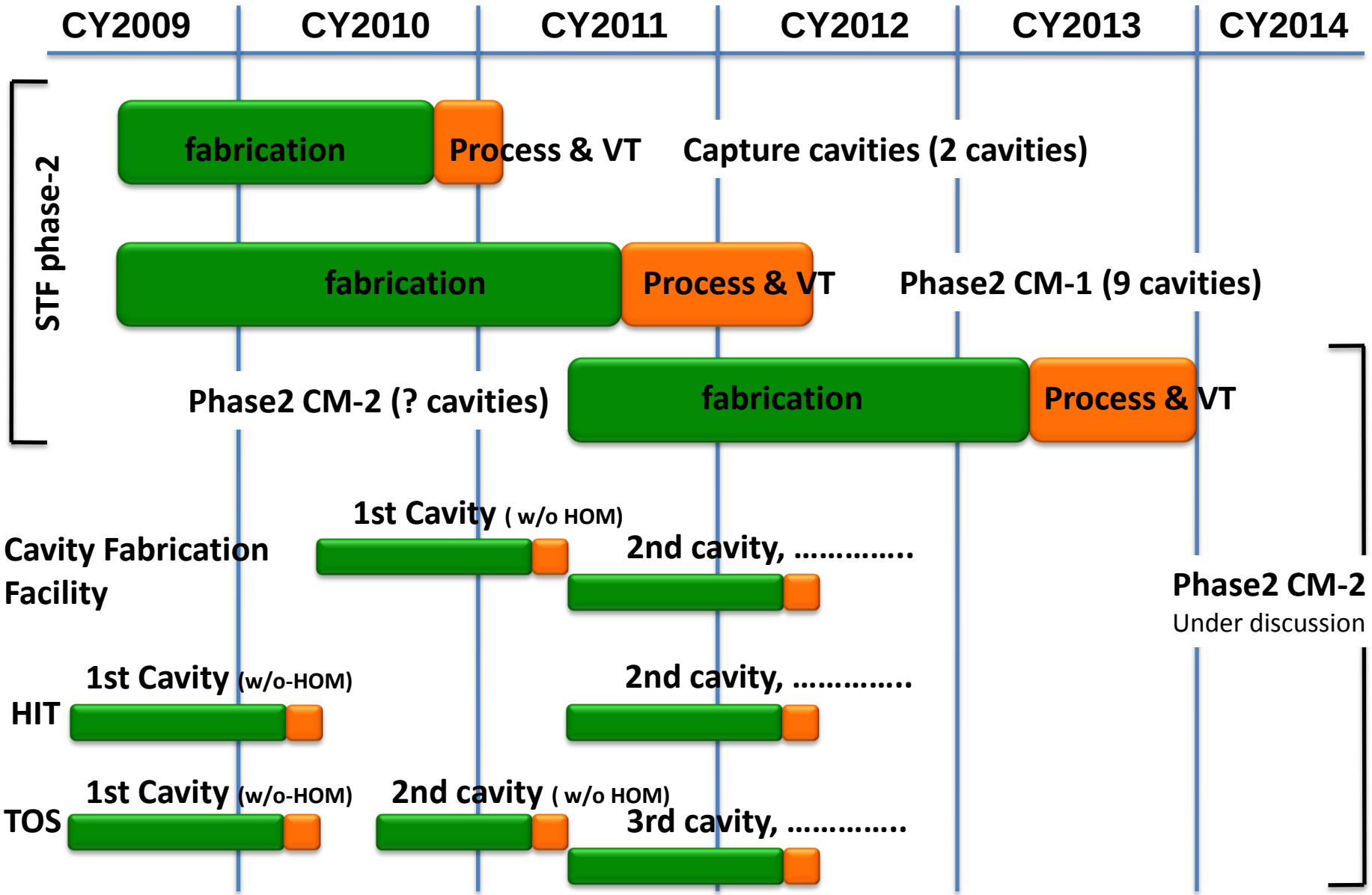
Beam parameters

	Q.B. operation	STF Phase2 operation
Pulse length	1ms	0.9ms
Repetition rate	5Hz	5Hz
Bunch Spacing	6.15ns (162.5MHz)	369.27ns (2.708MHz)
Number of bunch/pulse	162500	2437
Bunch charge	62pC	3.2nC
Total charge /pulse	10,000nC	7,798nC
Beam current	10mA	8.7mA
Bunch length	12ps(Laser, FWHM)	10ps(Laser, FWHM)
Max. beam energy	40MeV	21.5MeV
Beam power	2.0kW (40MeV beam)	0.8kW (21.5MeV beam)

STF Plans for 5 years (still under discussion)



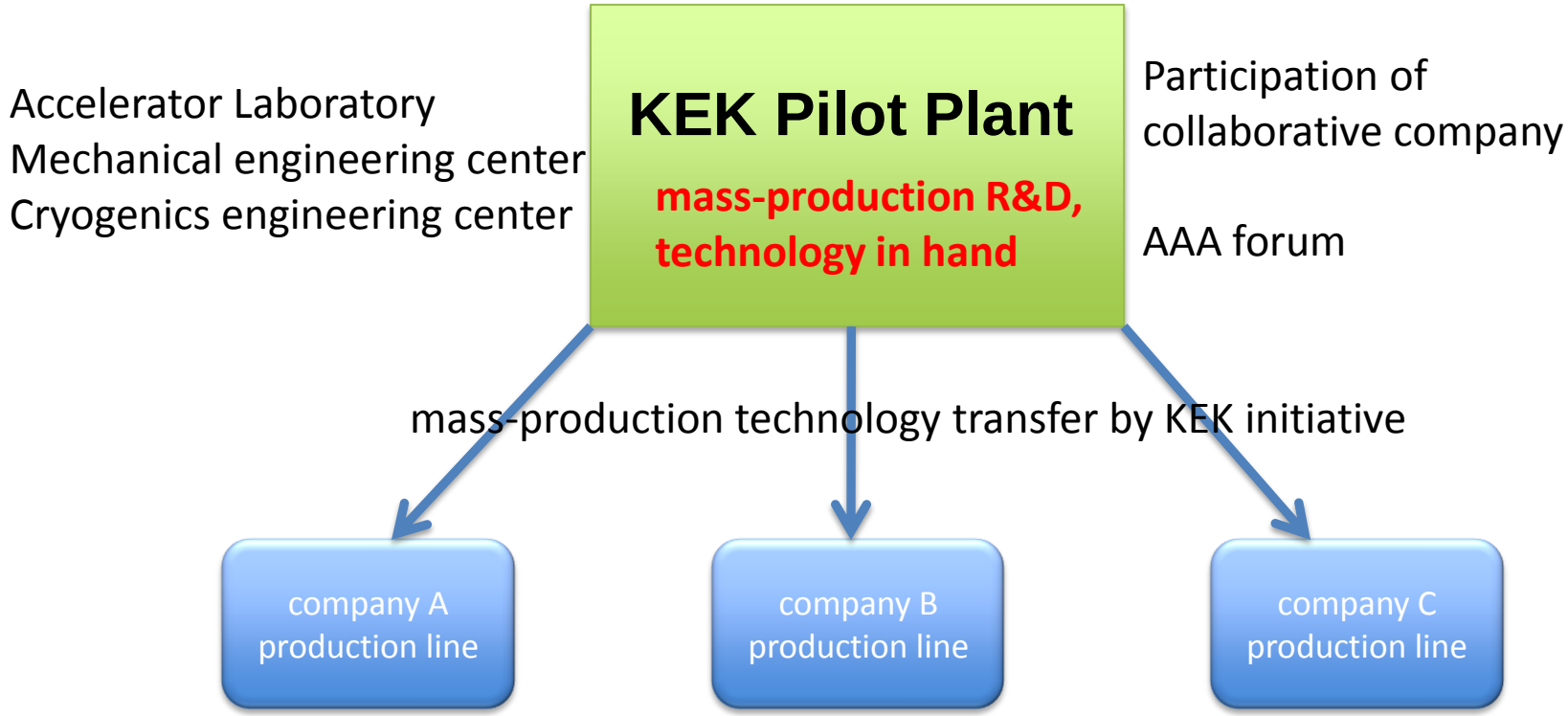
STF Cavity Production plan



Cavity Fabrication Facility
KEK Pilot plant

Industrialization of Cavity Fabrication

start preparation of ILC mass-production technology development



KEK Pilot Plant: main R&D

Center cell

EBW Quality Control Technology

multi-dumbbell, multi-cell, multi-cavity Jigs for EBW

End-group

Deep Drawing Technology

Fine-blanking (cutting-out) and Press-forming Technology

End-group Jigs for EBW

R&D Place in KEK

Refurbishment of 'P.S. energy center' building was completed.

Building 52m x 30m

Clean room 19m x 14m

clean room construction is completed

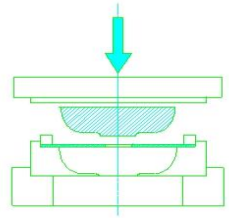
Pilot plant area

Pilot plant clean room

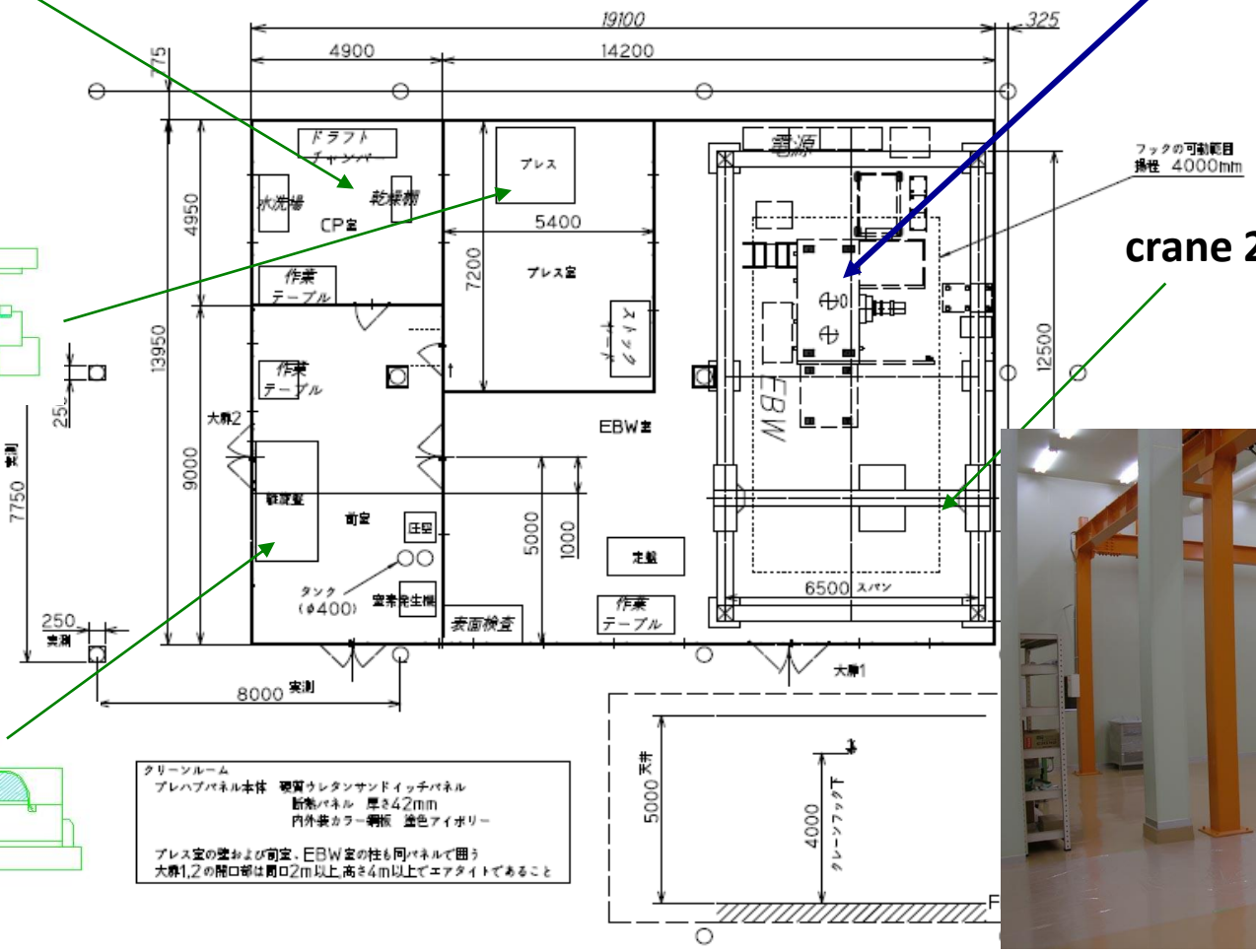
Chemical Polish room

19m x 14m ISO class-5 clean room

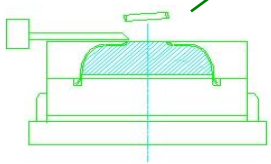
Electron Beam Welder



Press machine



crane 2.8t

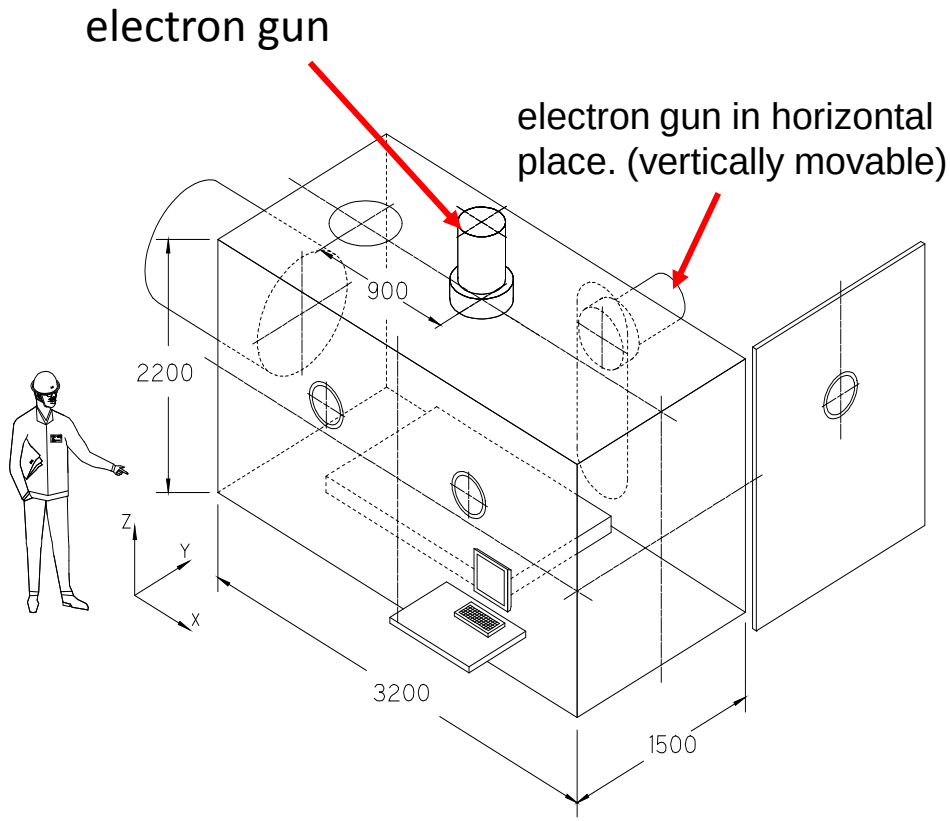


Triming machine

EBW place and crane girder

Main facility: Electron Beam Welder

we spent one year for survey of cavity EBW machine.
After bidding, one EBW machine was ordered.

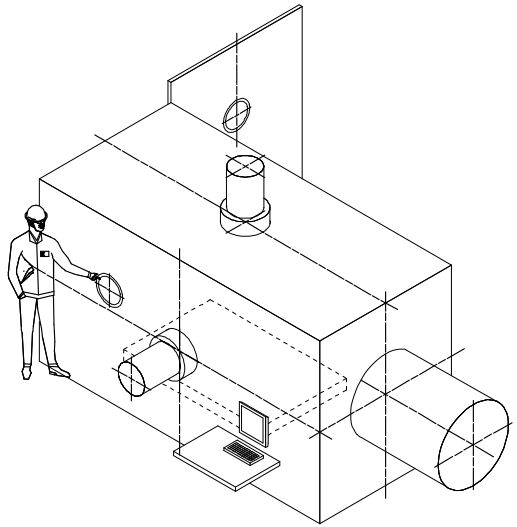


DESY EBW; the same company

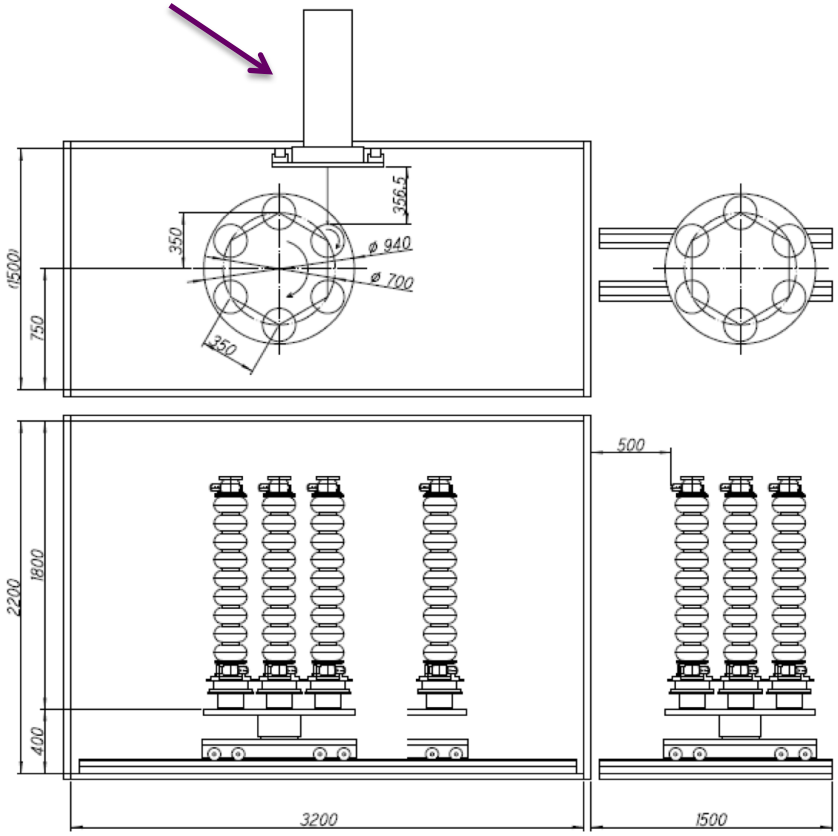
Steigerwald 150kV 15kW machine will be delivered in March 2011.

Plan of multi-cavity welding

6 cavities welding plan in the final process



electron gun from side wall

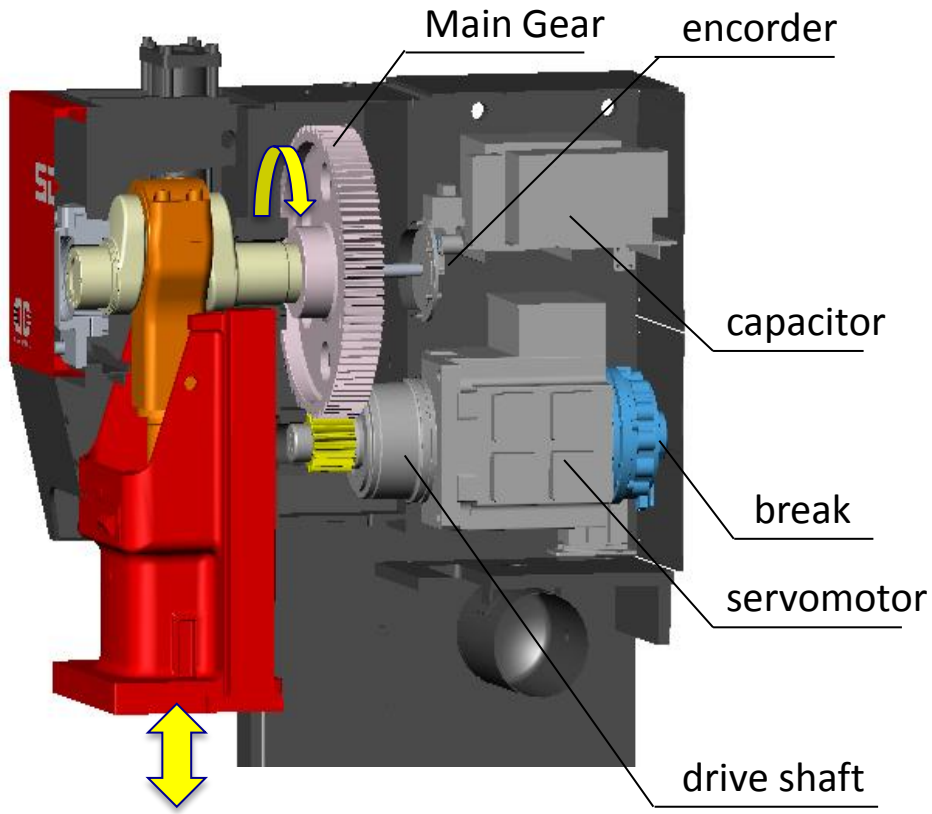


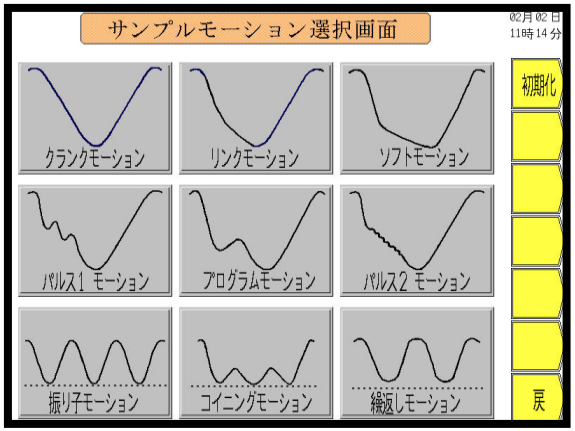
gun moves vertically

Digital servomotor Press machine

combination of servomotor and crank mechanism

from Amada presentation





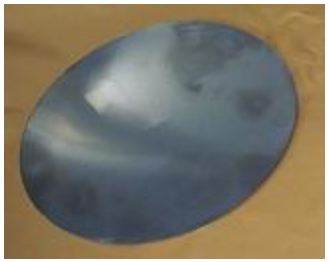
press motion controls

Deep drawing of cup; for example

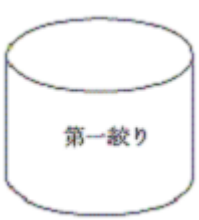
conventional press

TPL150

①plate
Φ165 0.5 t



→ ②1st deep drawing → ③2nd deep drawing → ④3rd deep drawing



SDE1522

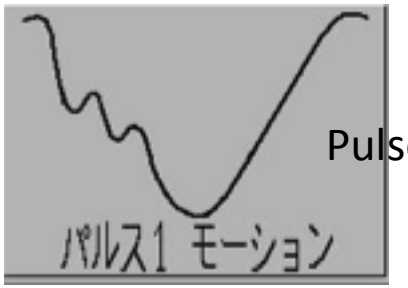
①plate
Φ160 0.5 t

→ ② one deep drawin

モーション設定	パルス1モーション
上昇移動量	0.1 mm
追い込み移動量	1 mm
繰り返し回数	30 回
加工ストローク数	10 min-1

no shock-line

digital servomotor press

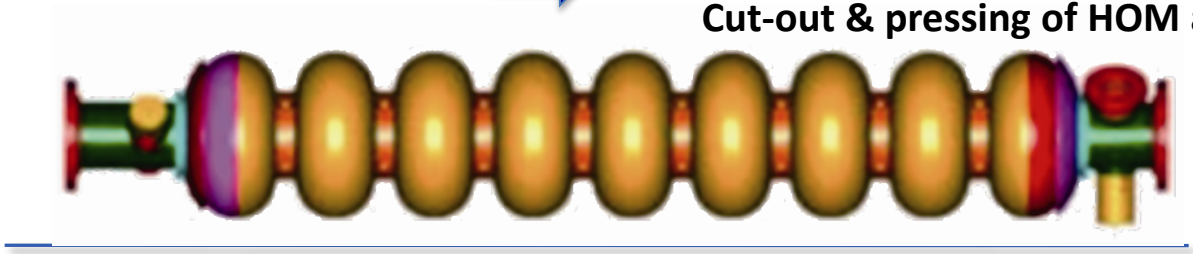


Pulse motion press

from Amada presentation

Press machine application

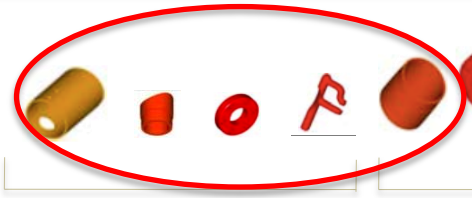
Deep drawing of HOM-cup, beam-pipe
Burring of beam-pipe
Cut-out & pressing of HOM antenna, etc



Short End group

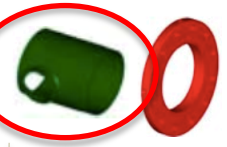
EBW １２ヶ所

End cell : short side

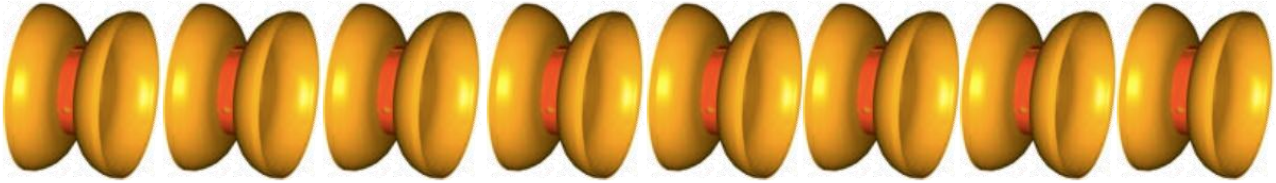


HOM1

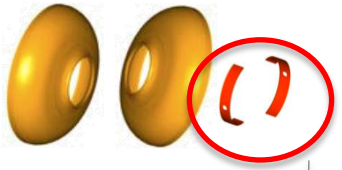
input port



beam pipe

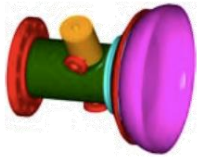


Dumbbell x8

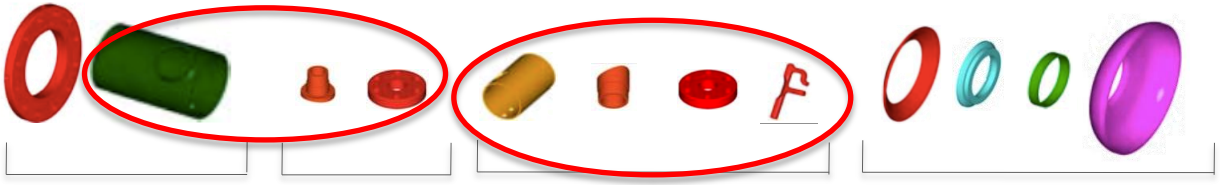


× ８組

center cell x8



Long End group



beam pipe

pickup port

HOM2

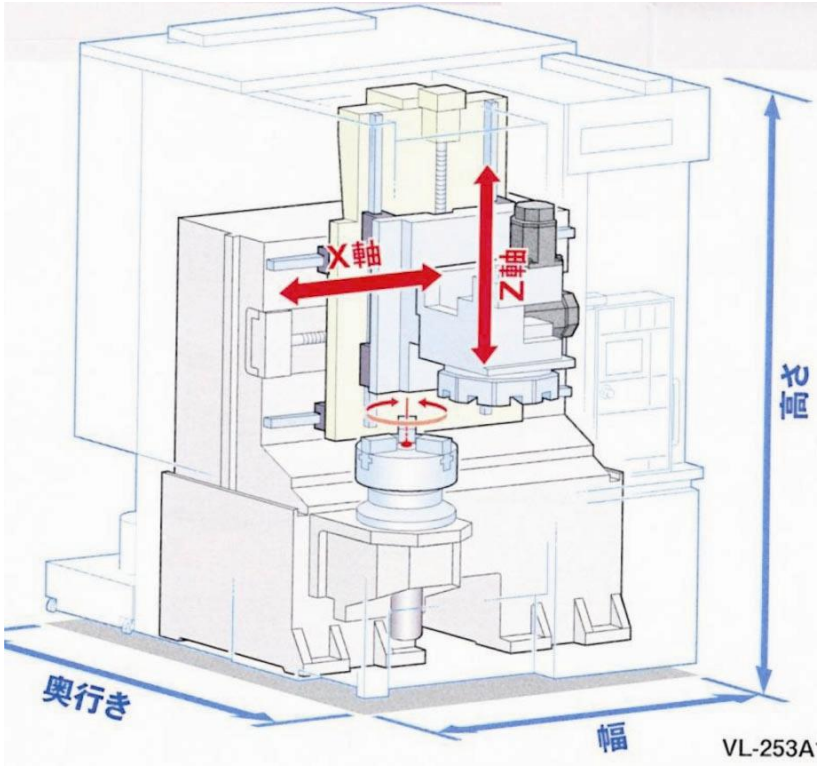
End cell : long side

Cavity Fabrication (TESLA Cavity)

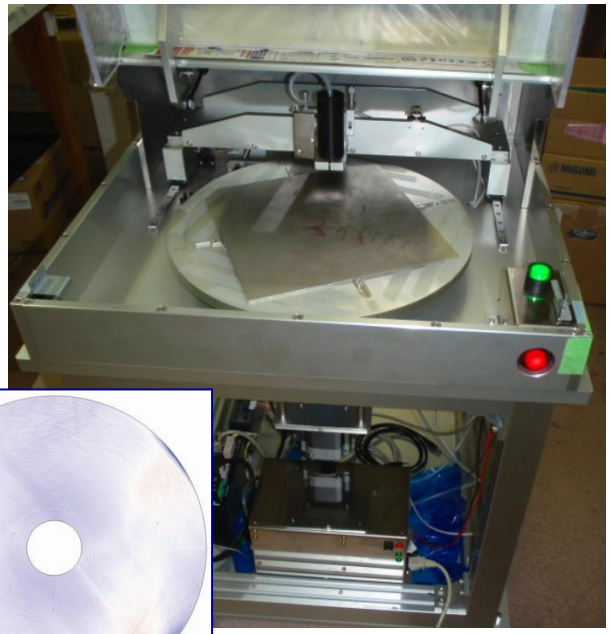
56 parts: Nb (RRR>300)= 46, Nb-Ti = 10, by press, burring, machining
75 Electron Beam Welding (EBW) place

Cell trimming machine

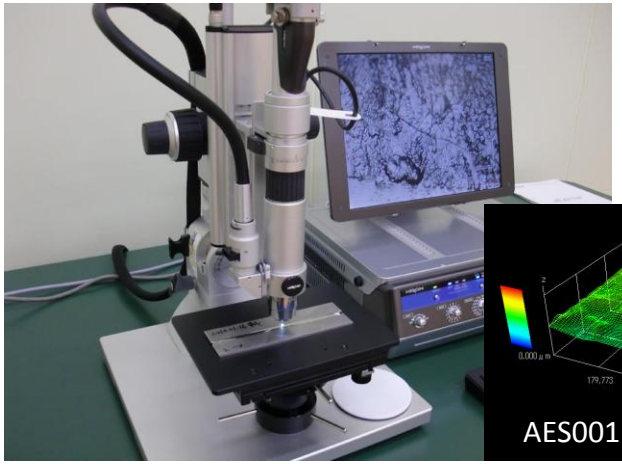
cell cup is held in horizontal plane, and rotate.



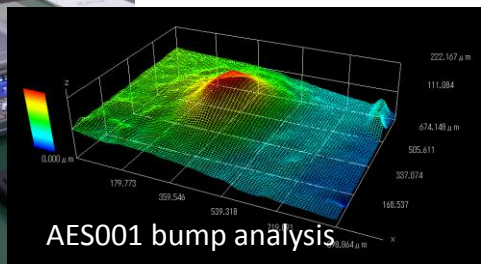
inspection instruments for fabrication support

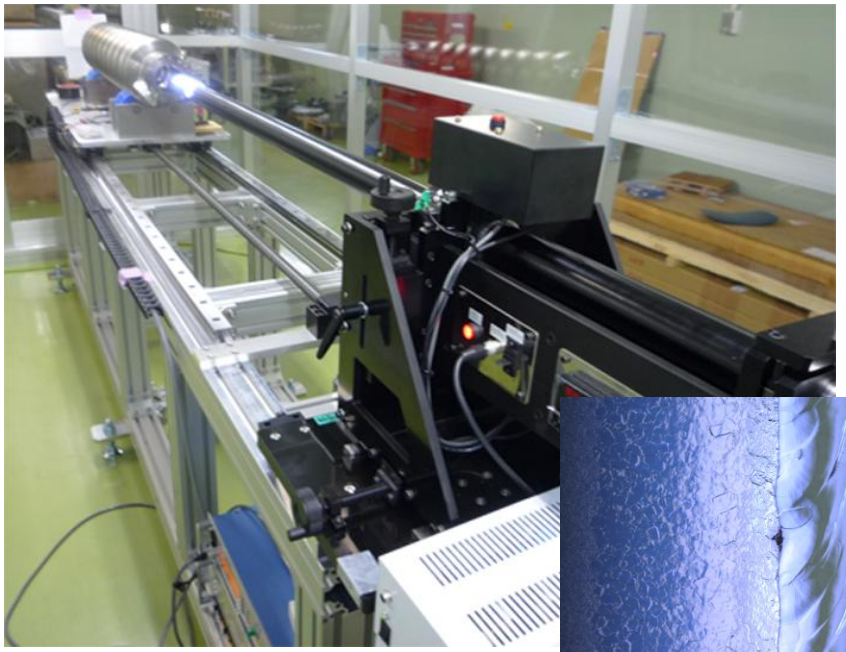


eddy current scanner



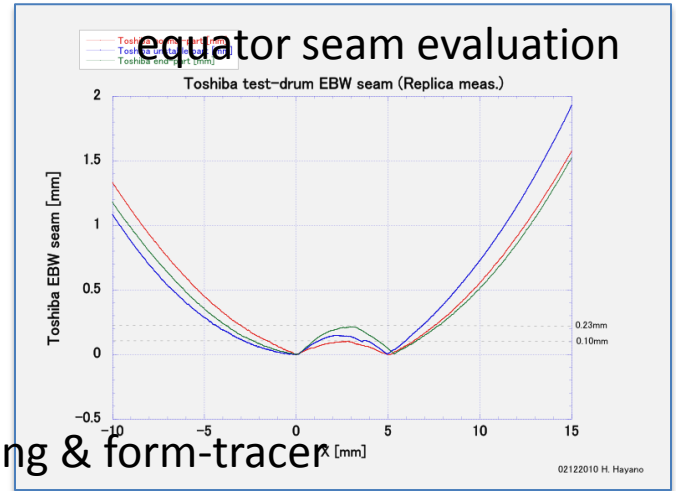
optical 3D profiler





inner surface inspection

equator seam evaluation



molding & form-tracer

2009 installation

Clean room construction
EBW performance was surveyed, bidded, and ordered
press machine
trim machine
optical instruments, eddy current scan for inspection
infra-structure (water, compressed-air, N_2-gas, etc)

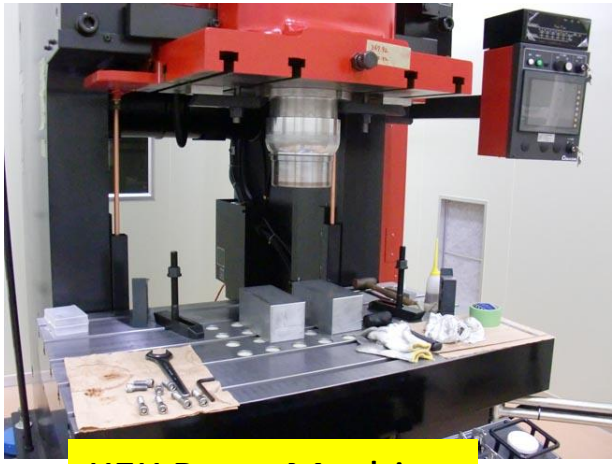
2010-2011 installation

EBW
Jigs of EBW
Chemical Polish system
Jigs of deep-drawing and burring
3D coordinate machine
microwave measurement system
control & data-base system

EBW, Press R&D were started

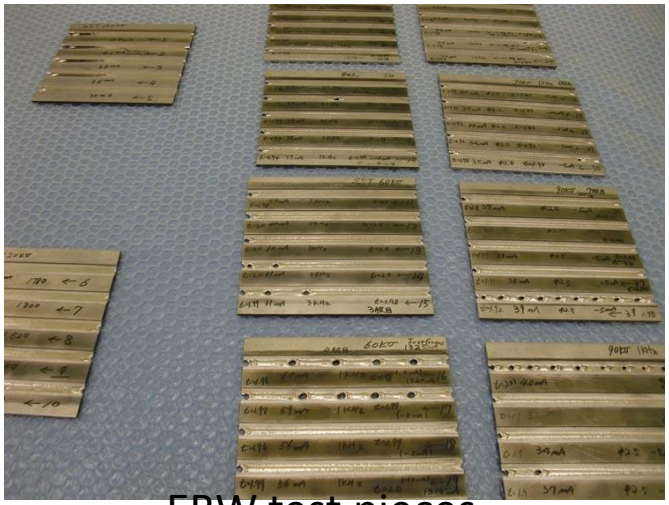
Tosei-electrobeam co.
SST EBW

Tosei-electrobeam co.
Mitsubishi-EBW



KEK Press Machine

using EBW Job-shop

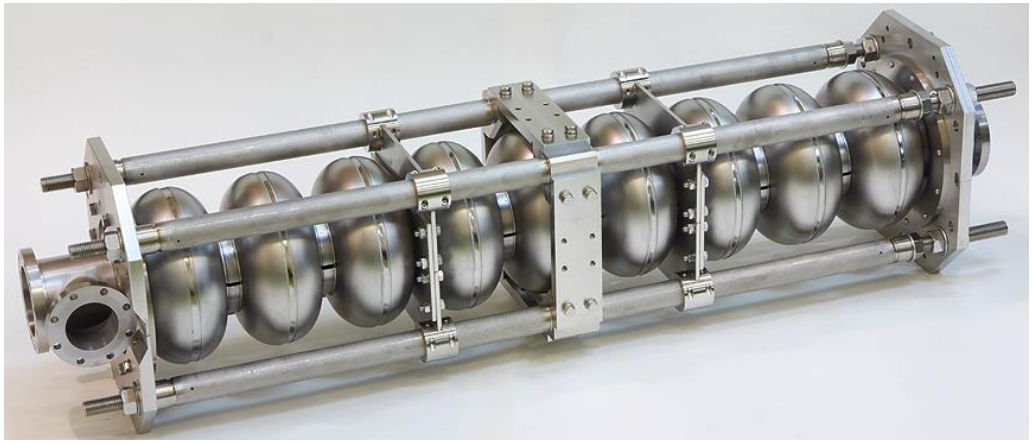


EBW test pieces

Press test cells

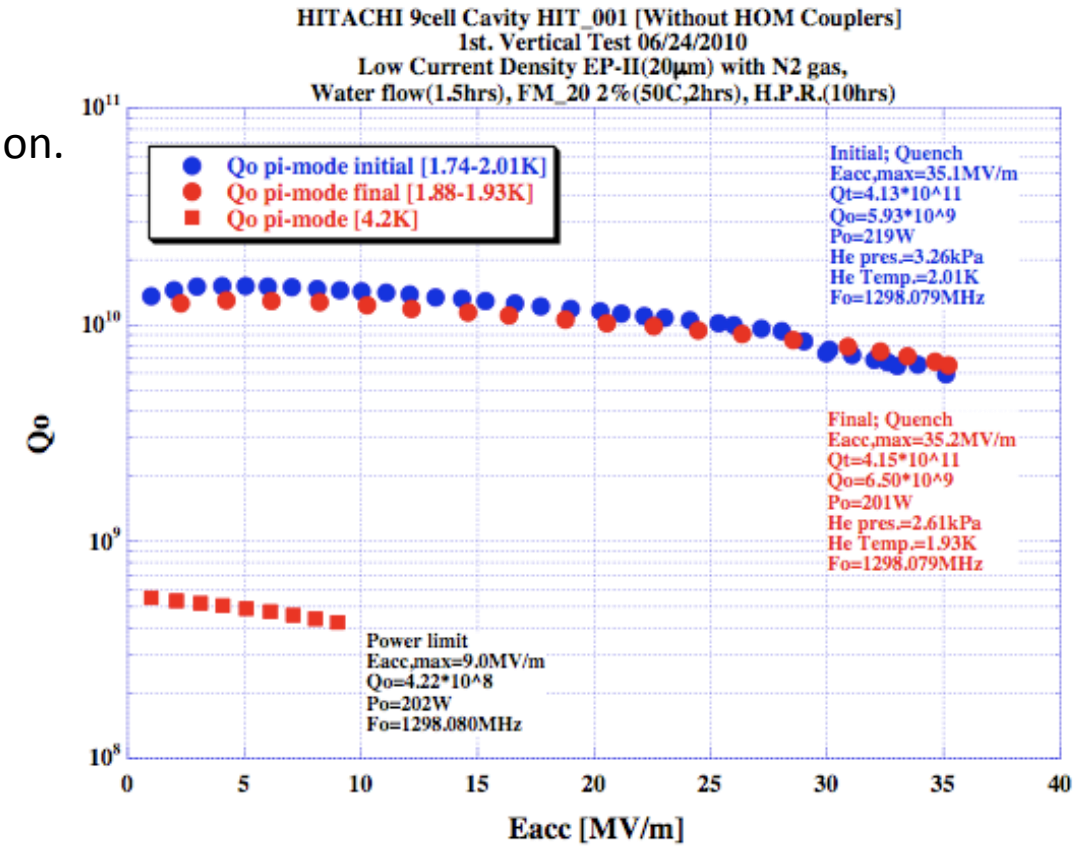
Vender development

KEK-Hitachi collaboration



2009: 9 cell cavity w/o HOM
fabrication.
Preparation of
High-pressure-code application.

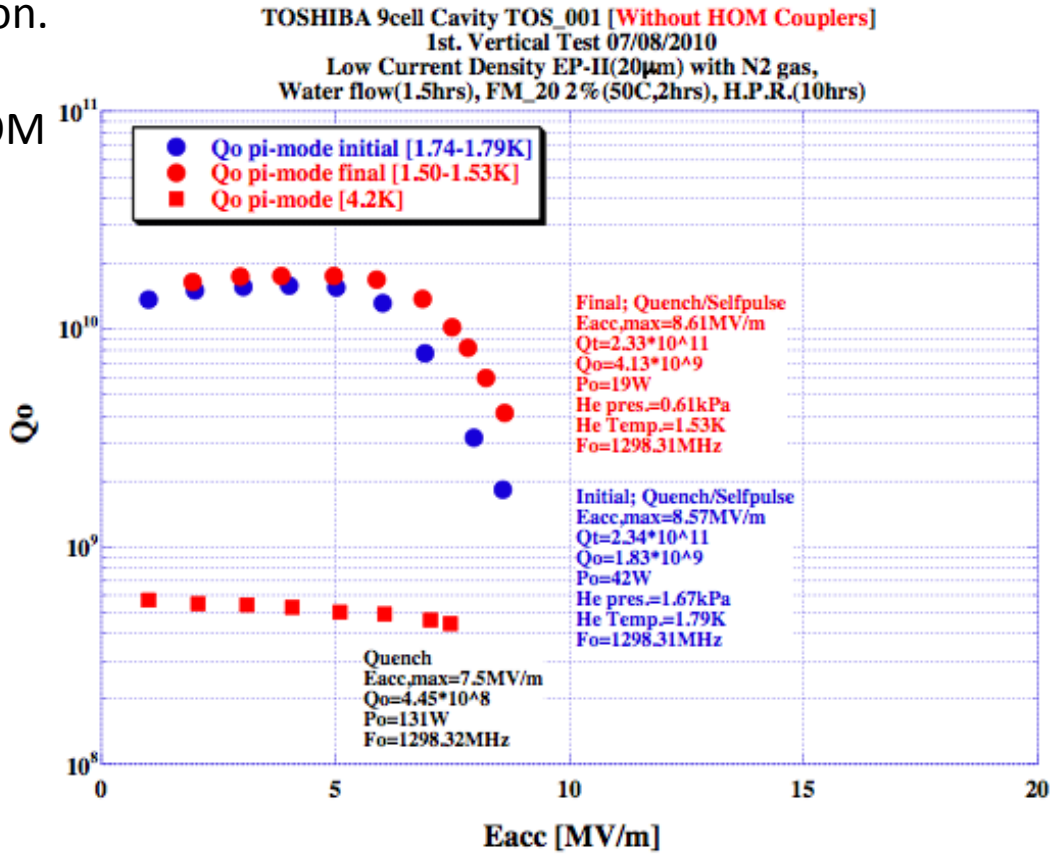
2010: HOM fabrication, and
preparation of the next
full-spec. 9 cell cavity.



KEK-Toshiba collaboration

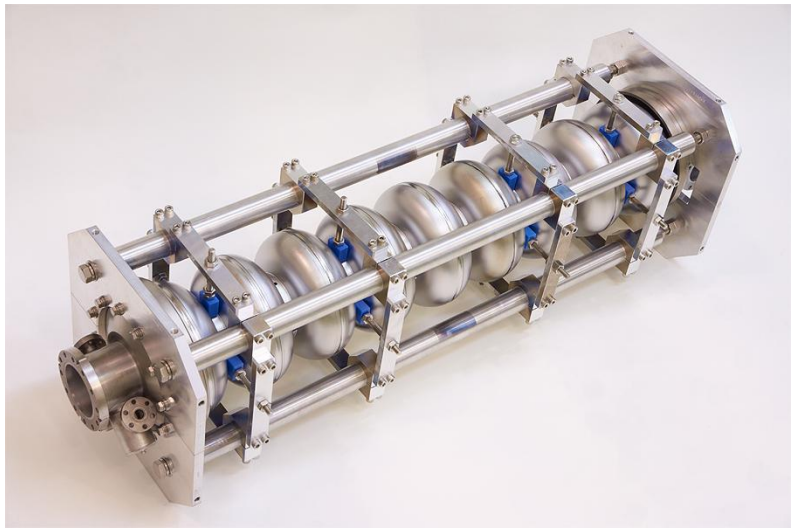
2009: 9 cell cavity w/o HOM
fabrication.
Preparation of
High-pressure-code application.

2010: one more 9 cell cavity w/o HOM
fabrication.
HOM fabrication, and
preparation of the next
full-spec. 9 cell cavity.

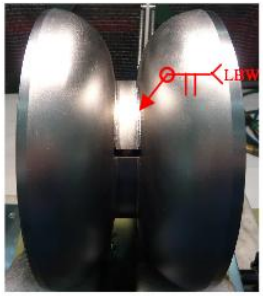


KEK-MHI development for cost-effective fabrication

MHI-A cavity



Deep drawing of HOM cup,
Laser beam welding,
more smooth EBW seam



MHI trial of cylinder forming to dumbbell by spinning

Summary

KEK cavity fabrication facility (R&D of EBW and press (deep drawing))

Project was started in 2009,
Housing was completed, Press machine and trimming machine was delivered.
EBW machine delivery is scheduled on March 2011.
produce 1 cavity by using EBW Job-shop in 2010.
produce several cavities by KEK EBW, then put into STF phase2 cryomodule.
Collaboration with press-company for deep drawing, burring, and cut-out forming is started.
Industry participation will be after EBW machine delivery.

Collaboration with industries

Hitachi, Toshiba: 2009-2010 two years collaboration
MHI: total 11 cavities were fabricated. 11 more cavity fabrication by contract was started.
During this fabrication, cost effective fabrication will be pursued.