Cavity activity at KEK

H. Hayano (KEK)

Cavity R&D : TESLA shape, LL shape, single cell, Hydro-forming

STF Facility : EP, CP, HPR, UPW, clean room, pre-tuning, vertical stand, coupler test stand, inner surface inspection

EDR plan : plans for 2008, 09, 10, 11

Status of Cavity R&D

TESLA shape cavities : total 6 9-cell cavities

	# of EP-proc.	Final Eacc,	Q,	status
BL-#1:	4,	20.7MV/m,	1.6E10	: dressed&waiting for installation
BL-#2:	5,	29.4,	2.0E10	: dressed&waiting for installation
BL-#3:	2,	20.1,	2.6E10	: installed in cryomodule
BL-#4:	3,	20.2,	1.9E10	: dressed&waiting for installation

BL-#5: under fabrication

BL-#6: under fabrication

LL shape cavities : total 8 9-cell cavities

LL-#0(SBP):	4,	27,	?	: 29.3MV/m(Q=1.0E10) at 2nd EP, modified to new SBP.
LL-#1:	4,	19,	4E9	:installed in cryomodule.
LL-#2:	1,	12.4,	1.1E10	:modified to new SBP.
LL-#3:	1,	---	----	: cold leak & used for tuner test.
LL-#5(SBP):	2,	12(<-22),	3E9(<-1.7E10)	:KEK made new-ICHIRO. went to JLAB.
LL-#6(SBP):	1,	12,	1.6E10	:PAL made new-ICHIRO.

LL-#7: new-ICHIRO under fabrication to be installed in cryomodule.

LL-#8: new-ICHIRO under fabrication to be installed in cryomodule.

SBP=simple beam pipe(no input port, no HOM couplers, no antenna port)

Status of Cavity R&D cont.

1 cell Cavities :

- **gradient, gradient spread study : total 17 cavities**
  - **IS#2 - #8, CLG#1-#2 : best gradient spread 46.7+/-1.7MV/m**
  - **IS#9 - #16 : CBP underway.**
- **end group study : total 5 cavities**
  - **ISE#1-#5 : studies of end-group effect underway.**
- **collaboration work with PAL, IHEP, etc.**

Hydro-formed cavity R&D

- **3 cell fabrication test : material preparation underway.**

Status of Cavity Package R&D

Dressed Cavity into Cryomodule :

TESLA shape cavities: total 4 dressed, 1 is in the cryomodule.
BL-#3 : in cryomodule, BL-#1,#2,#4 : waiting for installation.

LL shape cavities : total 1 dressed, extracted from cryomodule for leak survey and repair.
LL-#1 : under leak survey,
LL-#7,#8 : to be installed in cryomodule.

Tuner R&D

Slide Jack Tuner test : total 4 fabricated,
1 is waiting for cryomodule cool-down test.

Ball screw Tuner test : total 2 fabricated,
1 was tested at 100K.
Another 1 on LL-#1 will be in cryomodule after repair.

Coupler R&D

Two disc window coupler test : 4 fabricated, 4 powered.

Capacitive coupling coupler test : 4 fabricated, 3 powered.
1 was window break.

Status of Facility construction

Existing Facility in 2004-05 :

AR-East Building, Mechanical Eng. Center, Nomura plating Co.

CBP, HPR, PW, clean room, vertical test stand, pre-tuning (AR-East)
anneal furnace, EBW for 1 cell, hydro-forming (Mechanical center)
EP, CP, UPW, HPR (Nomura)

New Facility in 2005-07 : completion middle of 2008.

STF developments

EP, CP, UPW, HPR, clean room, vertical test stand,
pre-tuning(modified from J-PARC SCC), HOM study stand
automated pre-tuning,
coupler test stand (#1 klystron-modulator),
He Refrigerator (moved from AR-East),

Other R&D

Surface inspection (Kyoto-university)

EDR plan

STF Phase 1 (2005 -2008),

for quick startup of ILC SCRF, infra-structure development

subdivided to

Phase 0.5 : 1 cavity in each short cryostat (cool down:Nov. 2007)

Phase 1.0 : 4 cavities in each short cryostat (cool down:Apr. 2008)

Phase 1.5 : ??? (More cool down test in 2008?)

Cavity shape selection for STF 2 : Discussion is on going.
Decision within 2007.

STF Phase 2 (2008 - 2011), develop an ILC Main Linac RF unit

start design Apr. 2008 (with selected cavity shape, High pressure regulation)

fabrication & vertical test in 2009 and 2010 (for 28 cavities)

completion end of 2010

operation in 2011

??STF Phase 3 (2011 - 2015), demonstrate 3 more ILC ML RF units

GDE S0 task (2006 - 2009) develop ILC performance cavity

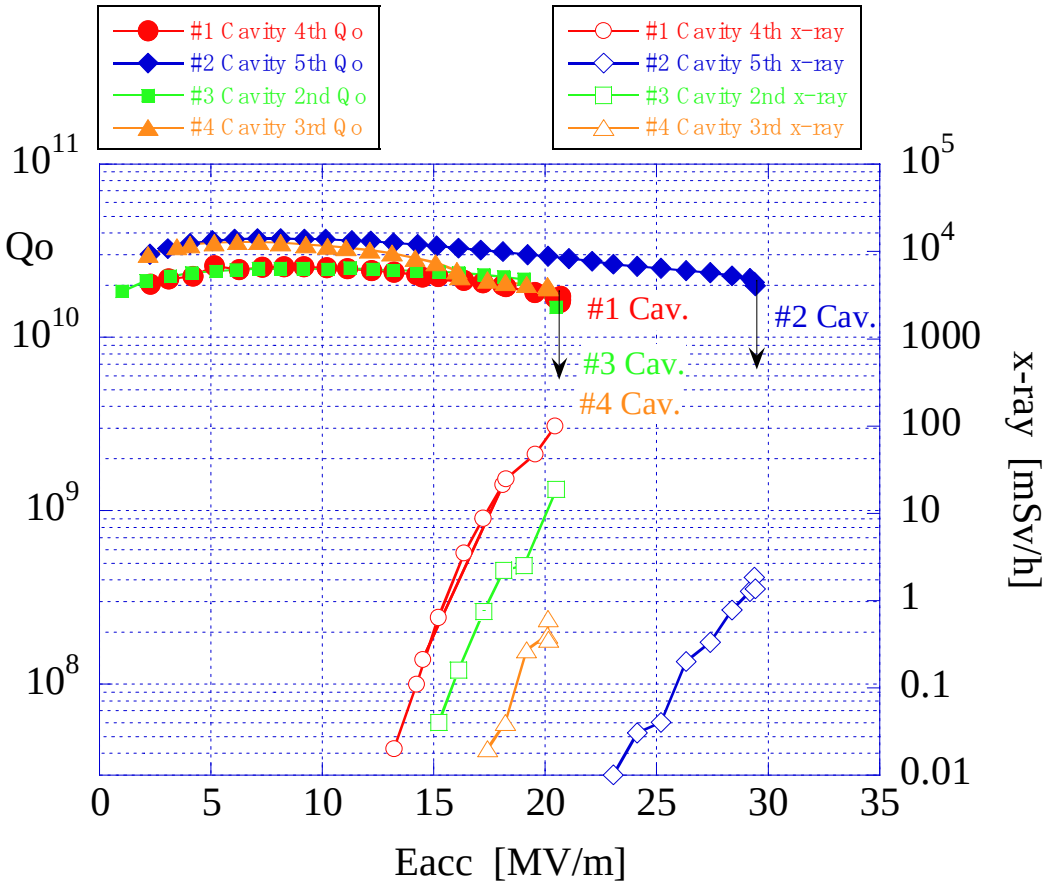
participation to S0 tight loop: 2007-2008

(KEK newICHIRO#5, ; FNAL AC6, AC7, ; DESY AC115, AC118, (AC116))

production-like study: KEK 10? cavities in 2008-2009

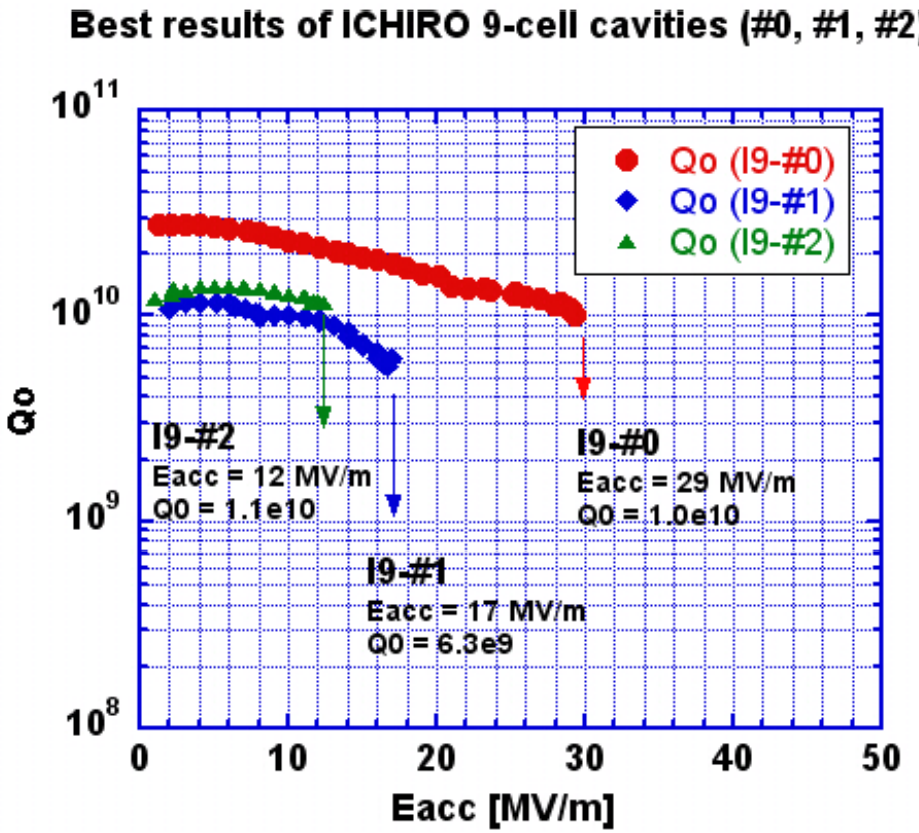
Summary of TESLA shape cavities

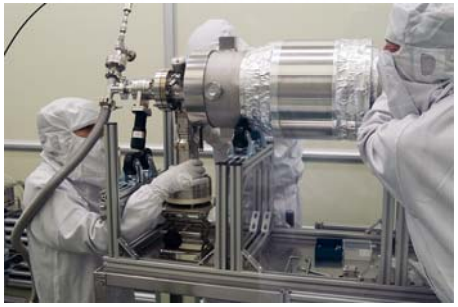
Gradient Performance



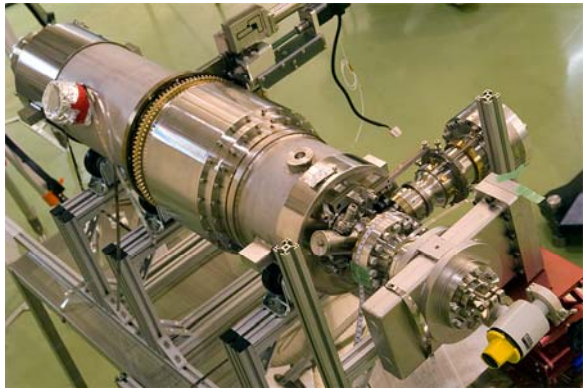
4 TESLA-style cavities (MHI) were processed, and jacketed.
One of them is already installed into cryomodule.
The other 3 are waiting for STF1.0 installation.

Summary of LL shape cavities





STF 0.5 assey



#0 : without HOM /input port

4 EP, 16 measurement

-> reached to 29MV/m,

Now under modification of end-group.

#1 : with HOM /input port

4 EP, 8 measurement

-> reached to 19MV/m

-> STF 0.5

#2 : with HOM /input port

1st measurement

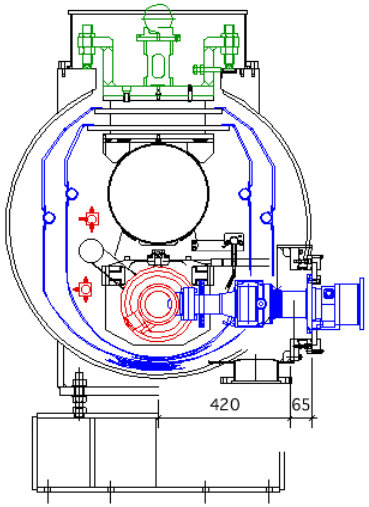
-> reached to 12.4 MV/m

#3 : with HOM /input port

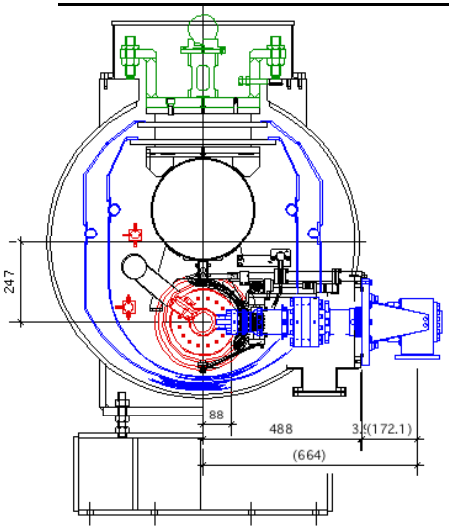
cold leak after 1st EP,
no vertical test was done

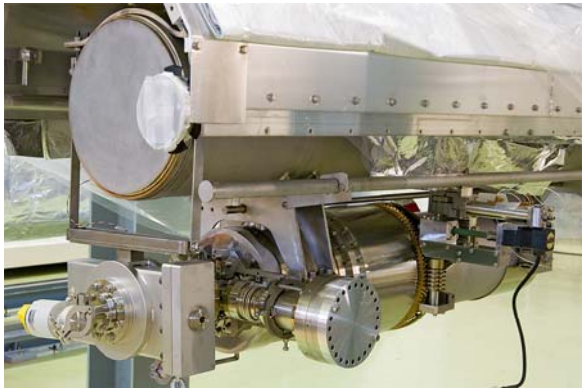
Cavity Installation into Cryomodule

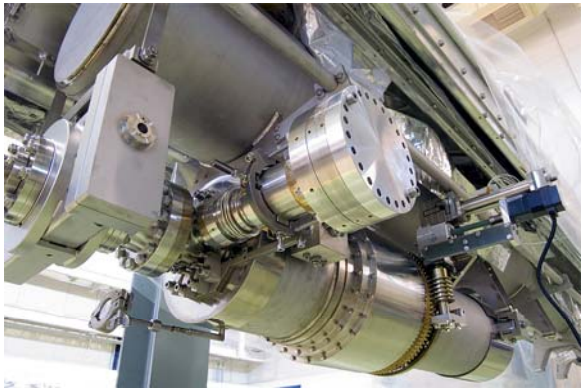
One TESLA shape Cavity, One LL shape cavity are installed into STF phase1 cryomodule. (STF Phase 0.5)



TESLA shape Cavity



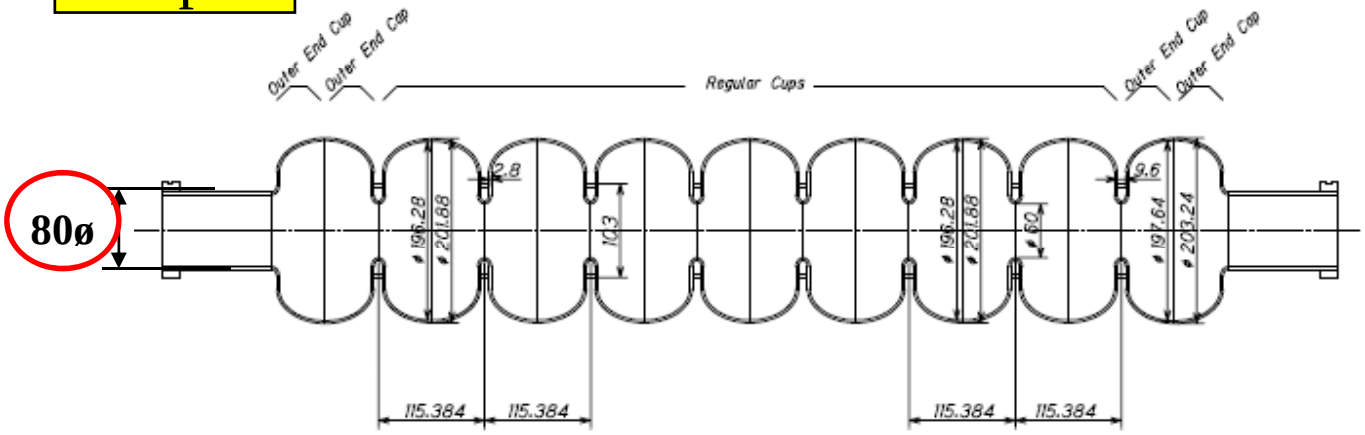




LL shape Cavity

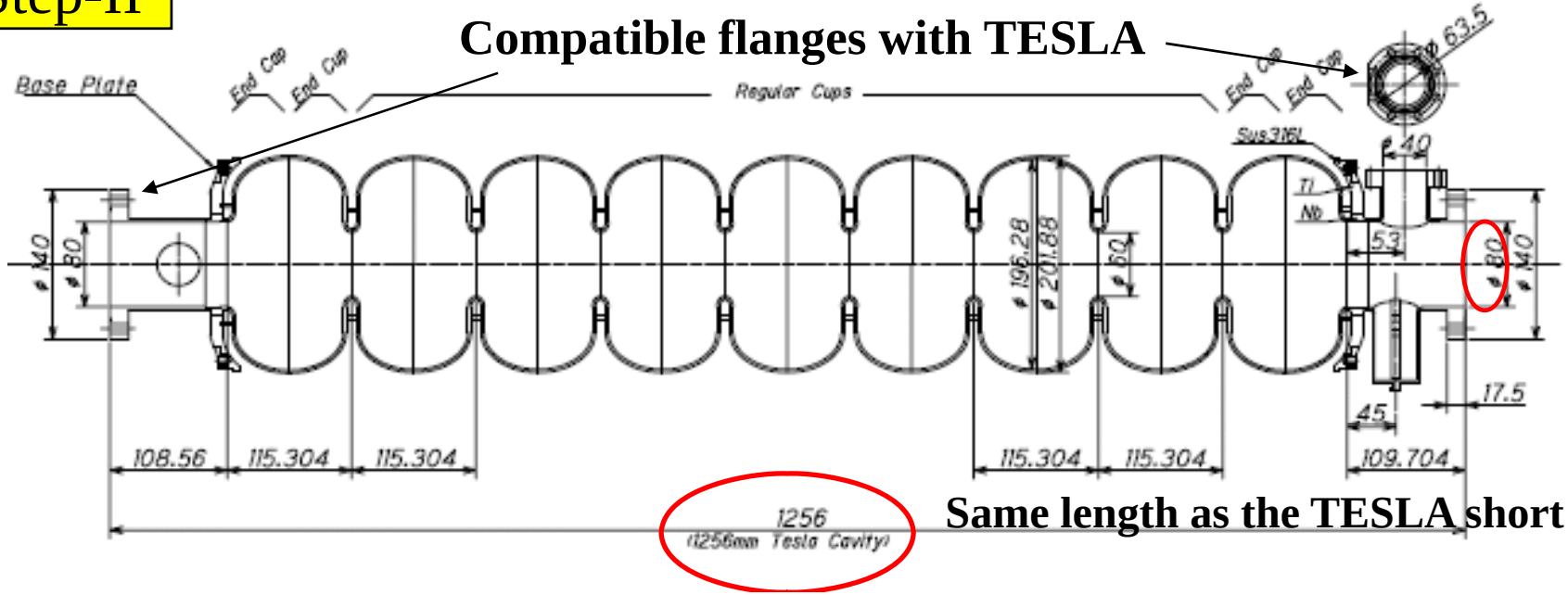
Improving steps of LL ICHIRO cavities

Step-I



Step-II

Compatible flanges with TESLA



Same length as the TESLA short

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Cavity treatment study using Single cell

Ichiro single cell in EP bed

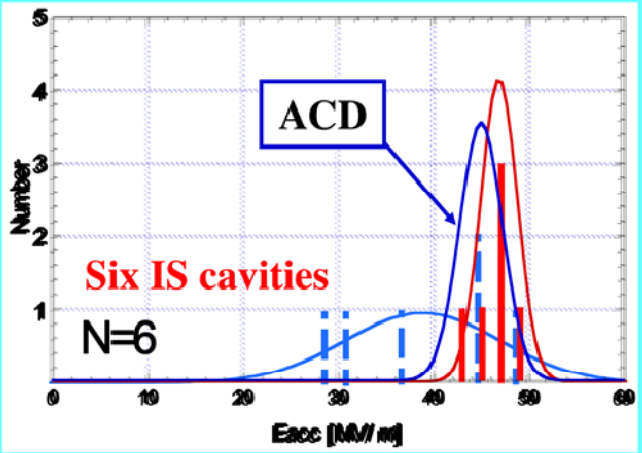
Statistics : 6 Ichiro single cell cavities

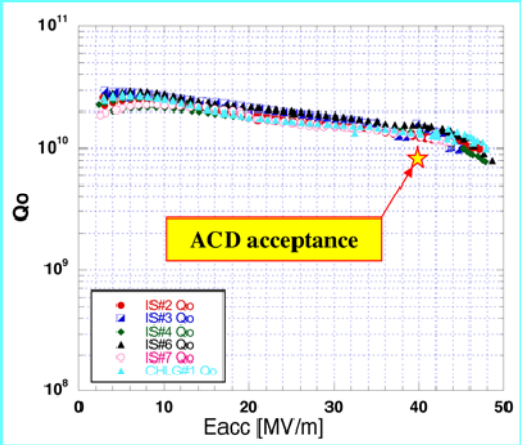
EP(80 um) + EP(20um) + EP(3 um, fresh EP acid)

EP(80 um, tank) + EP(20 um, tank) + EP(3μm, fresh EP acid) + HF + HPR + Baking

Ave. Eacc = 46.7±1.9MV/m

Scattering 5%





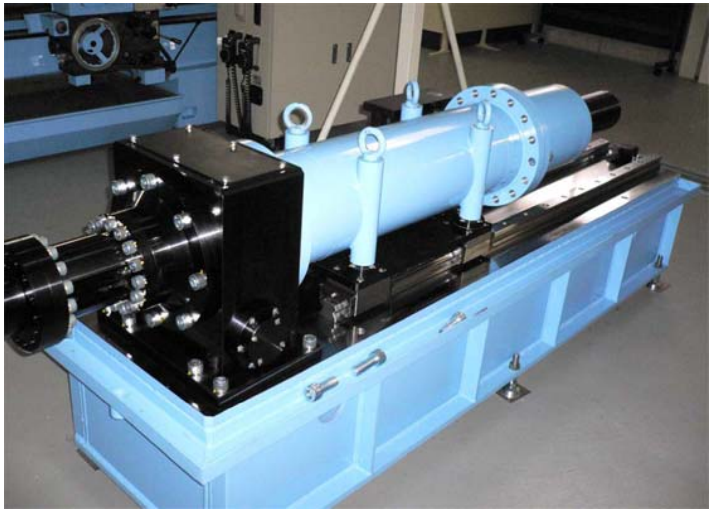
First trial yield rate (Eacc>40 MV/m) = 100%

11

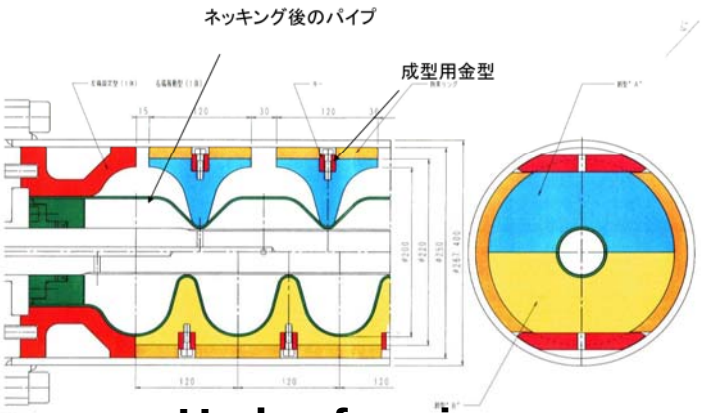
* JLAB degreaser is also tested, and statistics underway.

R&D of Cavity fabrication using Nb/Cu hydro-forming technology (mechanical center)

Necking machine



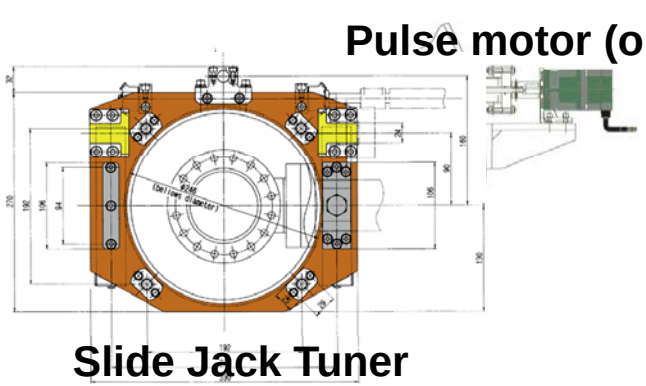
Hydro-forming machine

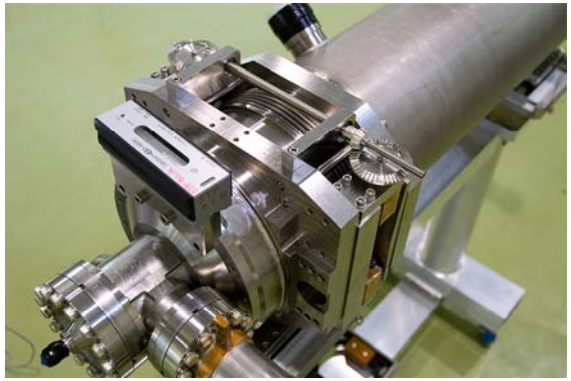


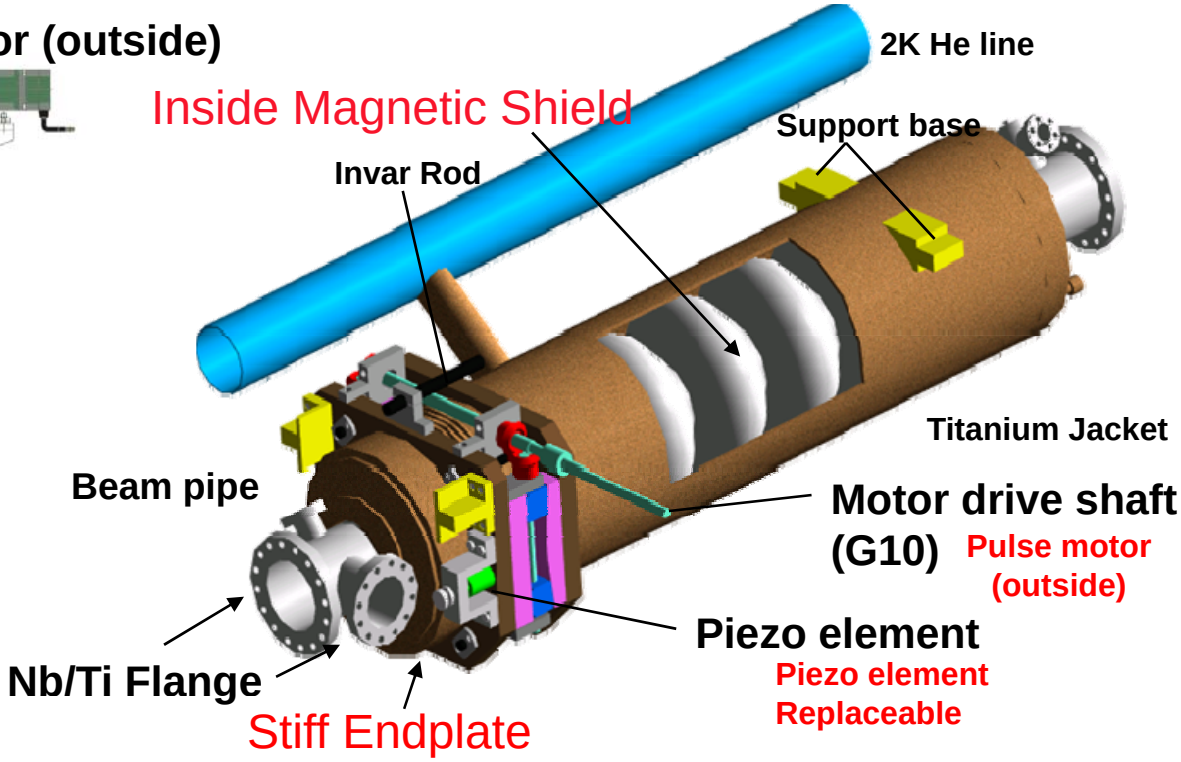
Hydro-forming

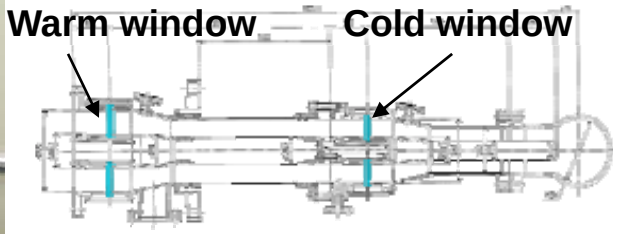
Formed Cu cavity test pieces

TESLA shape Cavity package





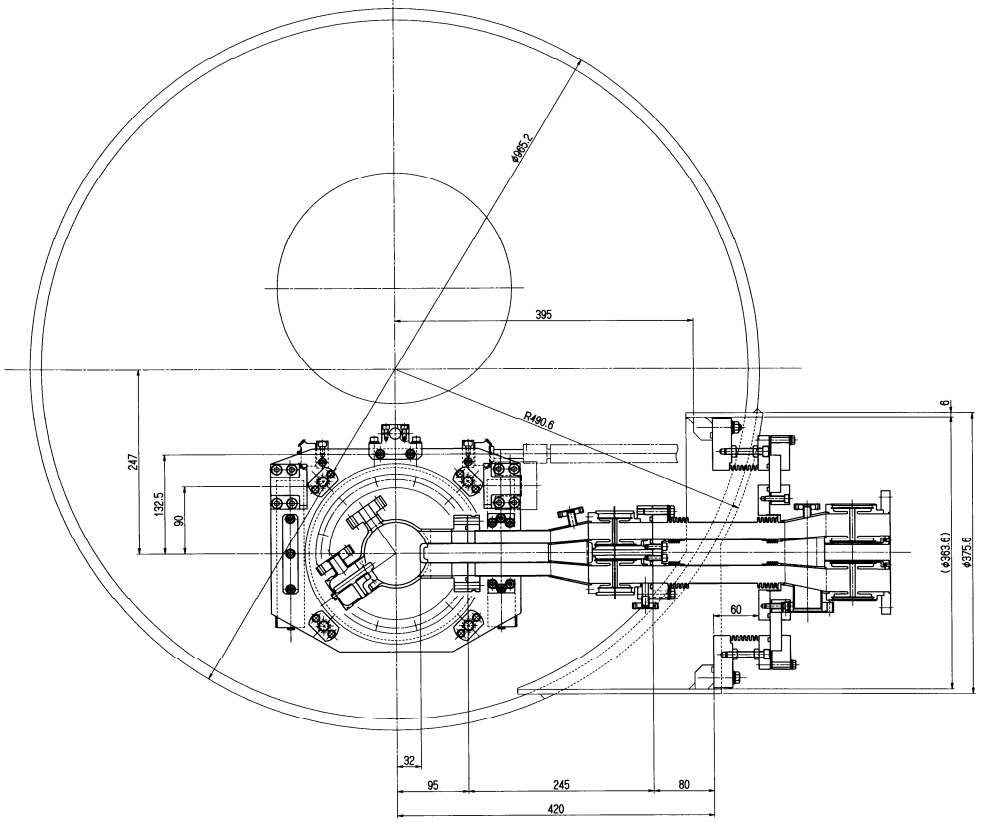


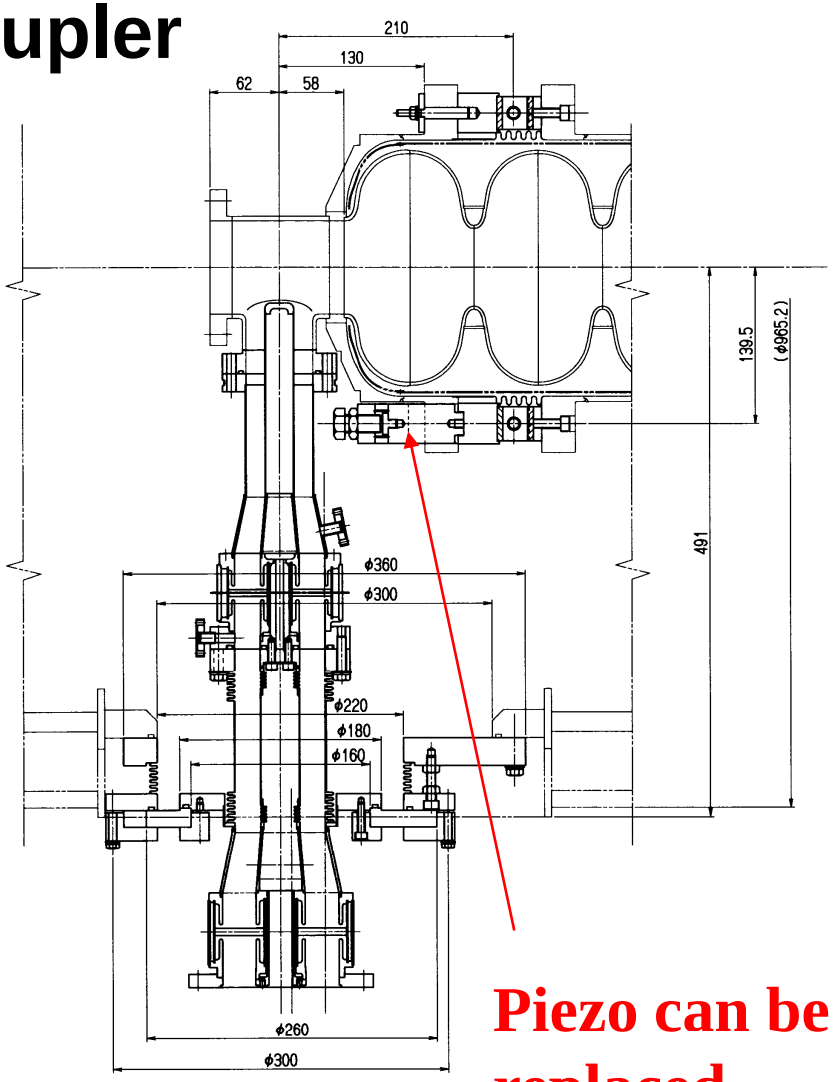


Fixed Coupler

Processed power
1.0MW 1.5ms width
1.4MW 0.5ms width

Two disc Window Coupler Installation



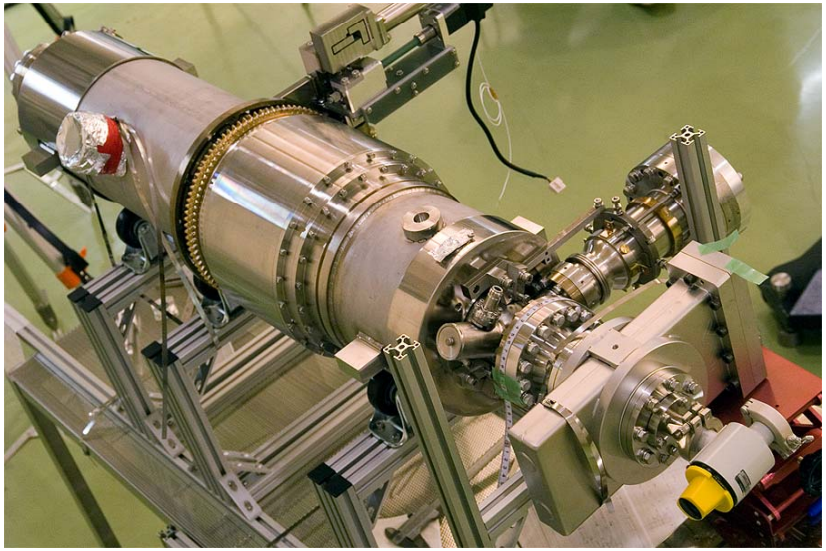


Piezo can be replaced through this hole.

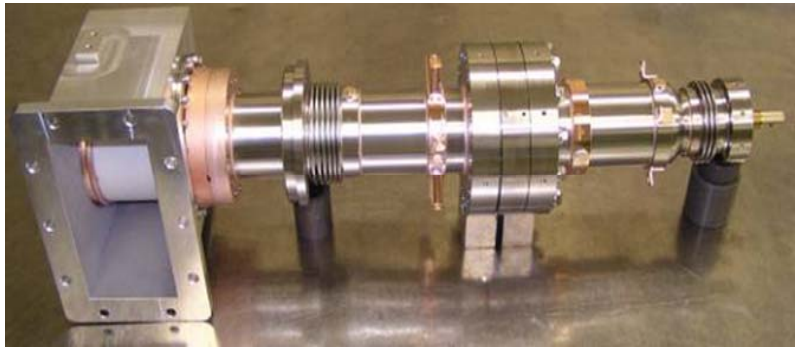
Coupler heat loss

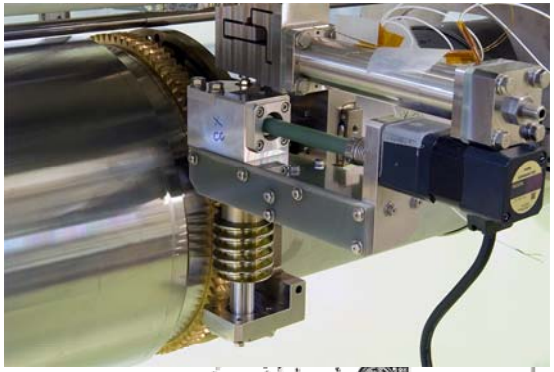
	80 K	5 K	2 K
Static Loss	5 W	1.1 W	0.05 W
Dynamic Loss	3 W	0.2 W	0.03 W

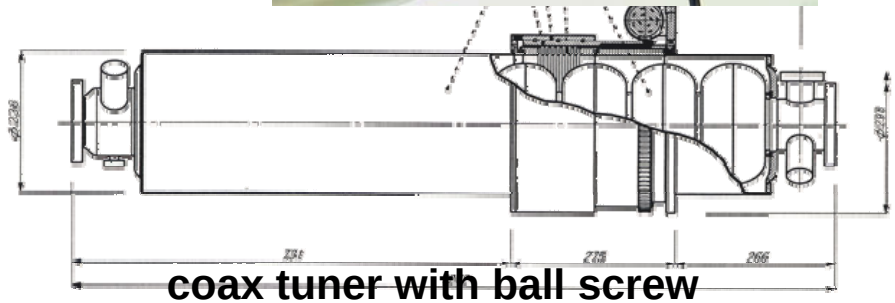
LL shape ICHIRO Cavity package



Input Coupler using capacitive coupling at window







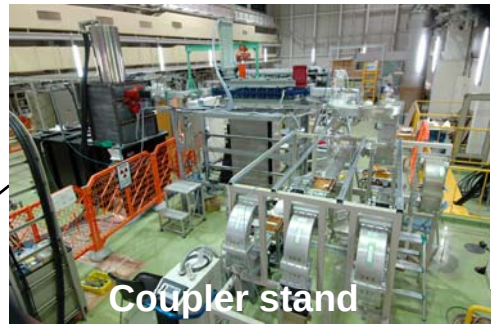
coax tuner with ball screw

Successfully demonstrated the high power performance up to 2MW!

The specification: 500kW, 1.5msec, 5Hz @ 45MV/m operation

New STF Facilities

STF棟（旧陽子リニアック棟）　平面図



Control room
制御室

Cryogenic System (from AR-East)

10m x 10m

5m x 15m

Cryogenic Compressor (from AR-East)

Common Assembly/work Area

cryogenic pumping area

Kly + Mod. (coupler test, RF Gun)

Kly + Mod. (phase1 Cavity)

New 10MW Kly + Mod. (3 cryomodule)

coupler test stand

Klystron Gallery

Vertical Test Area

10t crane

vertical hatch

Laser room

HPR

EP bed

EP PS.

CP, USC, CL

pure water system

Tank

2t crane

1st crane

Clean Room for cold mass assembly

7m x 25m Clean rooms

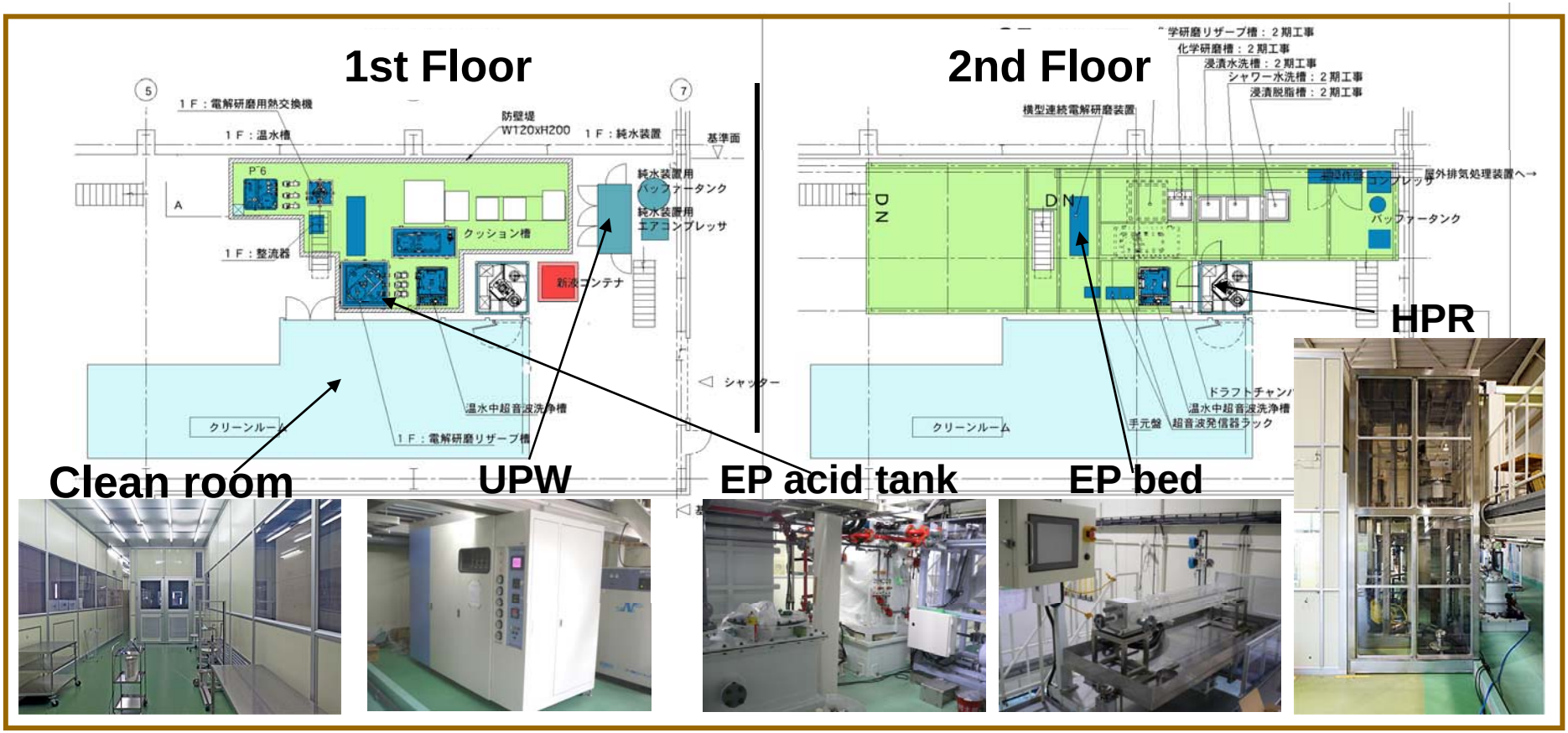
Cold mass assembly

Cryomodule Assemble Area

V7.2 H. Hayano, 7/10/2006

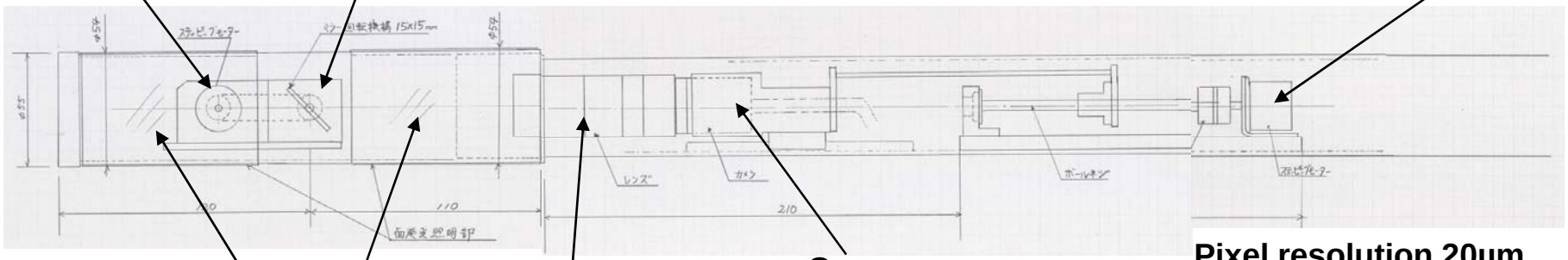
STF Cavity Surface Process Facility

Clean room: in operation for use of short cryomodule assembly.
UPW: in operation.
HPR:under construction. almost completed.
EP : under construction. will be completed in Oct. 2007.
External acid tank system: will be constructed in fall 2007.
Additional EP system for KEKB-SC&crab cavity: will be done in JFY2008.
CP: will be constructed in JFY2008.



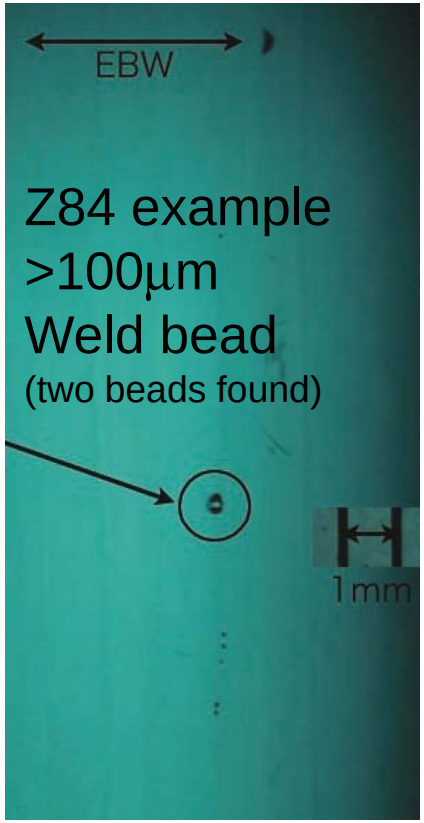
Inner Surface Camera development

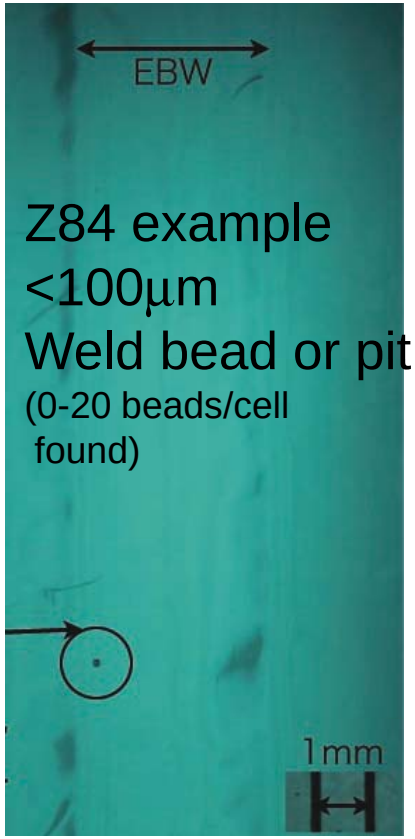
at Kyoto University



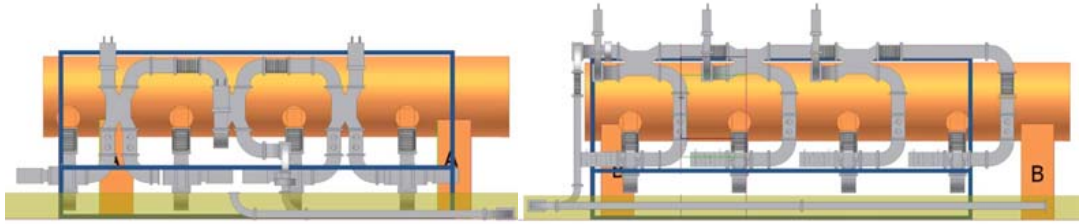
Pixel resolution 20μm

Scan test
Using Z84

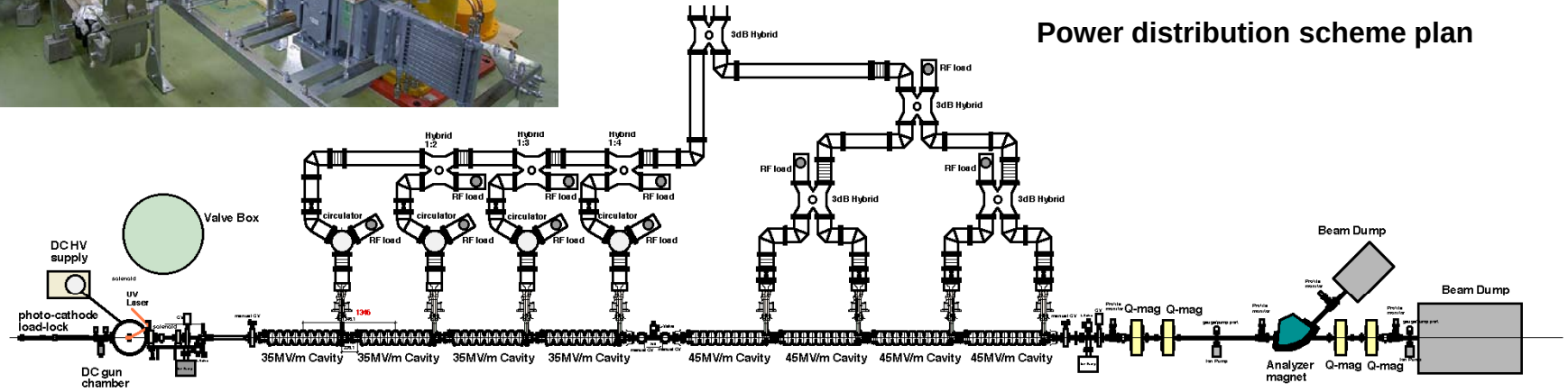




STF Phase 1 beam-line Plan



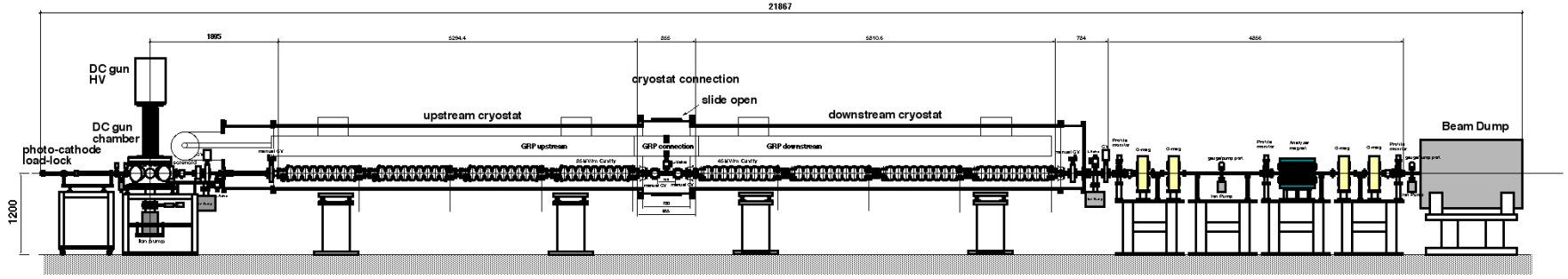
Power distribution scheme plan



Plain view

Tree distribution without circulator

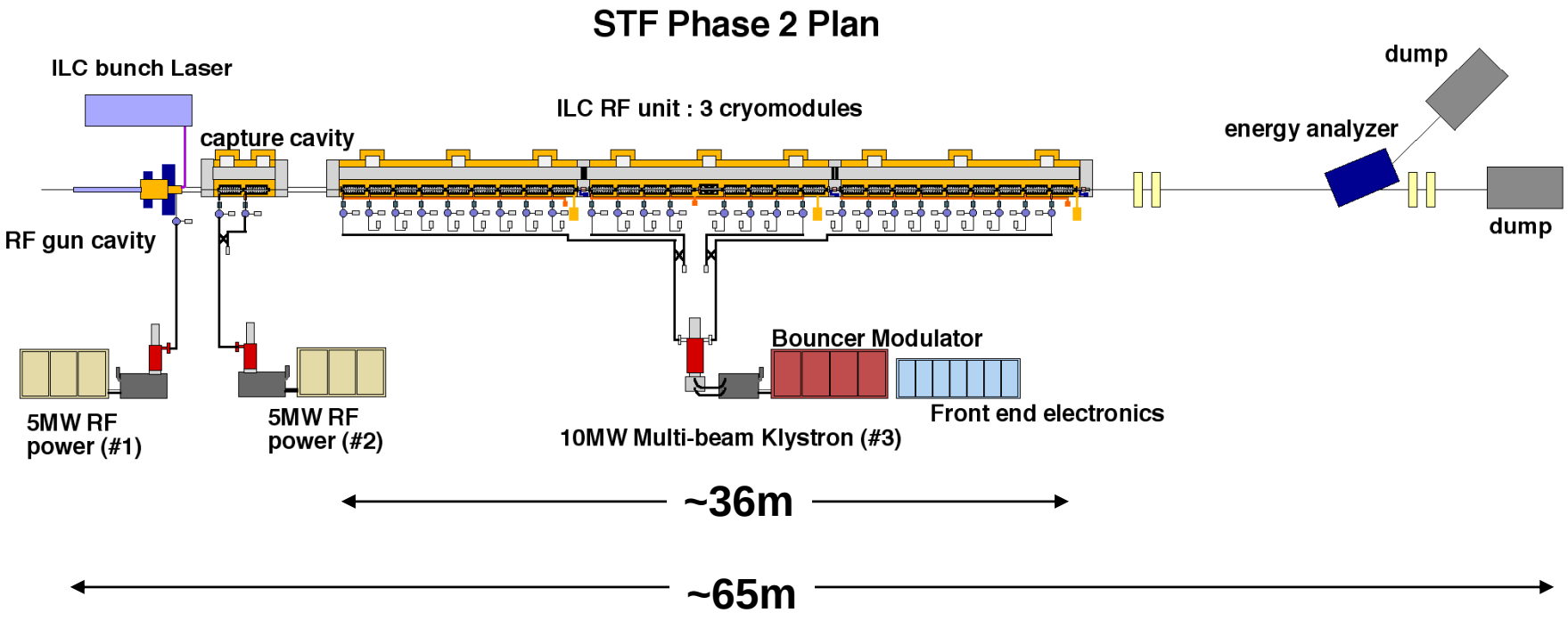
Photo-cathode DC-gun



Side view

H. Hayano
01/12/2006 V4.0

Plan of STF Phase 2 beam line



*detail design is not yet done.
(just for imagination)

End of slides