HLRF
S1-Global Preparation

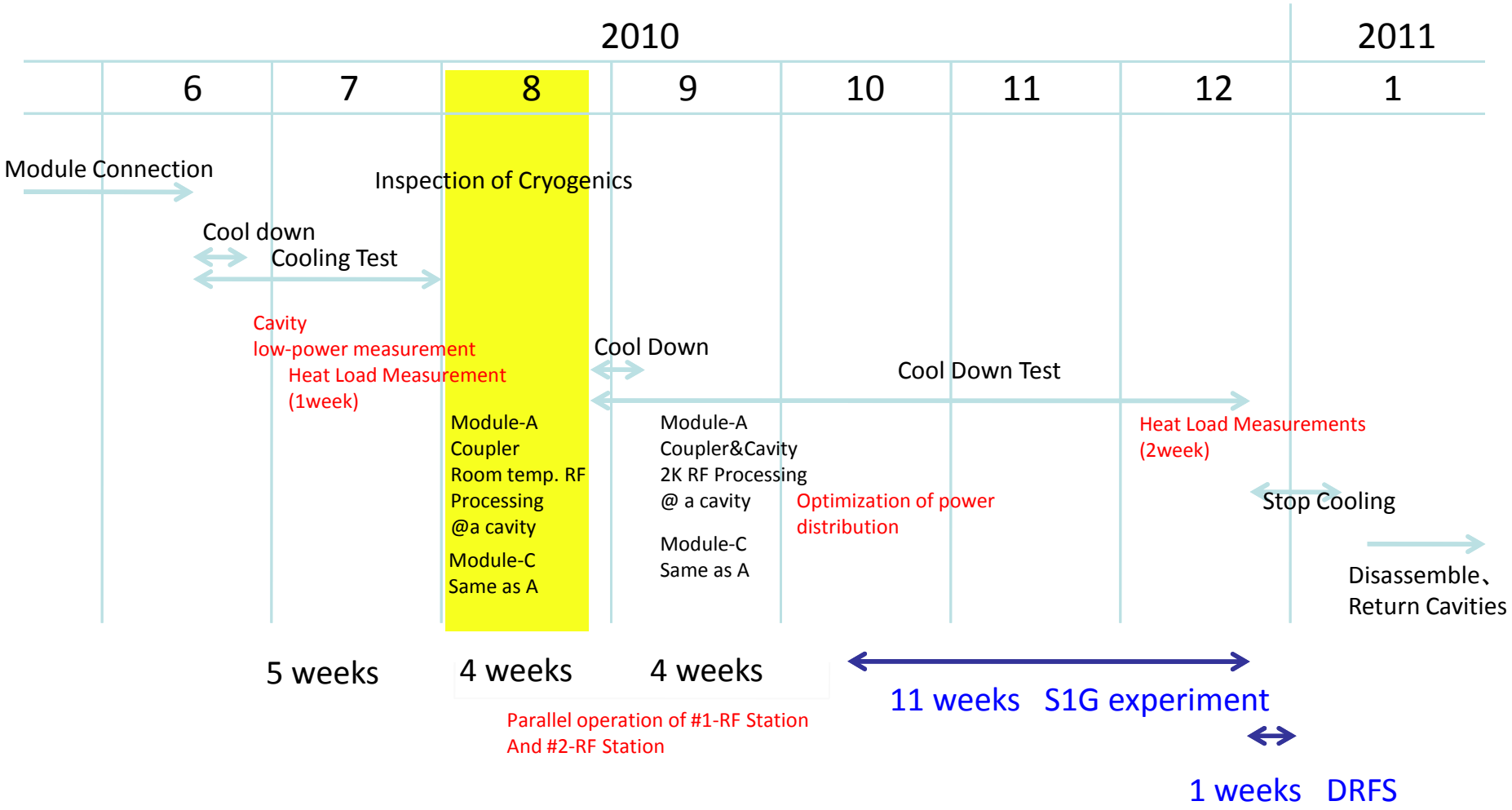
KEK
S. Fukuda

Content

- Time Schedule of S1 Global in KEK
- Achieving Goal of S1-global
- HLRF and LLRF in KEK
- PDS Layout for S1 Global

Time Schedule and Contents of S1 Global

Proposed S1 Global Schedule (By Hayano)



IPAC2010
May23-28,Kyoto

ICHEP2010
July21-28,Paris

LINAC2010
Sep12-17,Tsukuba

Japan Acc. Meeting
2010

Procedure of Cavity with jacket (By Hayano)

Module C (INFN module)

8 weeks

2009.01~2010.02

Module A (KEK module)

9 weeks

2010.03~2010.04

Connection of Module C (INFN module) and Module A (KEK module) in the Tunnel

6 weeks

2010.05~2010.06

Contents of Test in S1 Global (By Hayano)

First Cooling and Test

1: Low Power Measurement of an individual cavity of 8 cavities

Q-value, Frequency, Coupler adjustment , Tuner adjustment, Response for piezo, Micro phonics, Mechanical vibration and HOM

4 weeks (2010.06-07)

3 Sets of NWA and CT (KEK,DESY,FNAL) ,Computer Control

2. : Thermal Load Measurements (static) 1 week (2010.07)

Second Cooling and Test

1: Lorentz Detuning measurements, comparison, correction survey

Preparation of auto-measurements software by LLRF group 4 weeks (2010.10)

2: Achievement of average maximum accelerating field and investigation of stability and failure rate after long operation. 4 weeks (2010.11)

3 : Thermal Load Measurements (static and dynamic) 2 weeks (2010.12)

4 : Demonstration of DRFS System 1 week(2010.12)

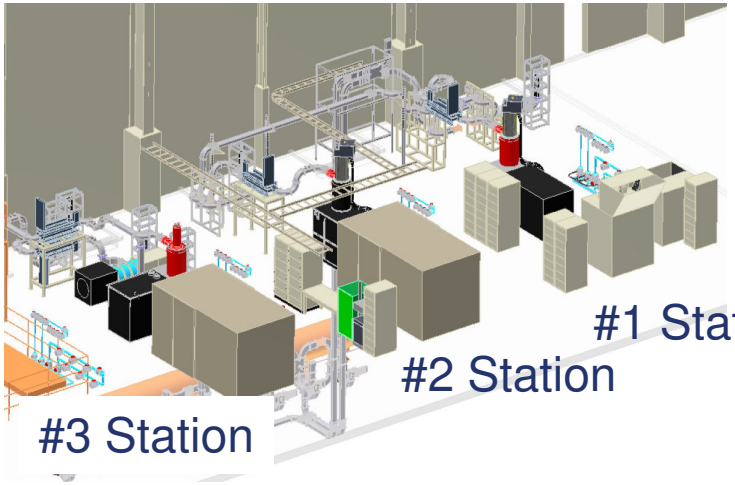
Purpose (Achieving Goal) of S1 Global

- SC Cavity Test under the Internal Collaboration
  - → Cavity Evaluation of 3 Region (US, EU and Japan)
- Achieving the Average Maximum Accelerating Field
  - → Cavity Evaluation of 3 Regions (US, EU and Japan)
  - → HLRF introduces Q adjustment mechanism and power adjustment mechanism to support this purposes.
- Demonstration of DRFS

HLRF &LLRF Configuration

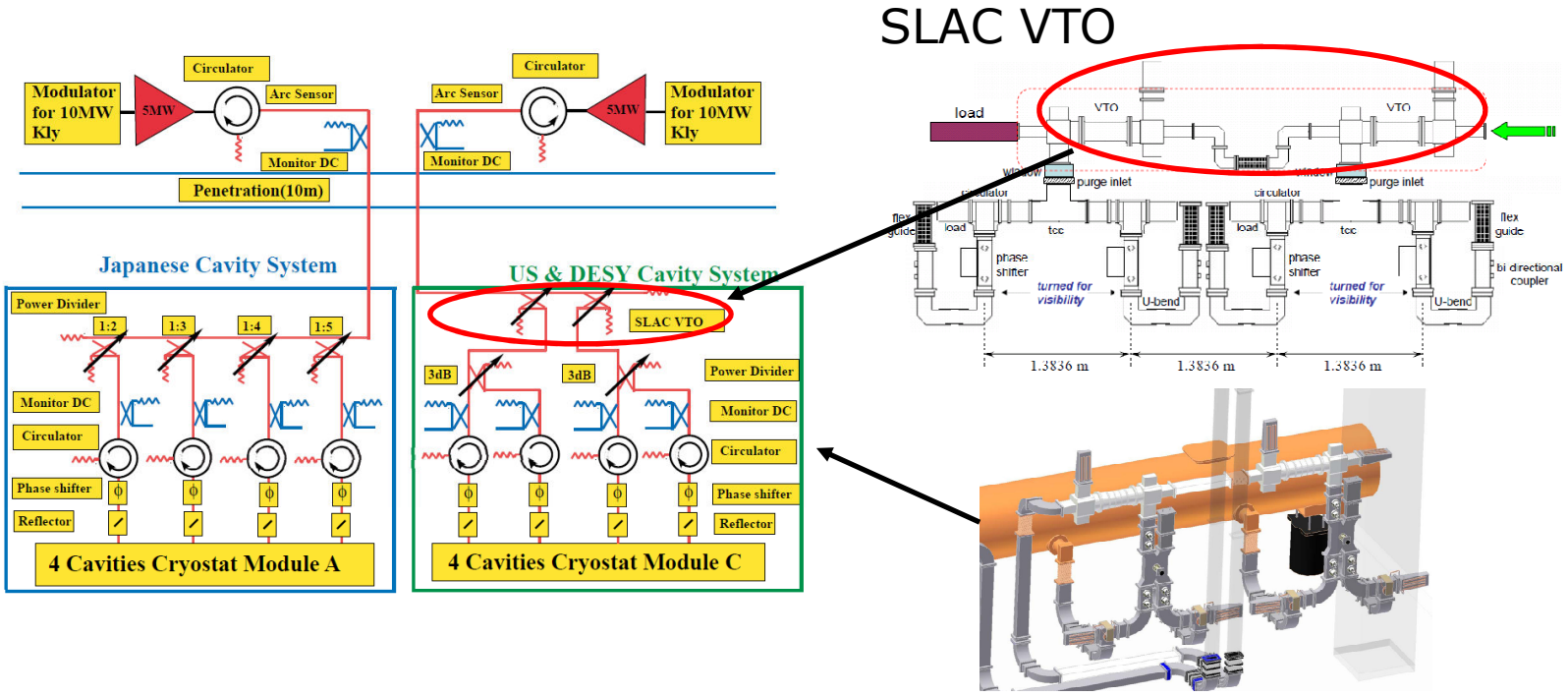
HLRF Status in KEK

- Three RF Stations will be available at the period of S1 global.
  - **#1 2.5 MW available: mainly used for coupler processing**
  - **#2 5MW available**
  - **#3 10MW from Horizontal MBK**
- In order to have an efficient program for cavity evaluation, 2 RF stations will be used.
- Individual coupler processing and cavity processing, two 4-successive runs will be possible.
- Ql adjustment by phase-shifter and reflector after circulator, and a variable tap-off hybrid will be used for power variation.



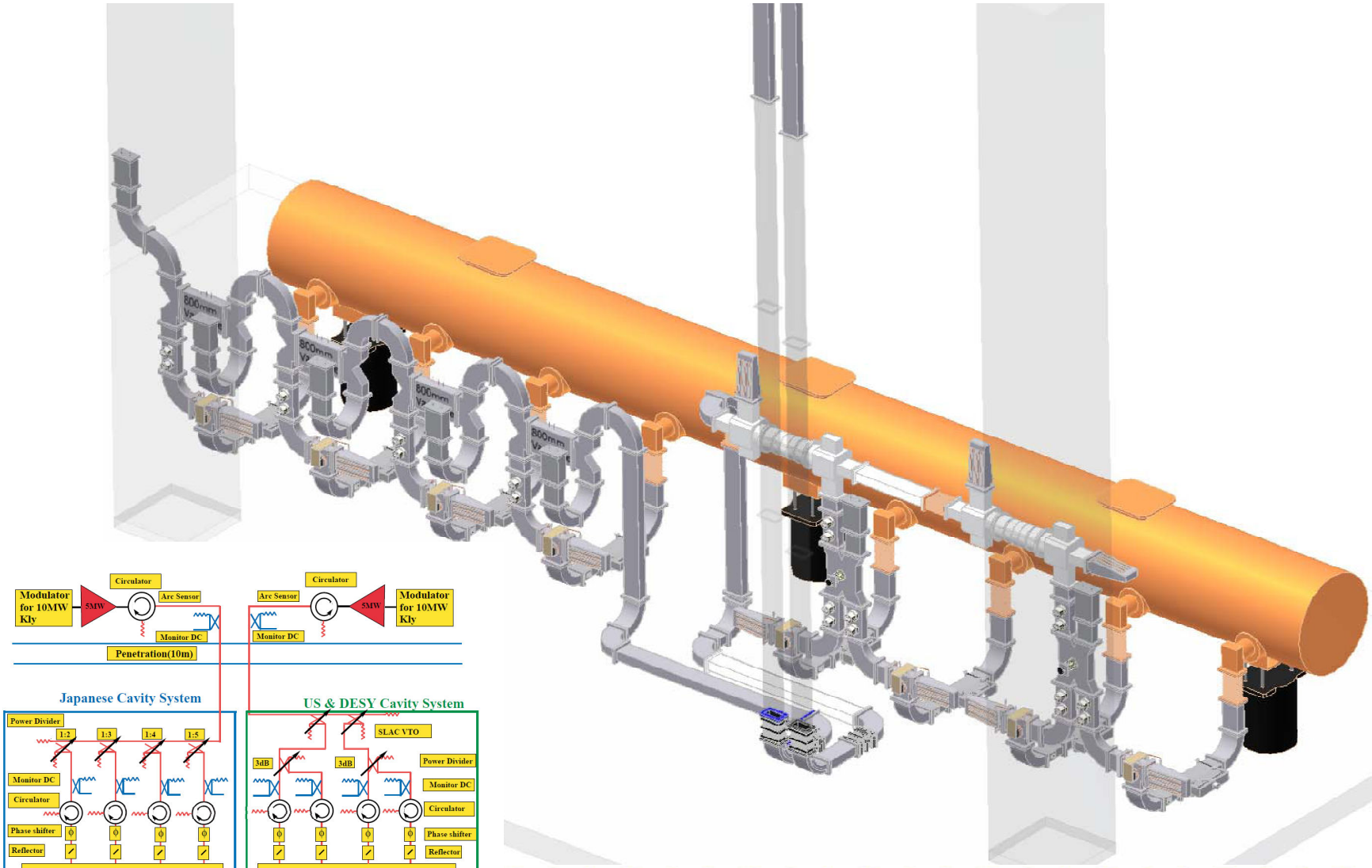
STF Building Klystron Gallery

Possible PDS Scheme for S1 global

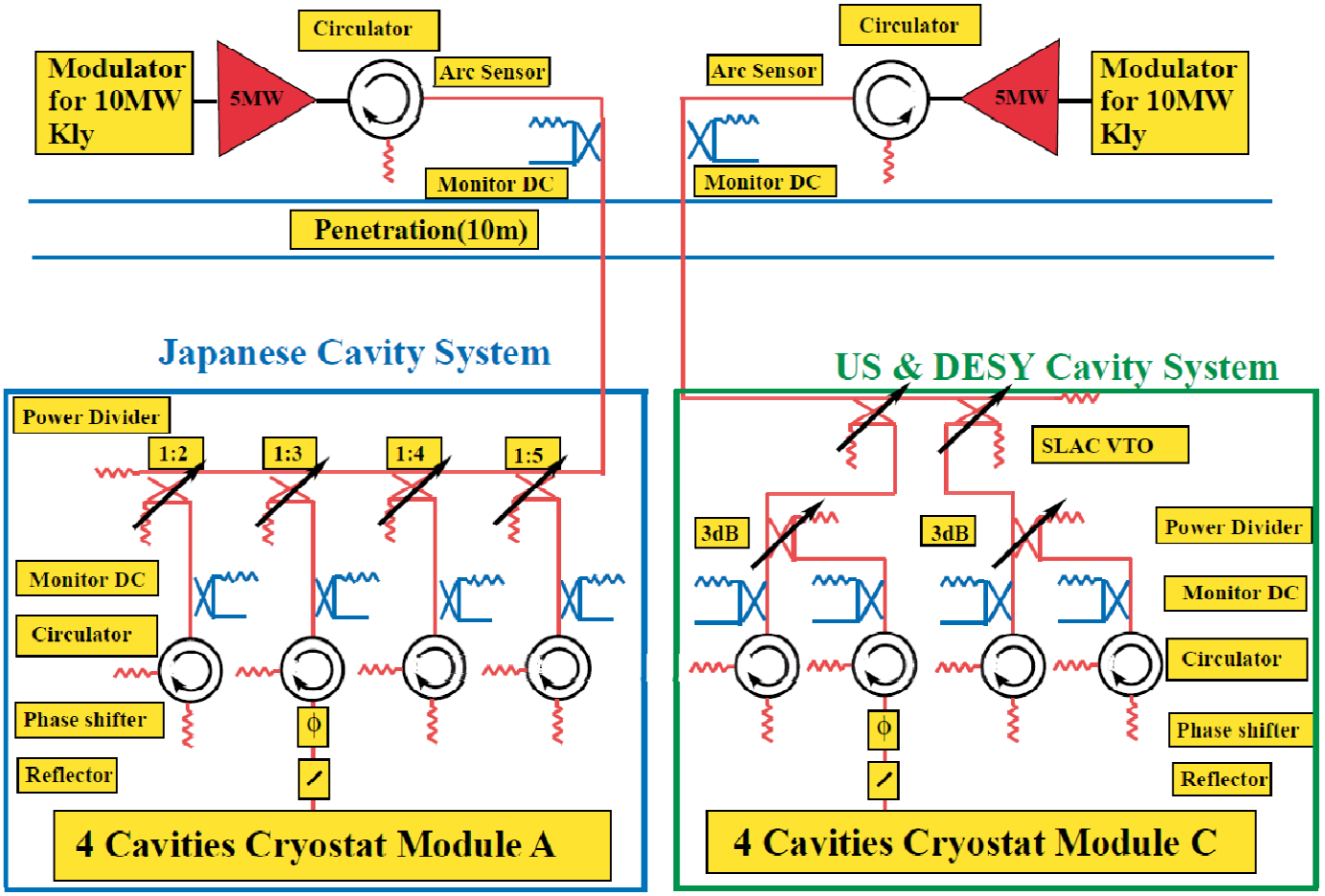


For S1 global, KEK cavities are tested using KEK's PDS and EU&US cavities are tested using SLAC VTO. All power dividers enable us to vary the power including the SLAC VTO (0-100%) and Ql is also adjustable.

Proposed Layout for S1 Global



Coupler Processing and Cavity Survey

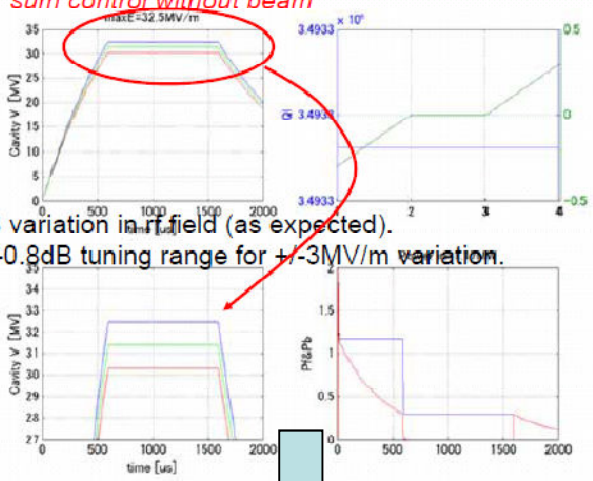


Variation in Loaded Q

Rf distribution and cavity field gradient

(simulation assumption)

- *4 cavities are driven.*
- *All cavities have same loaded Q (no variation).*
- *Rf distribution to cavities are -6.3dB, -6dB, -6dB, -5.7dB. (+-0.3dB)*
- *Vector sum control without beam*

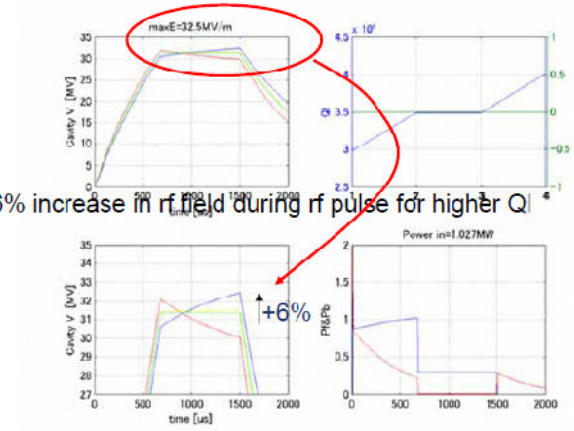


- +/-0.3dB variation in rf field (as expected).

-> need +/-0.8dB tuning range for +/-3MV/m variation.

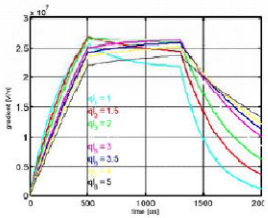
Ql variation and cavity field gradient

- *All cavities have same rf distribution (-6dB).*
- *Loaded Q variation of the cavities are -15%,0%,0% and 15%. (+-15%)*
- *Nominal loaded Q is 3.49e6.*
- *Vector sum control without beam*

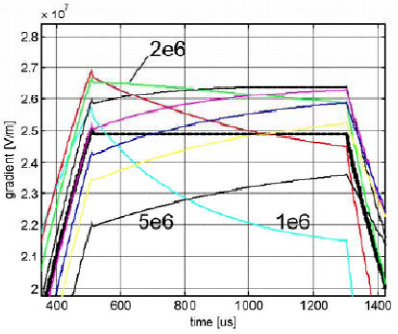


- +6% increase in rf field during rf pulse for higher Ql

Variations in Loaded Q



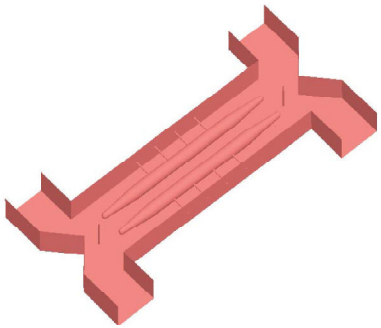
8 cavities



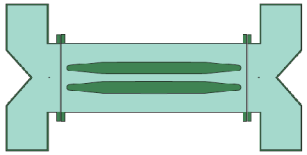
By adjusting the Ql, flat cavity V
Is achieved. By adjusting the power
Level, maximum cavity field gradient
Of each cavity will be expected.

Phase shifter and Variable Hybrid developed in KEK

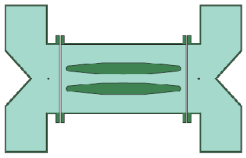
Variable H-hybrid 1040



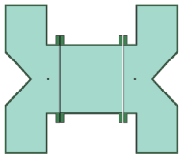
Module structure gives a flexibility:



Variable hybrid with full splitting range

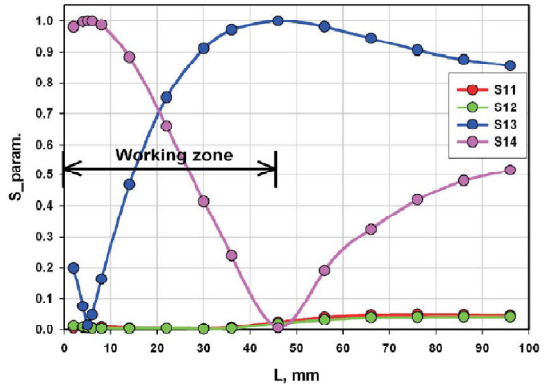


Variable hybrid with partial splitting range

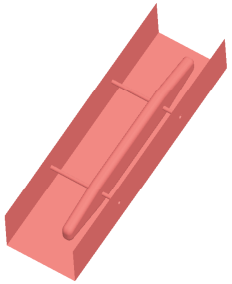


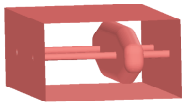
Hybrid with fixed splitting

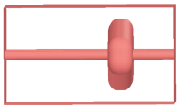
Variable H-hybrid 1040mm

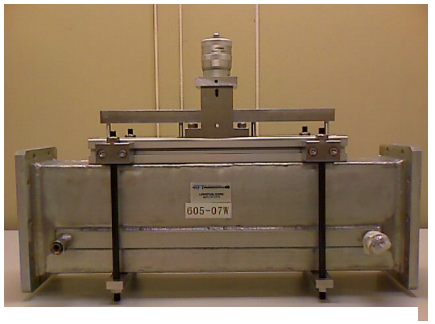


Phase-shifter

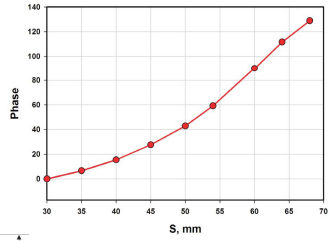


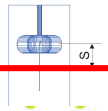






Phase shift vs S



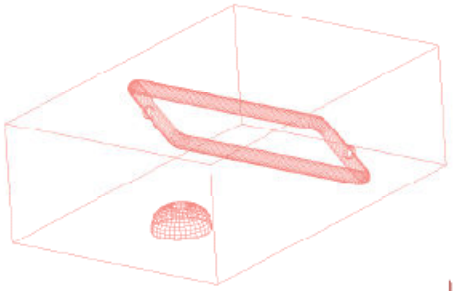


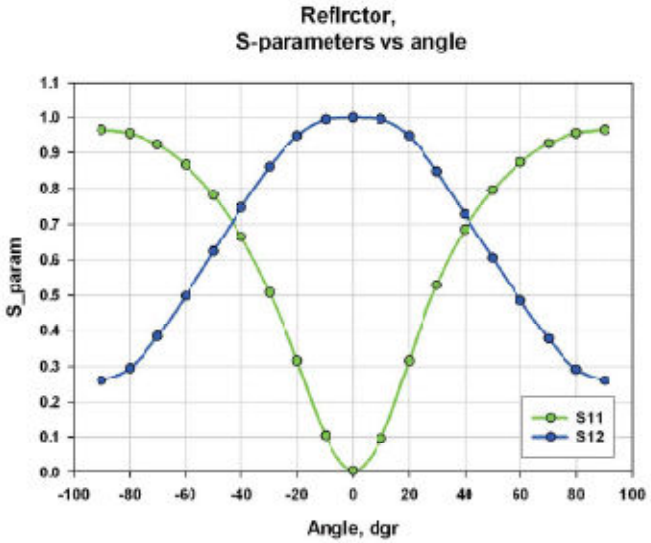
Phase shifter,
S11 for different displacement S

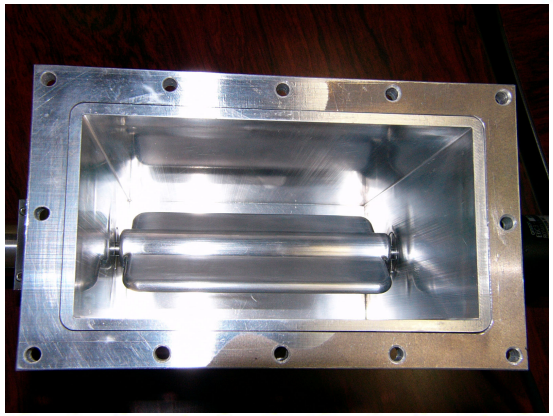
Reflector (S. Kazakov)

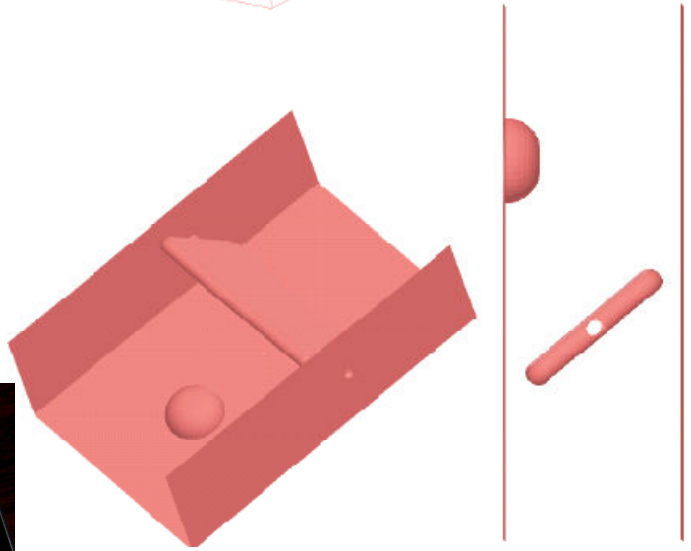
Parameters:

Max. Power (no reflection)	2 MW
S11 renge	0 - 0.97
S12 rerenge	1 - 0.26



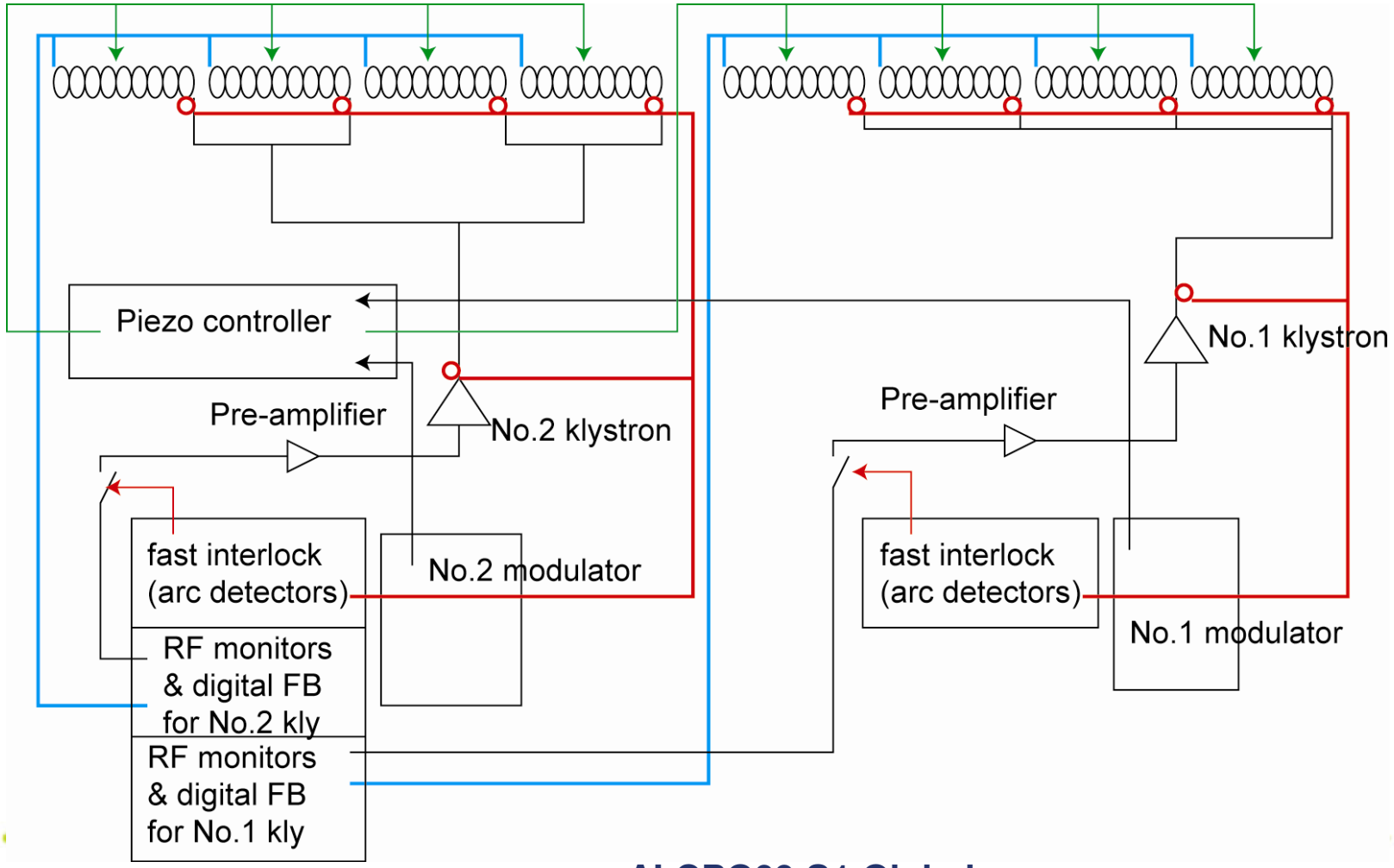






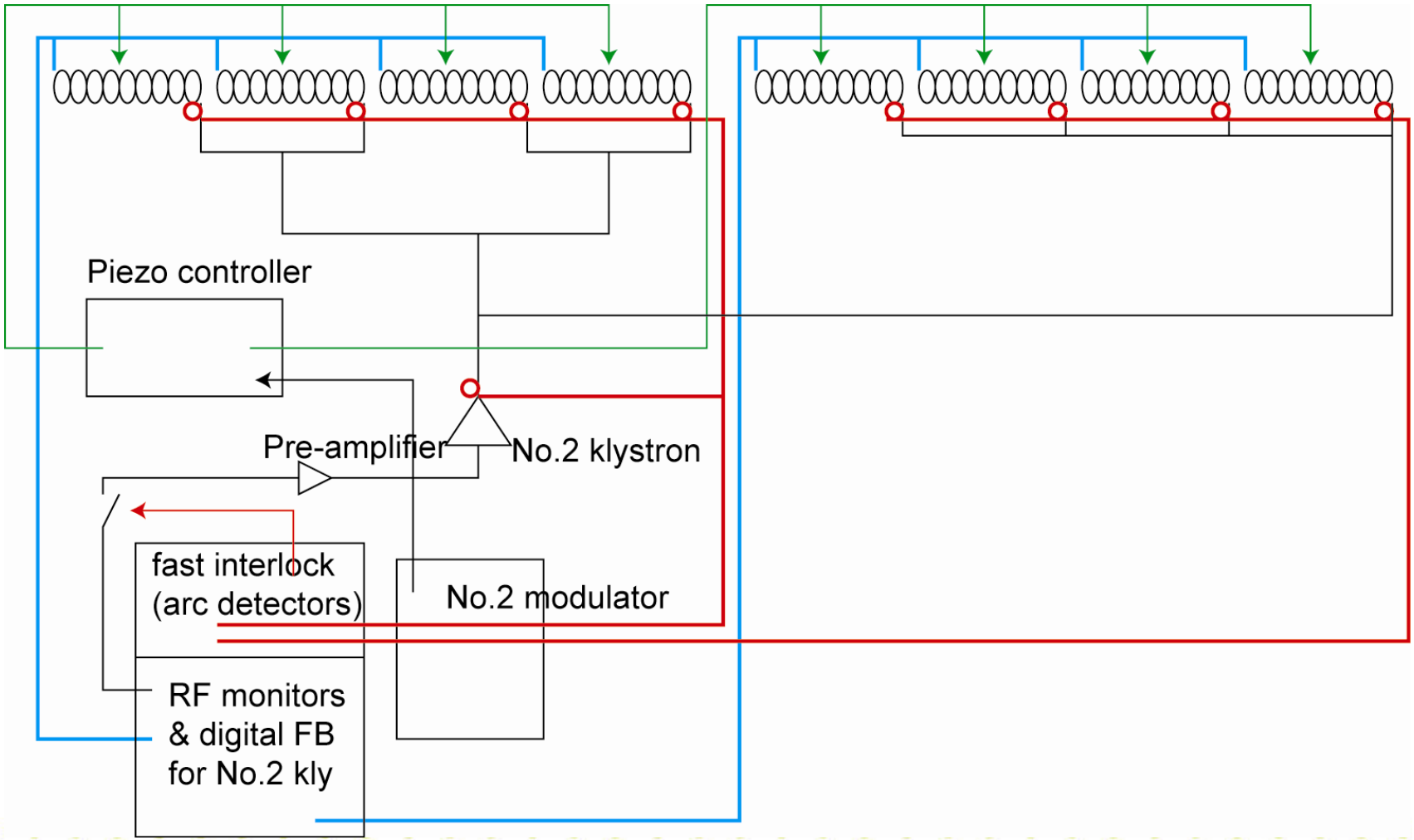
Global S1 1st stage

- Each 4-cavities is driven by a klystron (in order to reduce the conditioning time).
- Digital llrf controls are located near No.2 klystron.
- Only fast interlock (MPS) system will be located at No.1 klystron.



Global S1 2nd stage

- All the cavities are driven by No.2 klystron.

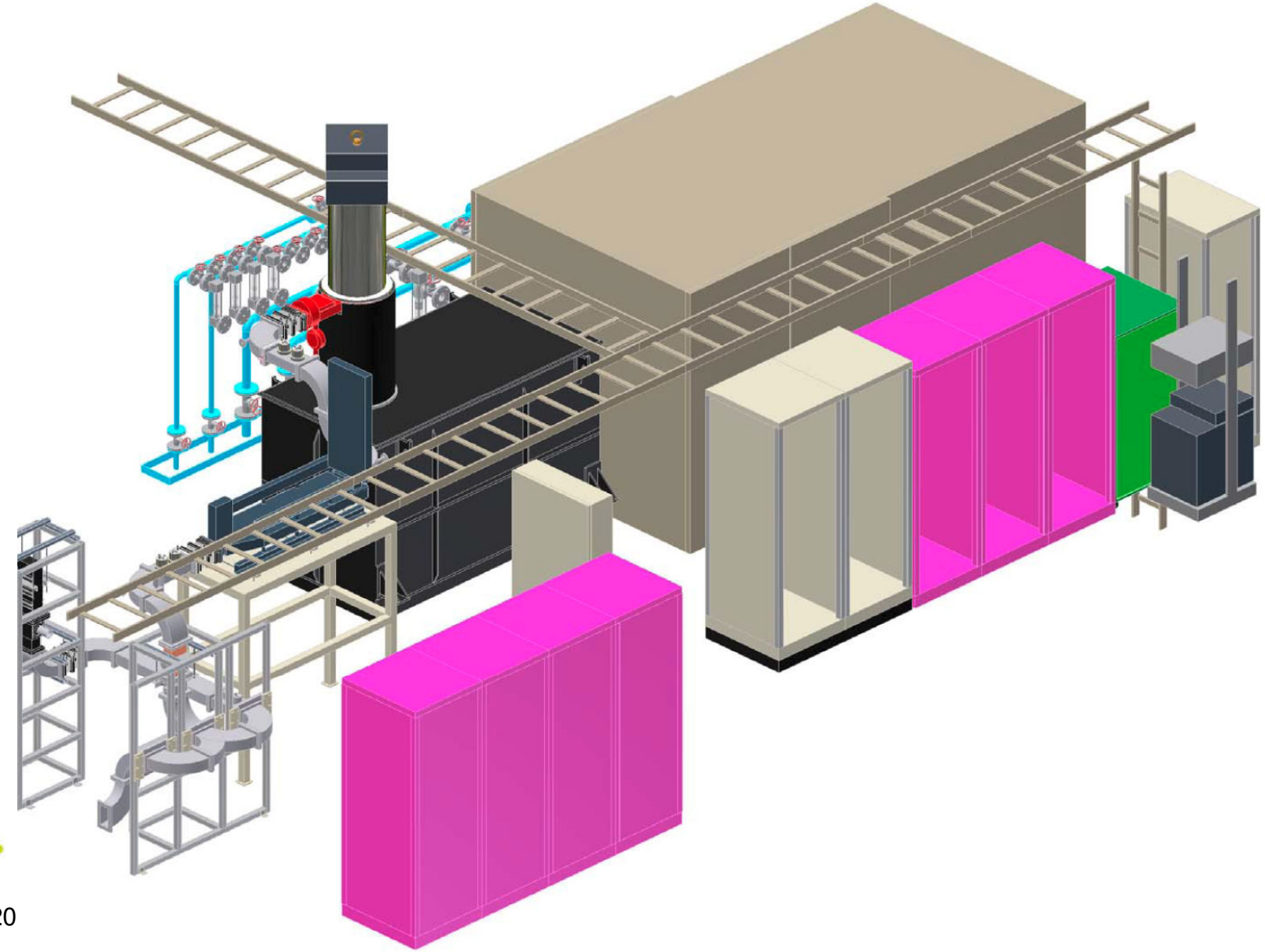


Rack layout for Global S1

- Total 7 racks will be located near No.2 klystron

Unit	height (mm)	rack #1	rack #2	rack #3	rack #4	rack #5	rack #6	rack #0
40	1778	connectors to cavity group	connectors 1 (roof)	connectors 2 (roof)	connectors 3 (roof)	connectors	connectors	
39	1733.55							
38	1689.1							
37	1644.65							
36	1600.2	Timing					oscilloscope3	
35	1555.75							
34	1511.3							
33	1466.85		VSWR interlock	RF switch				
32	1422.4							
31	1377.95						oscilloscope2	
30	1333.5				downconveters	Display2		
29	1289.05							
28	1244.6	oscilloscope1	PLC	Display1			connectors	
27	1200.15							
26	1155.7							Display2
25	1111.25	connectors						
24	1066.8						powermeter x3	
23	1022.35				IQ mod. #2	NIM PIN for #2		
22	977.9							
21	933.45	powermeter x3	NIM interlock	NIM Arc				
20	889				NIM clock2		NIM clock4	
19	844.55					NIM clock3		
18	800.1							
17	755.65	IQ mod. #1	Fan					piezo controller2
16	711.2							
15	666.75		connectors					
14	622.3			500 W amp. For #2	connectors	connectors	connectors	
13	577.85	NIM clock1						
12	533.4							
11	488.95							
10	444.5							
9	400.05		cPCI #1		cPCI mon1	cPCI #2	cPCI mon2	
8	355.6							
7	311.15	Synthesizer		power supply				piezo controller1
6	266.7							
5	222.25							
4	177.8							
3	133.35							
2	88.9							
1	44.45							

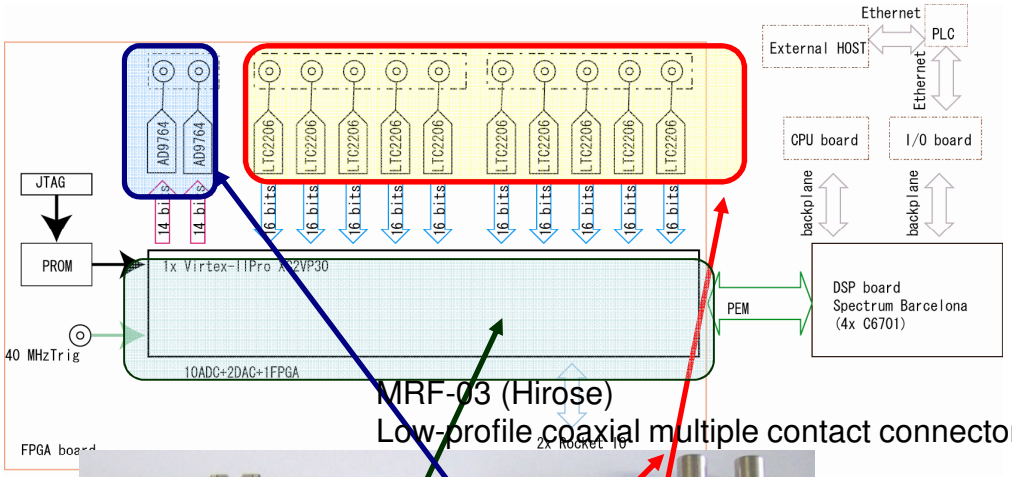
Rack layout (2)



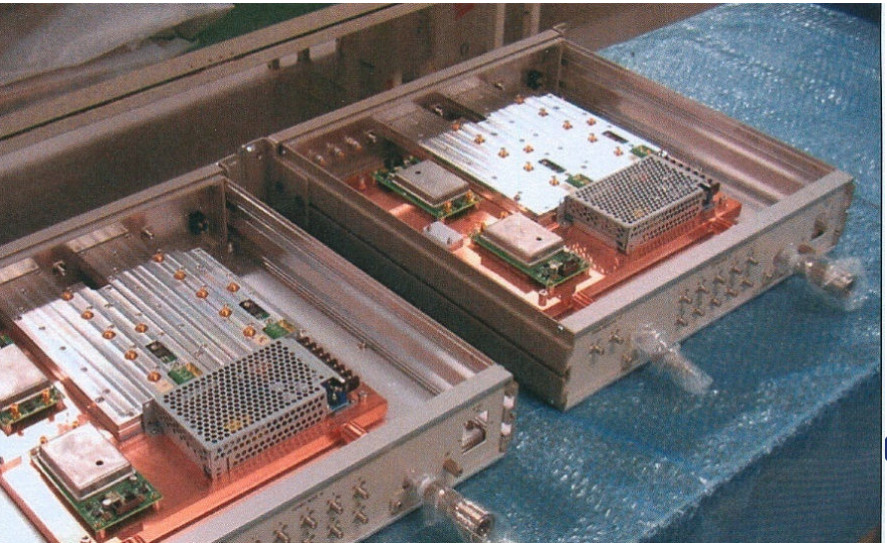
Digital LLRF system

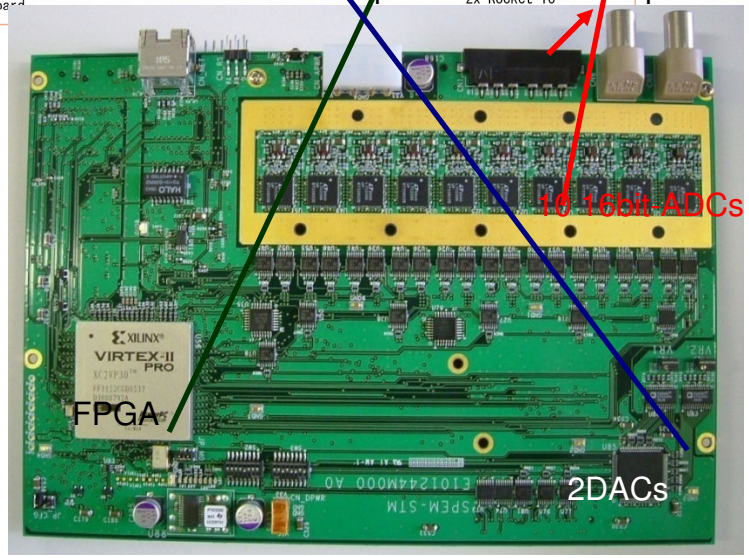
- Digital LLRF system consists of cPCI , downconverters and IQ modulator.

Custom FPGA board
: Mezzanine card of the commercial DSP board
10 **16bit-ADCs** and 2DACs + 2Rocket IO
40 MHz clock



Downconverters & IQ modulator

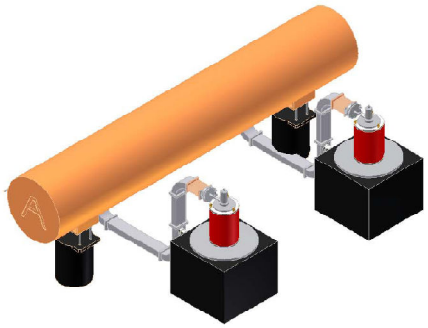




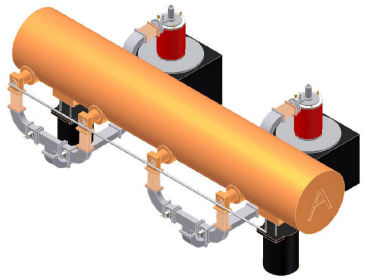
DRFS Demonstration
(For 1 week)

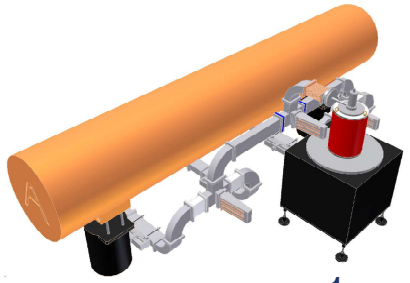
DRFS Demonstration

DRFS Demonstration test is approved for 1 week period. 1 unit of DRFS is Planned be manufactured in FY2009. Hopefully another 1 unit will be made Until the S1 global period to show the 2 units DRFS demonstration.

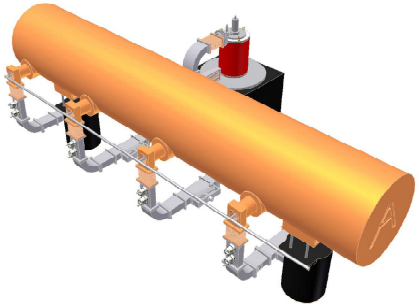


Two units DRFS





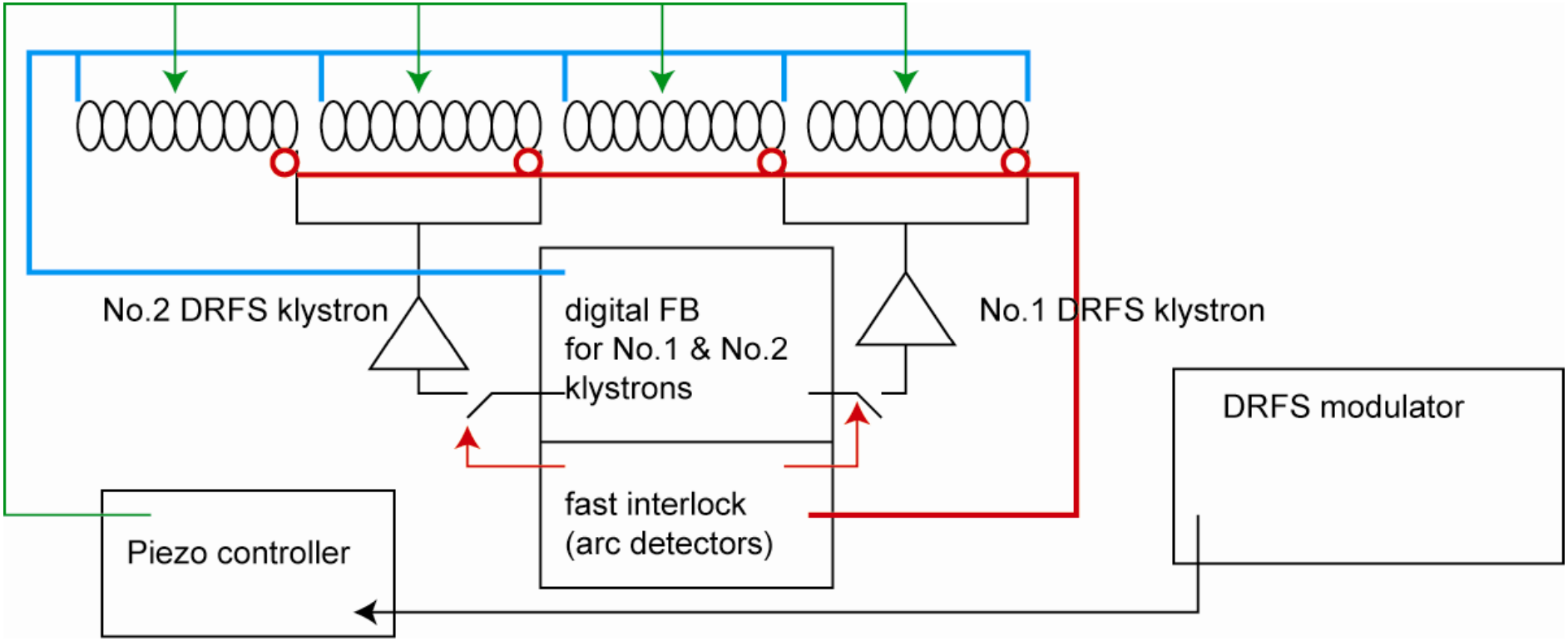
1 unit DRFS



Two units DRFS demonstrate the feasibility of basic DRFS system. For the case of 1 unit DRFS 1 unit system for 4 cavities of low power option is demonstrated.

Global S1 3rd stage

- digital LLRF systems (cPCIs) will move from the klystron gallery to the tunnel.
- Fast interlock will be also located at the tunnel.



Summary

- Preparation of S1 global testing including the time schedule is reported.
- Purpose of S1 global is to demonstrate SC cavities are operated with average maximum accelerating field with the internal collaboration.
- In order to fulfill this purpose, HLRF introduce Ql and power adjustable way using reflector and phase-shifter. This will help for all cavities to achieve the maximum performance.
- PDS plan for the S1 global is shown in this report.
- SLAC VTO will be planed to be introduced for EU and UA cavity system
- LLRF plan for S1 global is also reported