

Nextef status and expansion plans

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Nextef

100MW X-Band station in KEK

y/m

2007/8 Start operation

2007/12 Commissioning Power production went upto 100MW

2008/1 Start Retest of KX03

2008/9 Start test of T18

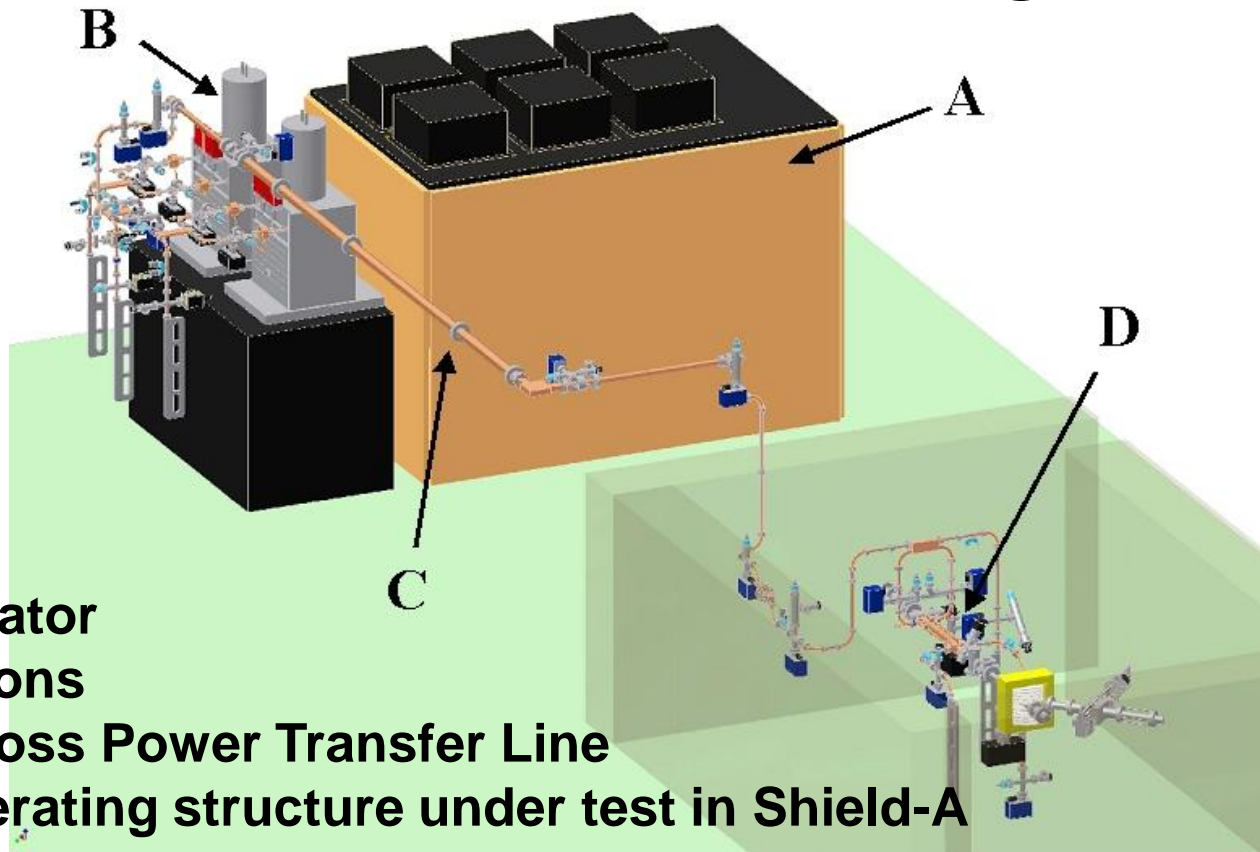
2009/7 Start TD18Quad#5 test.

2009/12 Testing TD18Disk2 (ongoing)

Features

- Combined power of klystrons to produce 11.424GHz RF of peak power above 100MW (maximum power available depends on the pulse width).
- Use of PPM klystrons (originally developed for GLC project).
- Associated with a concrete shield (Shield-A) which is fully equipped for the structure high power tests.
- No beam available.
- Currently it is running for a series of CLIC prototype structure tests.

Nextef station configuration



A: Modulator

B: Klystrons

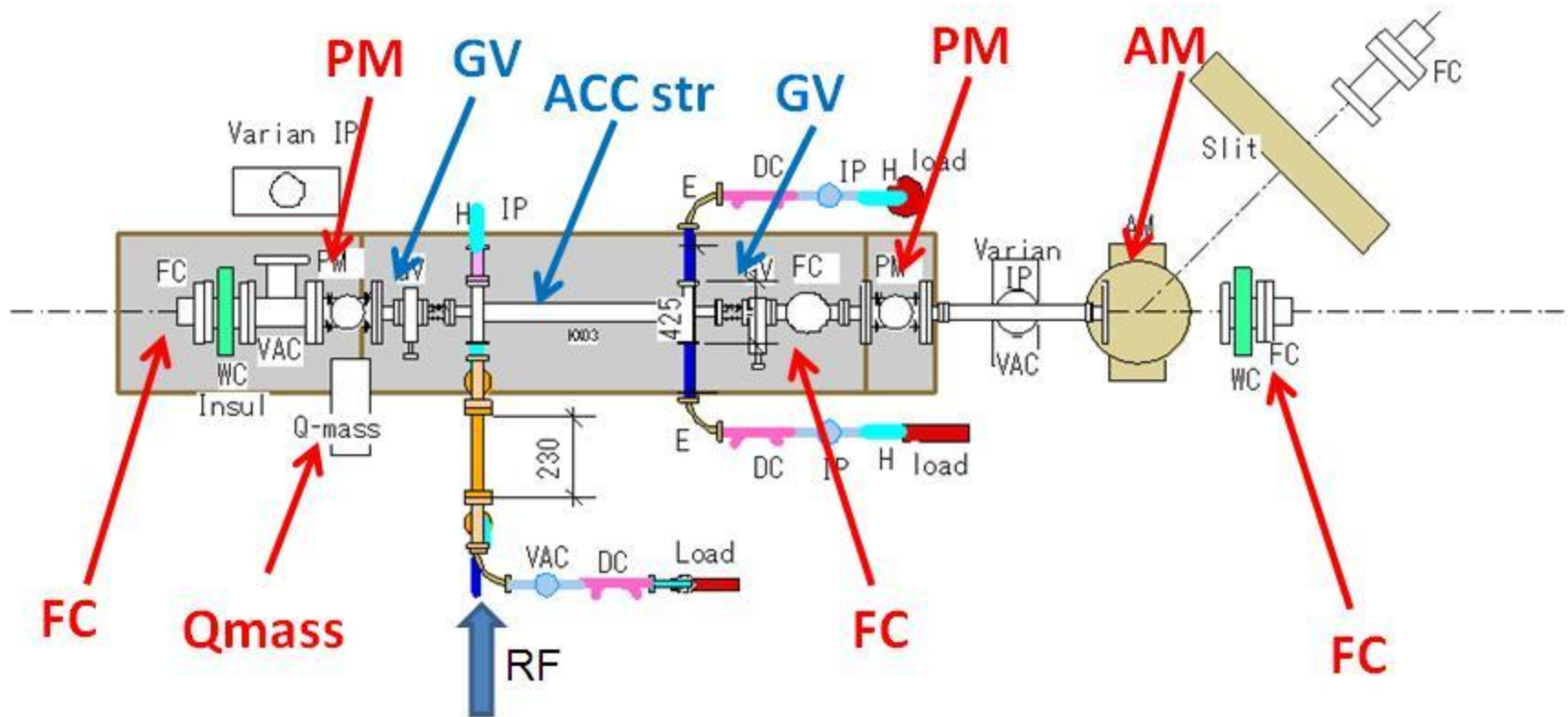
C: Low Loss Power Transfer Line

D: Accelerating structure under test in Shield-A

- The modulator drives two 50MW PPM klystrons.
- The combined power is transferred into Shield-A.
- Local control room (not shown in this picture).

Plan View inside Shield-A

observables along beam axis



ACC str: Structure under test

**FC: Faraday Cup, PM: Profile Monitor,
AM: Analyzer magnet, GV: Gate Valve.**

Performance

- **24Hr operation is possible due to the linkage with KEKB Linac operation. (The linac operation=6000Hr/year.)**
- **Local control as well as a remote control through Linac control system.**
- **Possible to store / handle the operation data as well as experimental data through Linac control system (LINUX and EPICS).**

Specifications

Frequency	11.424GHz
Max power production	100MW
Max power for test *	75MW
Pulse width	400ns
Repetition rate	50pps

* Measured Transmission Loss is 25%.
4th X-band Structure Collaboration Meeting,
CERN

What we have achieved and what we should do next: Nextef

- Continuous run established (Total RFON time is more than 20000hrs from 2006) .
- Maximum power 70MW, 250ns, 50pps for recent structure tests.
- The maximum power production is about 100MW. It is practically determined by the performance of one of the klystrons: Frequent Klystron gun breakdowns occur in one of the klystrons at the cathode voltage above 460kV. Below this voltage klystrons are stable.
- In order to increase its peak power, a pulse compressor system will be installed in this JFY. We expect the system will be ready to go in 2011.

Nextef Pulse Compressor

- A pulse compression system (PCS) will be installed in order to improve the peak power of Nextef 100→150MW. 100MW power available for structure tests.
- A practical solution to getting higher peak power, necessary for the structure tests in the future.
- Use of single delay line (circular waveguide of phi 80mm). The circular polarized TE11 mode is employed to store energy in the line.
- The compression gain of 3 expected. Final power of 150MW 150ns pulse width is expected in Phase 1.

PCS INPUT :X-band PPM Klystrons: 25 MW each X2 X 750ns

PCS OUTPUT: Gain 3 → 150MW, 150ns.

- In Phase 2 we utilize TE12 mode also to obtain 300ns output pulse while the peak power will be kept.

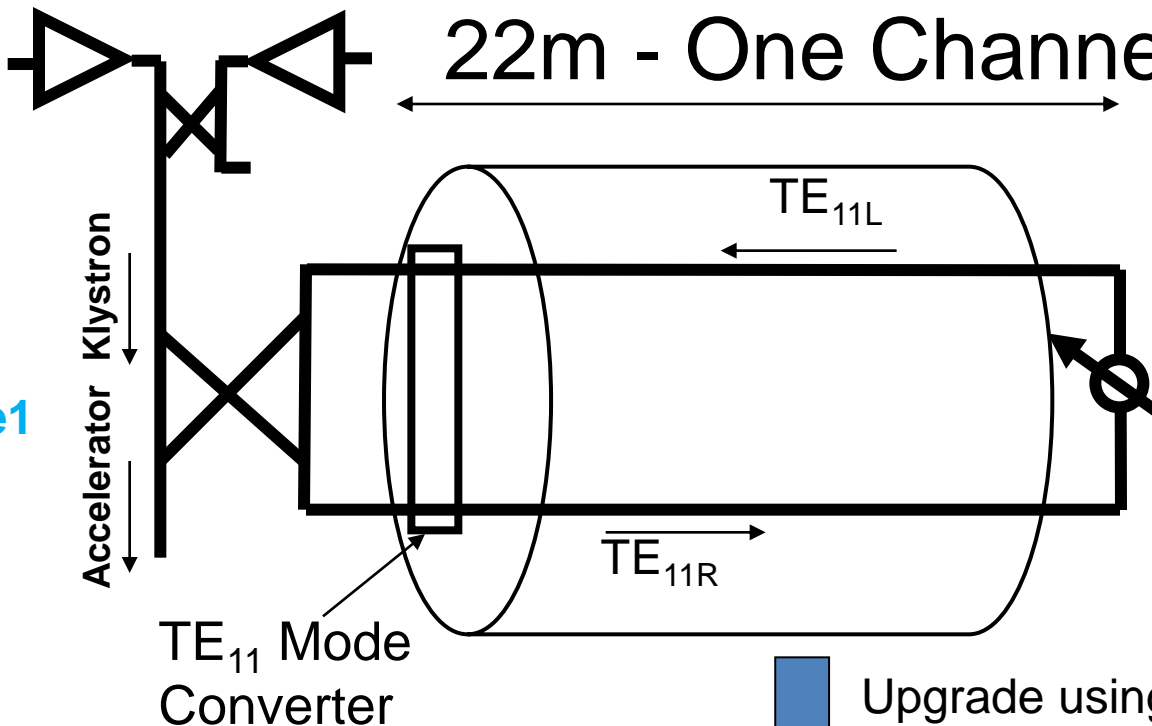
Nextef Delay Line Pulse Compressor

22m - One Channel

25 MW×2 Klystron
 ×gain=3
 → 150MW

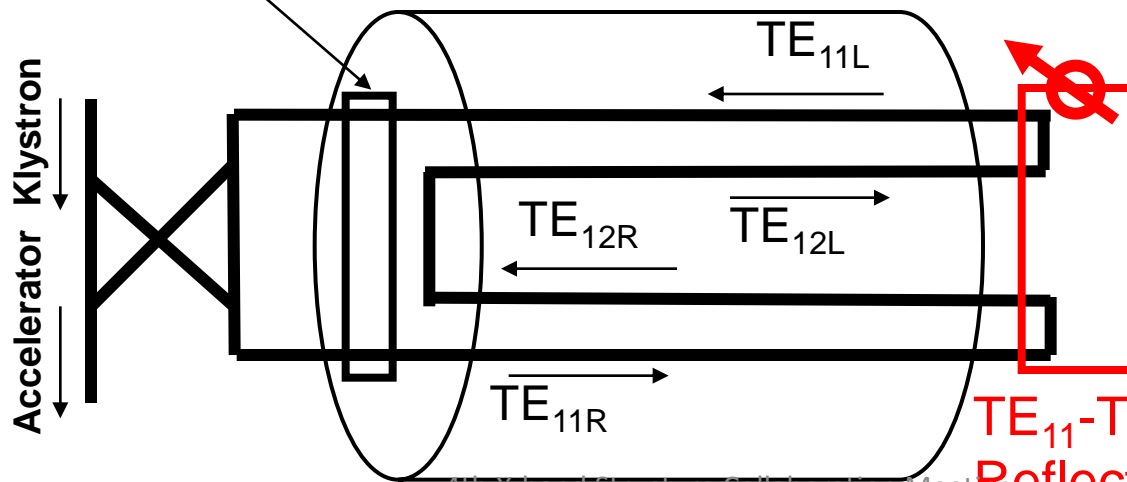
750ns → 150ns
 Gain = 3.6 @ 3dB

Phase1



Upgrade using higher mode

Phase2



1500ns → 300ns
 Gain = 3.3 @ 3dB

TE₁₁-TE₁₂
 Reflector (Mode exchanger)

Nextef pulse compressor Layout

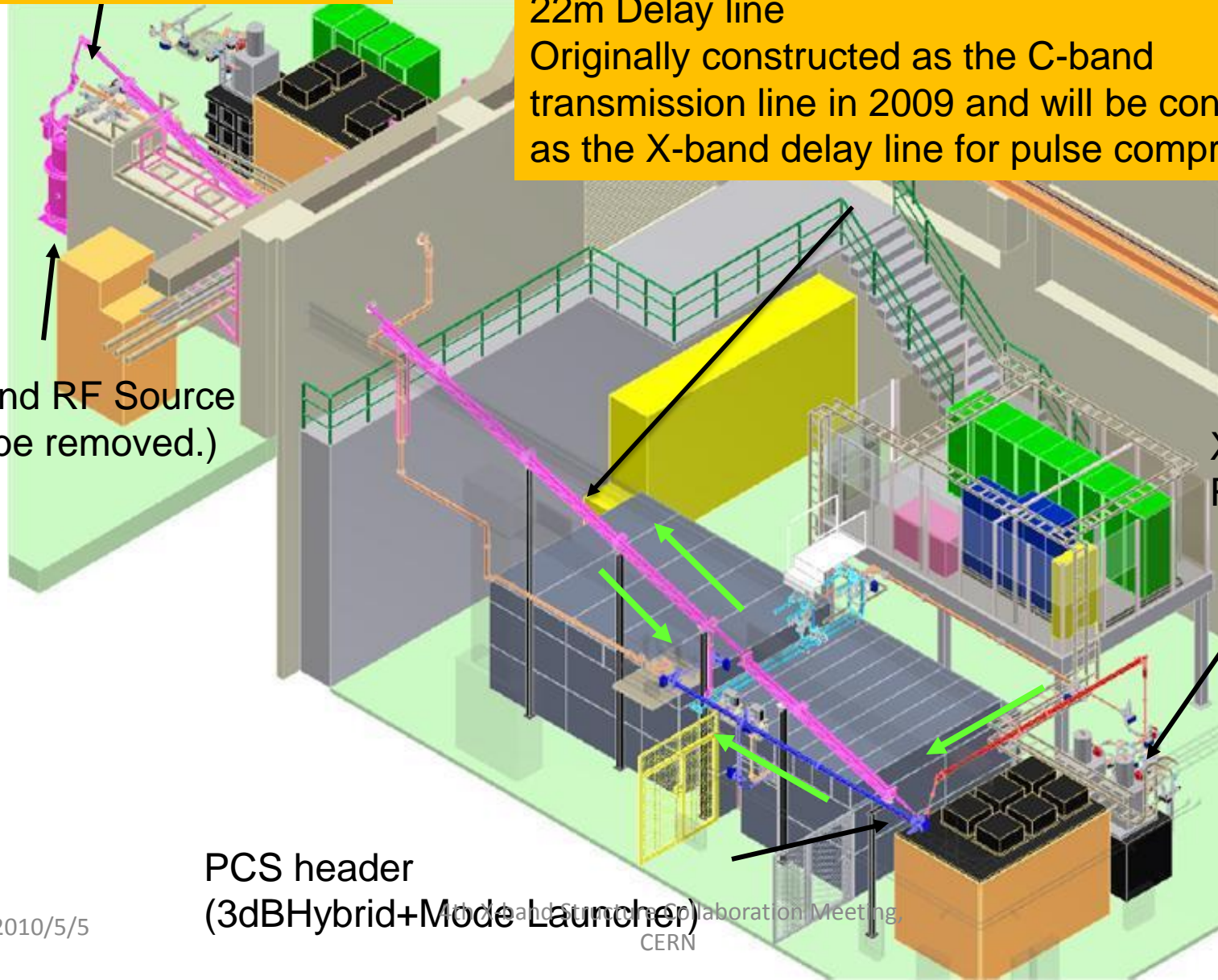
The reflector will be put.

22m Delay line
Originally constructed as the C-band transmission line in 2009 and will be converted as the X-band delay line for pulse compressor.

C-band RF Source
(will be removed.)

X-band RF Source

PCS header
(3dB Hybrid+Mode Launcher)



Status

Most of the components such as the mode converters, circular bends and vacuum ports so on are in their final fabrication process(Brazing).

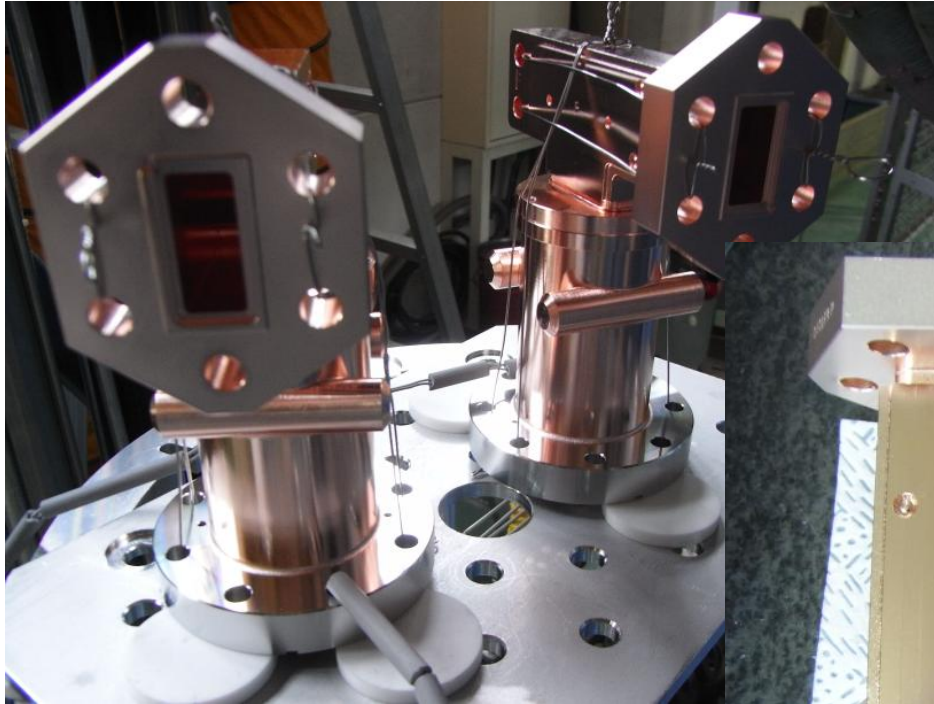
The whole components will be ready to install in this summer.

The construction schedule has not been finalized yet, because it depends strongly on the high power test programs of X-band ongoing as well as C-band accelerator structure test as a collaboration with INFN Frascati done in Nextef area, scheduled in this autumn.

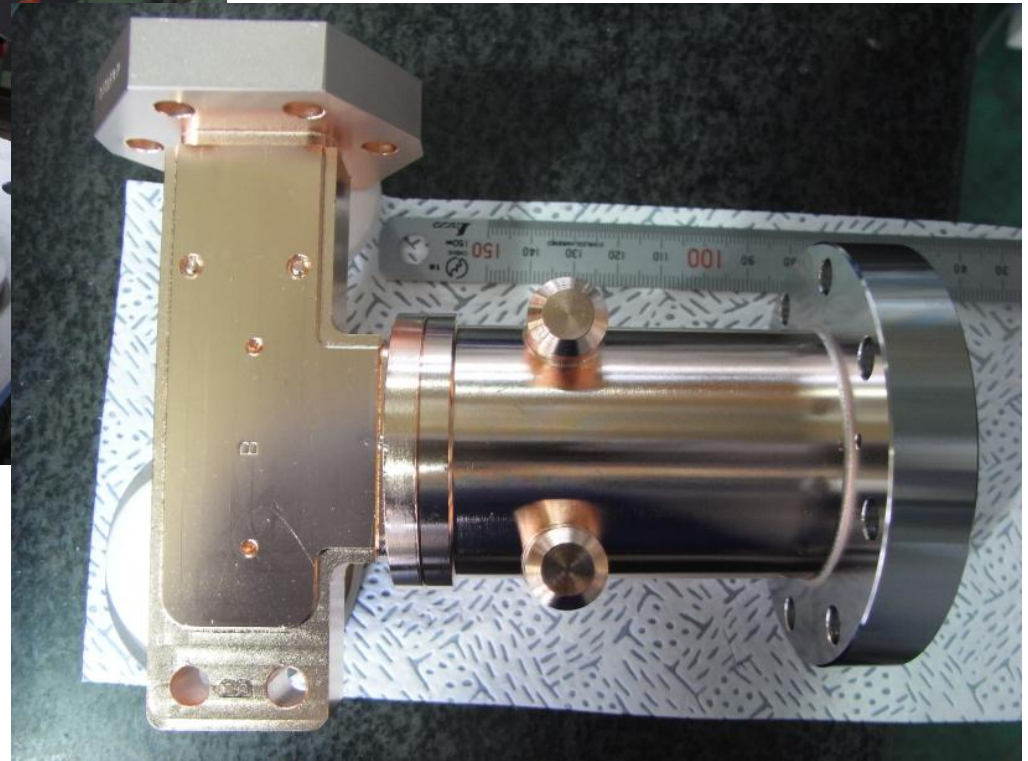
The construction work will be done in spring of 2011.

Production of RF components:

Kazakov Mode Converter



(Rect TE10→Circ TE01)



KT-1

(y/m)

2006/ 5 Start operation (as an X-band klystron test stand)

2006/6 Klystron test (PPM6A)

2007/1 Started to run for “small experiments”

2008/5 Narrow waveguides (SUS003 followed by CU005) testing.

2009/9 Testing RF Loads

Features

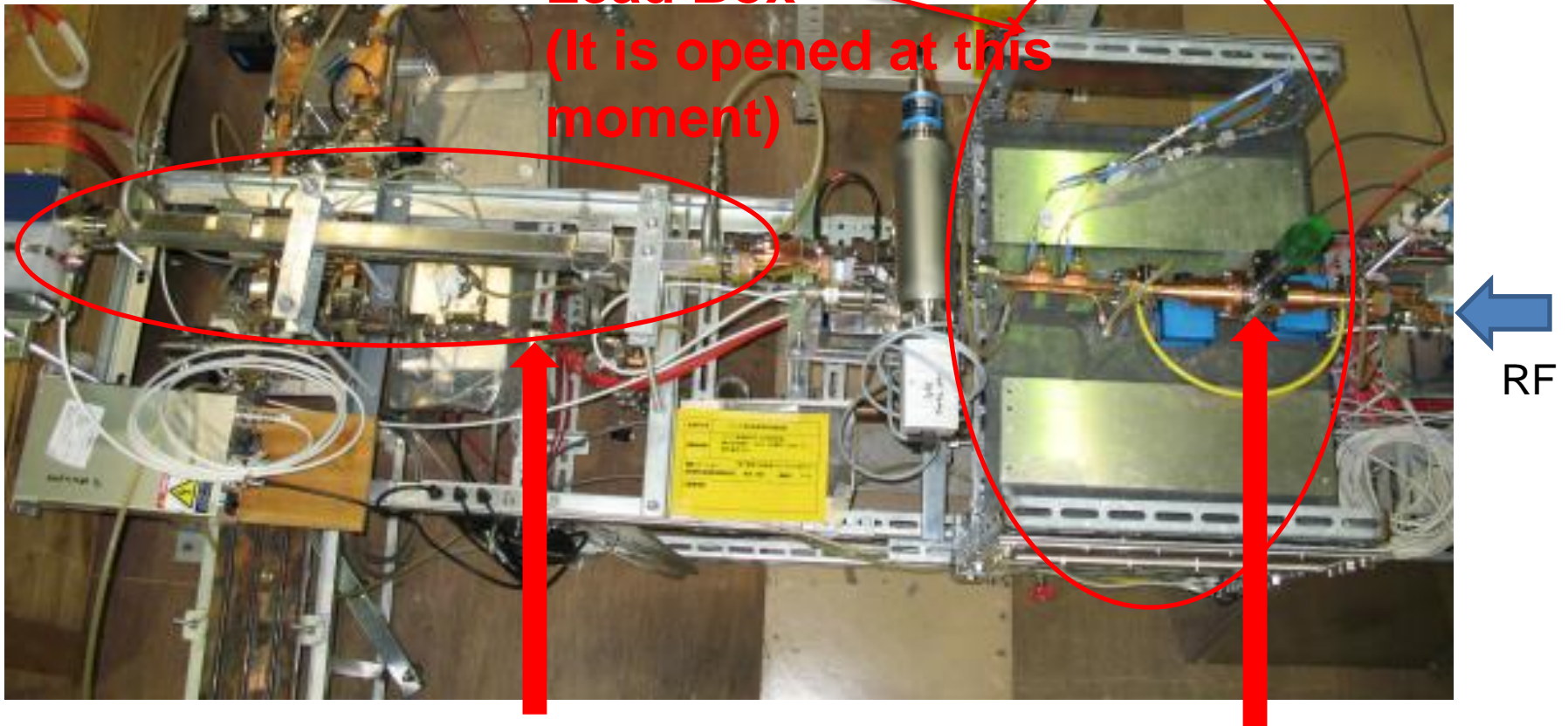
- A 50MW facility originally started as a klystron test station in 2006.
- Use of a single PPM klystron, 11.424GHz RF of peak power of 50MW, 400ns is available. This station runs for small-size experiments such as a narrow waveguide and RF component test (e.g. RF load).
- The current klystron sitting at KT-1 is old (constructed in 2003, repaired 2004) but it has been healthy so far.
- 24Hr operation is possible (as Nextef be).

Recent Test done at KT-1

Test of CERN Cinel load and KEK Waveguide valve

Lead Box

(It is opened at this moment)



**CERN CINEL
High power RF Load**

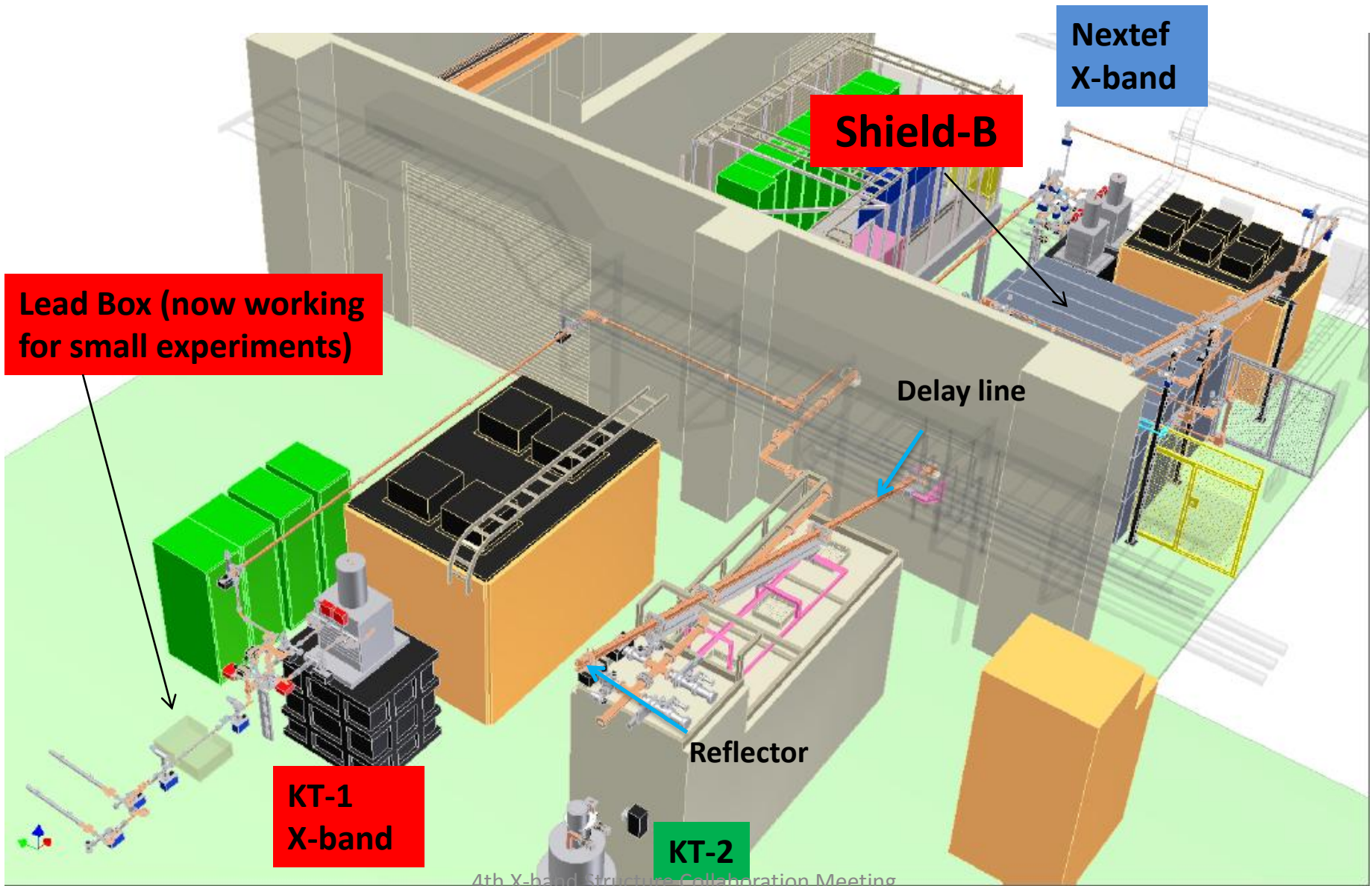
KEK Waveguide valve

Improvement Plan for KT-1

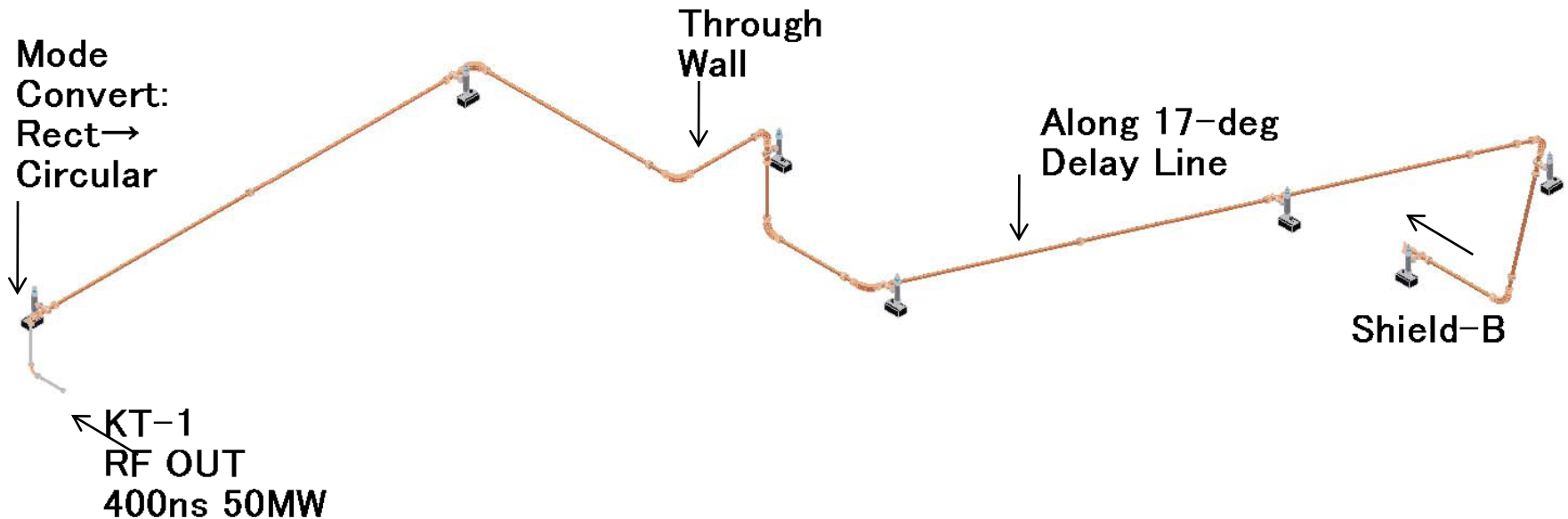
There has been some requests on the testing of the cavity structures such as single cell structures, short structures, so on. Those experiments do not require much power and it can be provided by our single klystron.

However it is difficult to perform these programs at current KT-1 station where only a small lead box is there for small experiments. It is not practical to make a good shield nearby.

A simple solution to this is to use Shield-B which locates in next door. This can be done by constructing a new power transfer line.



Whole Configuration of the Proposed Power Line from KT-1 to Shield-B



The power from the klystron is transmitted through the circular waveguides (40mm diameter) with TE01 Mode. Those circular pipes, bends and vacuum ports are now under fabrication process.



Power delivery from KT-1 to Shield-B

We are able to start basic studies with structures using this test setup, though it sacrifices the usual KT-1 klystron activities (=Klystron test) somehow. (I guess this is not a big problem.)

This experimental activities should complement the series of high gradient tests on CLIC prototype structures proceeded at Nextef.

Proposed Schedule

		2010												2011											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Nextef Shield-A	TD18_Disk2	high power test																							
	T24							high power test																	
	TD24													high power test											
																				Structure (Not specified yet) test					
	PCS	Components Fabrication												Construction				Commission							
KT-1	high power test for components																								
Shield-B	C-Band(NFN)							high power test						Commissioning											
	New Line	Components Fabrication												Construction				High power test (Powered by KT-1 KLY)							

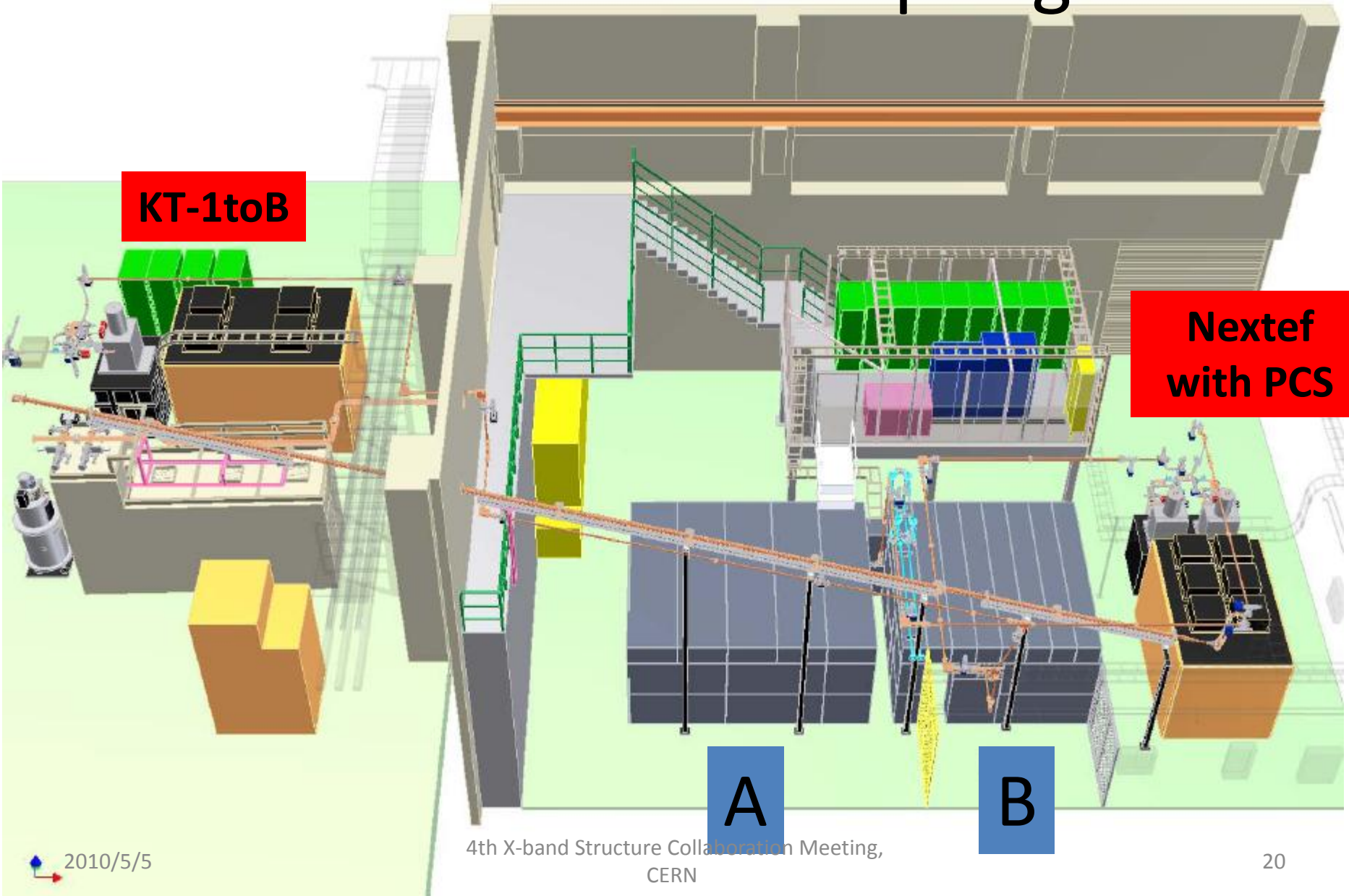
Nextef and KT-1 as of spring 2011

KT-1toB

**Nextef
with PCS**

A

B



Conclusions

Most of the components of those lines for Nextef Pulse Compressor and KT-1 to B are now in the final stage of the fabrication (brazing). The whole parts will be ready for construction soon.

The construction depends on the schedule of the testing in Shield-A and -B. The construction work will start in the end of this year. These lines will be ready to operate at least in next spring.

We expect the power of more than 100MW * with 150ns pulse width in Nextef as well as that of 35MW *, 400ns in Shield-B available for the various studies in spring 2011.

* Due to the transmission loss.