

System Test session

STF Status and Future plan

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System Test at STF : purpose

- (1) Continuous experience on cavity and cryomodule;
fabrication, surface process, assembly, installation.**

- (2) Beam performance development;
LLRF control, orbit, optics, instrumentation, RFgun.**

- (3) Man-power bringing-up;
SCRF, LLRF, instrumentation, beam operation.**

System Test at STF : configuration

Electron source : beam generation with ILC-like bunch structure

Cs2Te-Photo-cathode RFgun with L-band Cu-cavity, powered by 5MW klystron

Capture cryomodule : boost energy for following acceleration

Two Superconducting 9-cell cavities in short cryomodule, powered by DRFS klystron

ILC-like cryomodule : ILC-like cryomodule demonstration

CM-1: Eight SC 9-cell cavities in ILC cryomodule

CM-2a : Four SC 9-cell cavities in half-size ILC cryomodule (MHI cavities)

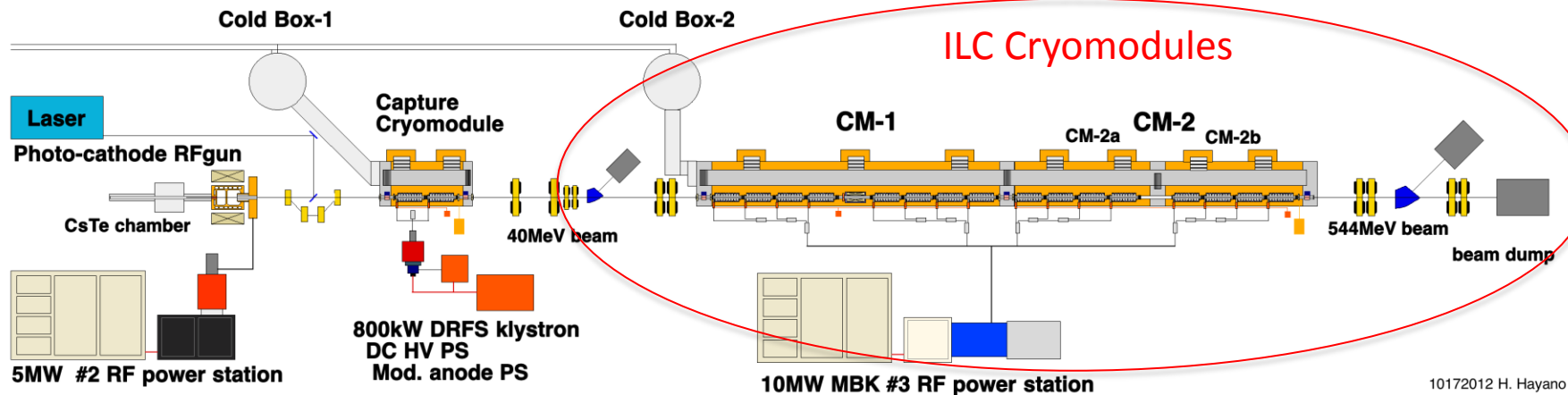
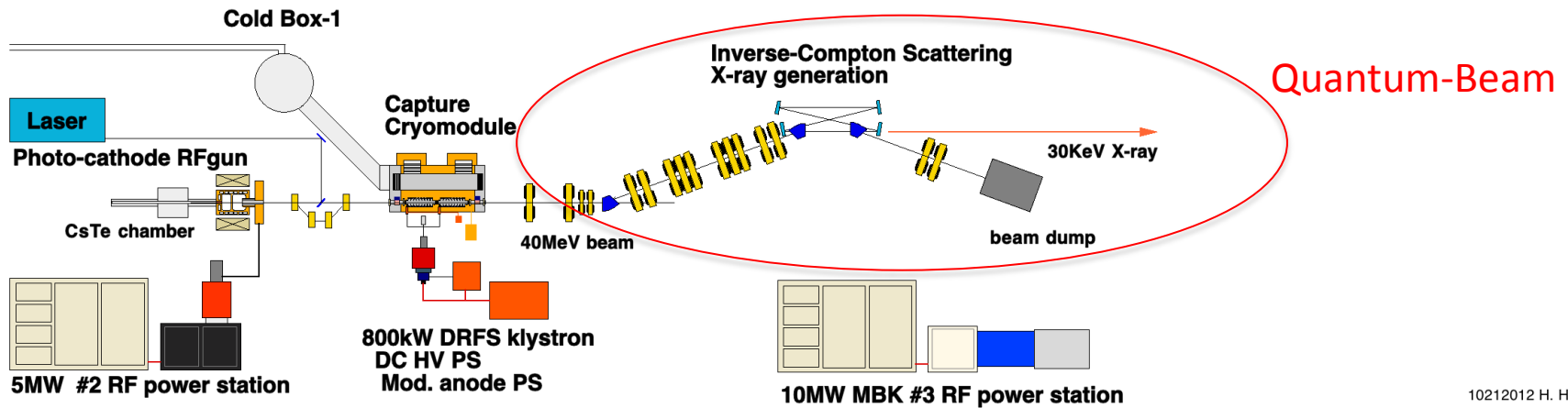
CM-2b : Four SC 9-cell cavities in half-size ILC cryomodule (KEK cavities, others)

CM-3a : under discussion

CM-3b : under discussion

STF Accelerator Plan (2012- 2015)

STF Phase-2 Injector part (Quantum Beam Experiment)

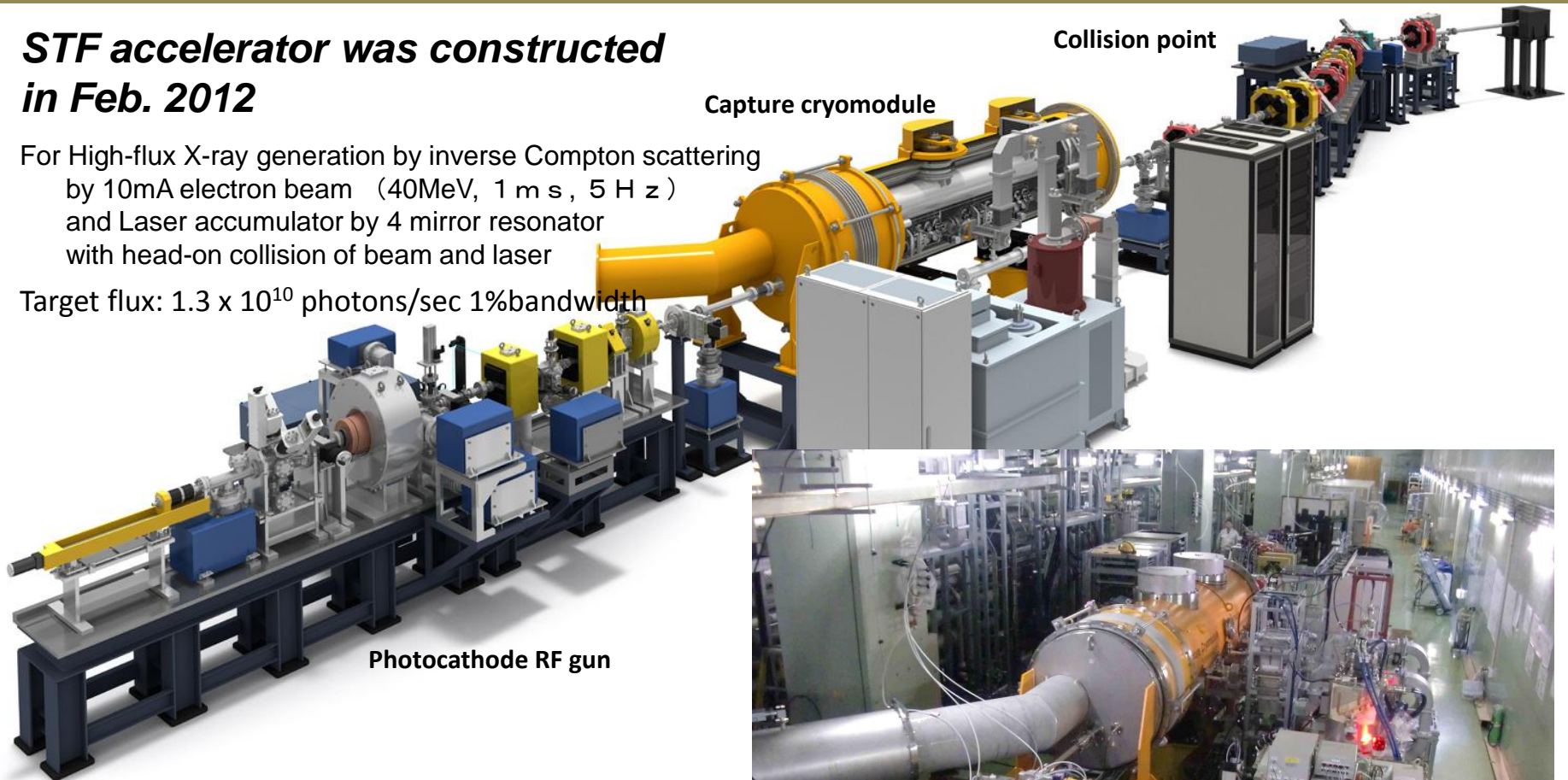


STF Accelerator (Quantum-Beam Experiment)

**STF accelerator was constructed
in Feb. 2012**

For High-flux X-ray generation by inverse Compton scattering
by 10mA electron beam (40MeV, 1 m s, 5 H z)
and Laser accumulator by 4 mirror resonator
with head-on collision of beam and laser

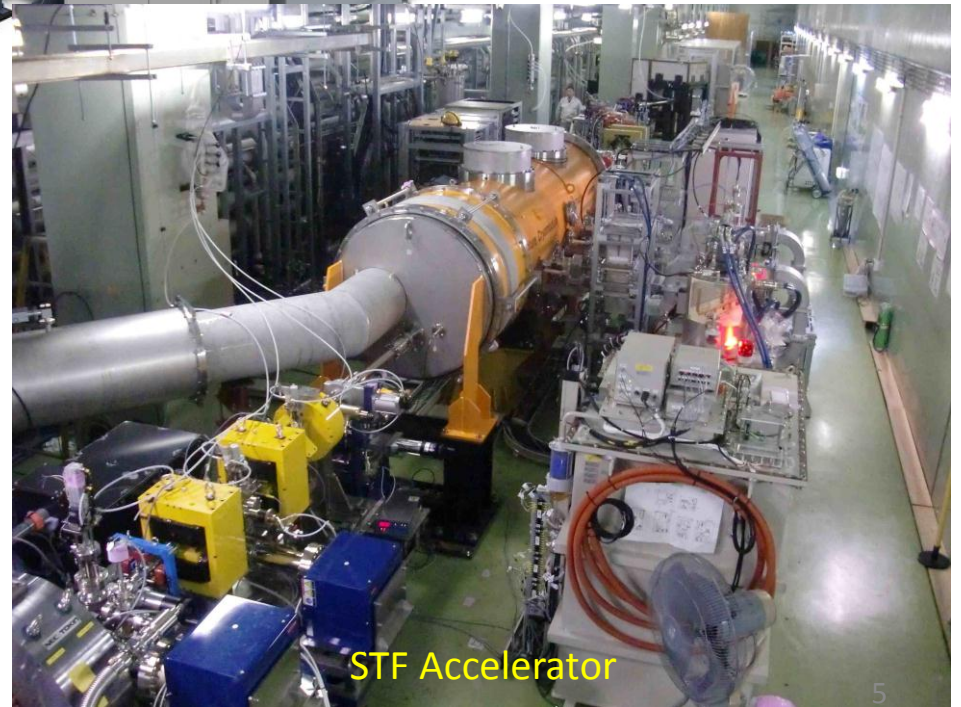
Target flux: 1.3×10^{10} photons/sec 1%bandwidth



Photocathode RF gun

Capture cryomodule

Collision point

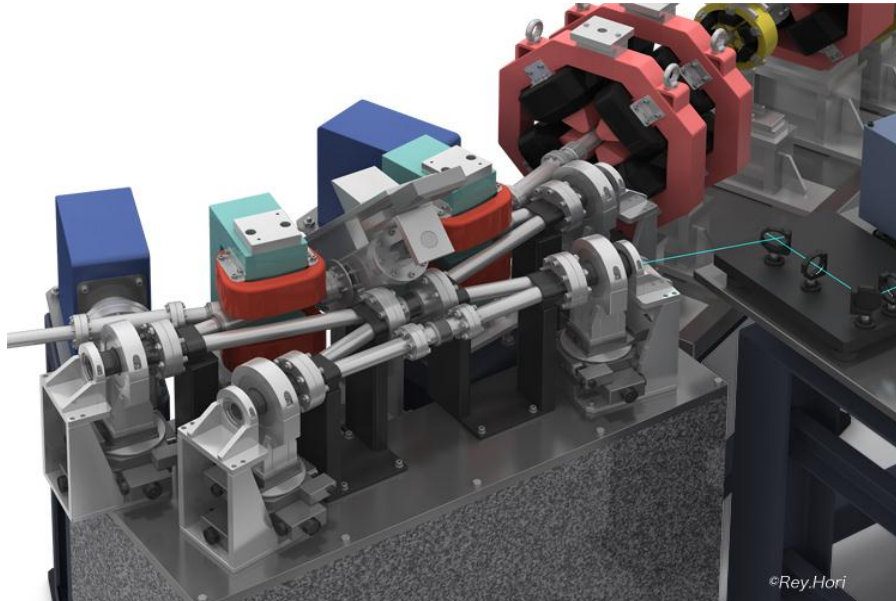


STF Accelerator

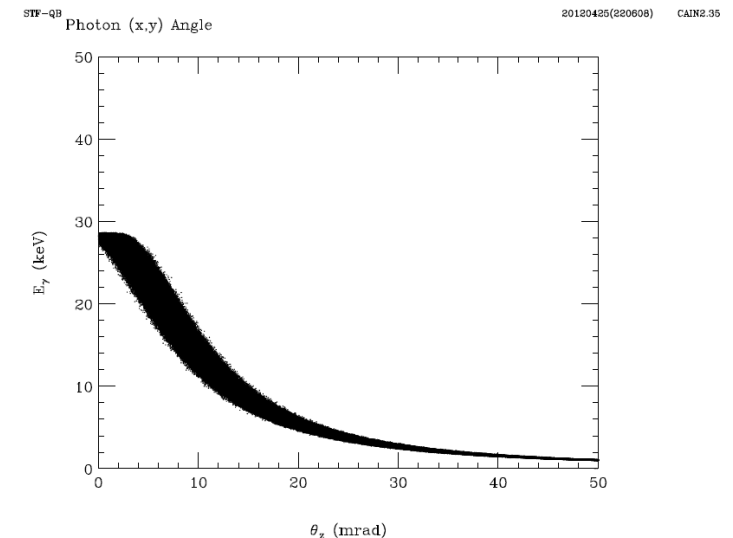
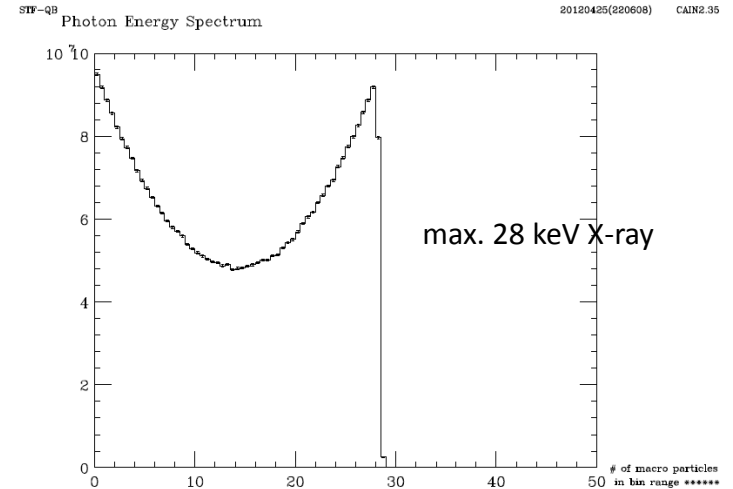
2012 Fall run : September to December
Target : High-flux X-ray generation,
Various accelerator study

Plan of X-ray generation by Inverse-compton scattering

4-mirror laser accumulation, head-on collision with e-beam 40MeV, head-on collision



	Electron	Laser
Energy	40MeV	1.17eV ($\lambda=1064\text{nm}$)
Energy spread	0.1% (rms)	
Beam size(rms)	10 μm	10 μm
Pulse width(FWHM)	12ps	12ps
Intensity	61.5 pC/bunch	50mJ/pulse
Number of bunches	162500	----
Emittance	0.5 π mm mrad	
Collision angle	0deg (Head on)	
Rep. Rate	5Hz	



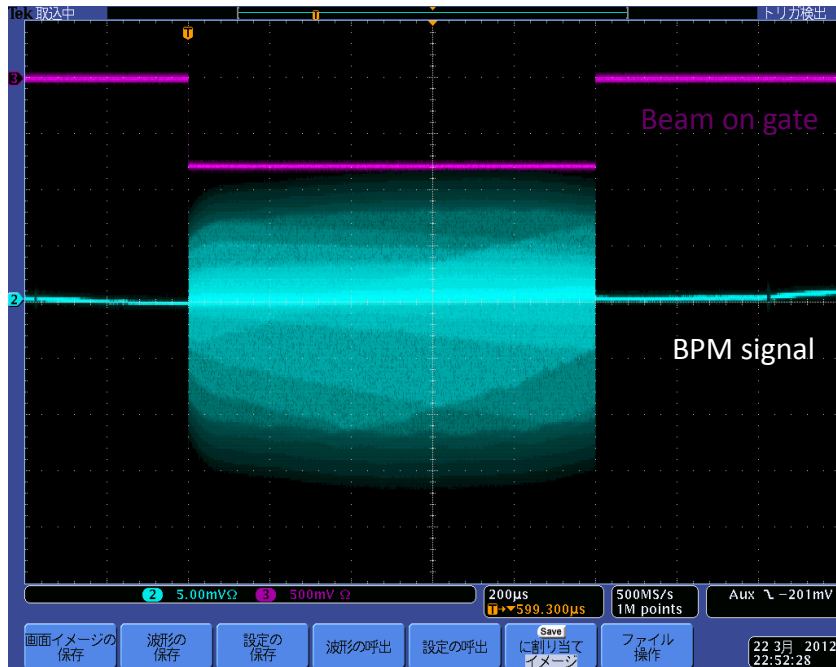
target: 1.3×10^{10} photons/sec/1%bw

STF Beam Parameters

	Quantum-Beam Accelerator	STF Phase2 Accelerator
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)

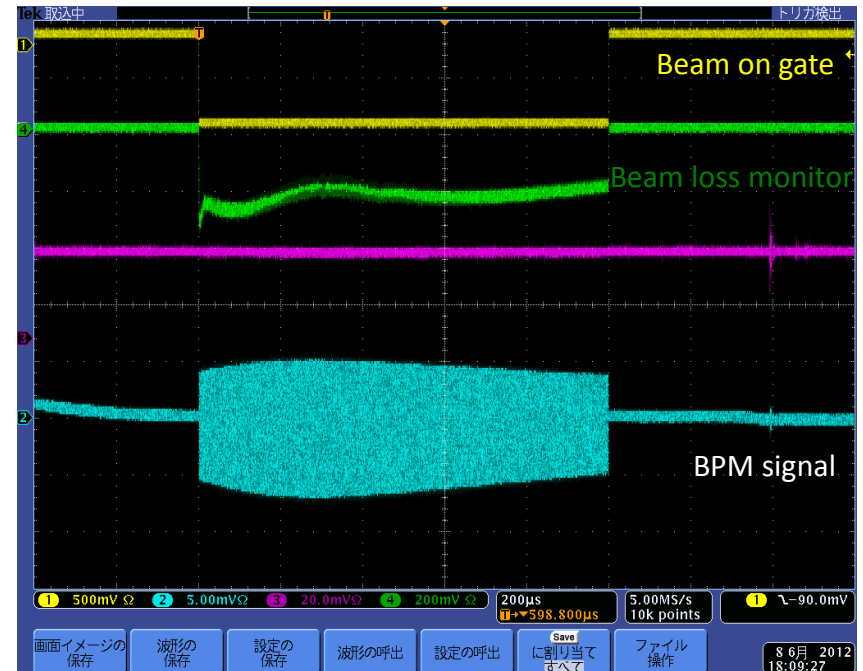
Achieved Long bunch train generation and acceleration

1ms bunch train extraction from RF-gun



1ms flat Beam extraction from RF-gun 1ms
(RF feedback ON) 03.22.2012

Beam acceleration by Capture Cryomodule



Beam acceleration with 1ms train (15pC/bunch)
(Gun/SCRF RF feedback ON) 06.08.2012

2.5mA

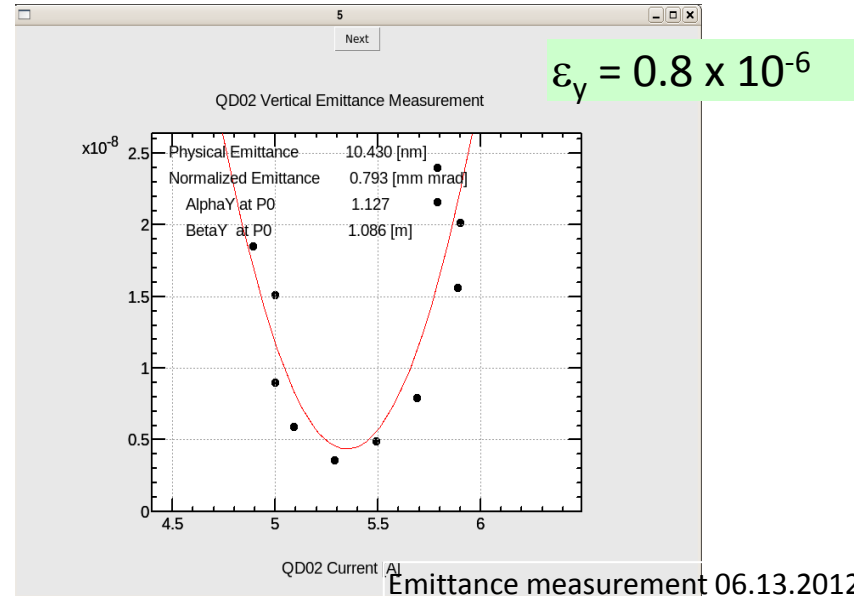
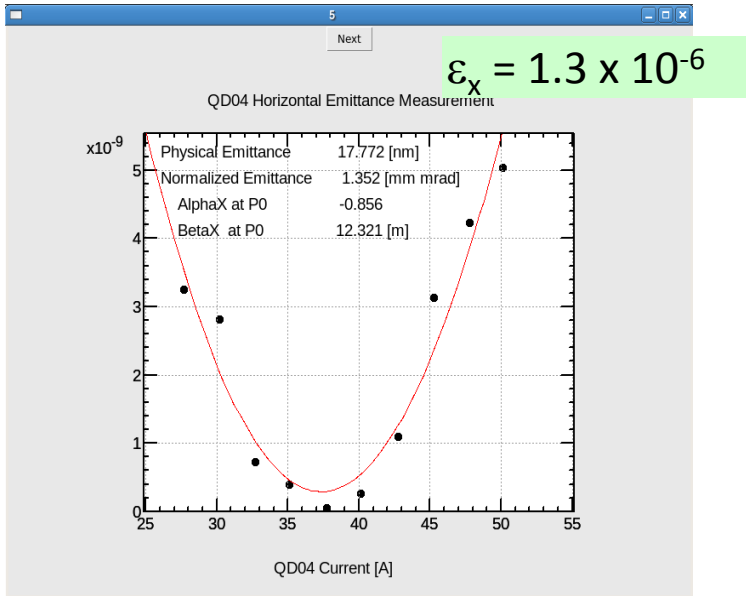
* ILC(TDR) : 5.8mA beam current, 0.727ms train length

Achieved beam performance (1)

Target Emittance: 0.5×10^{-6} at 62pC/bunch

X emittance @WM-PRM-05

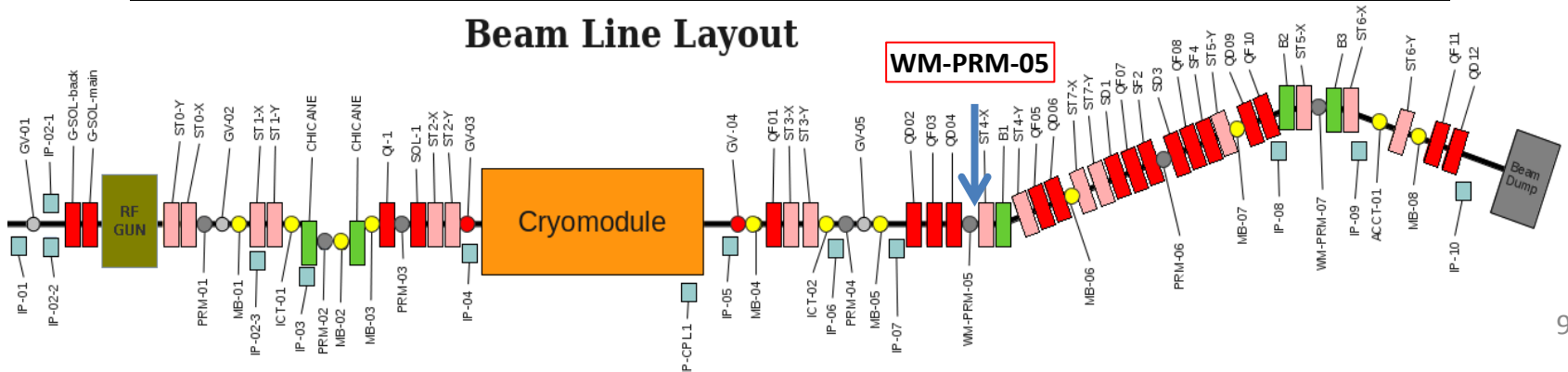
Y emittance @WM-PRM-05



Emittance measurement 06.13.2012

Date	Normalized Emittance [mm mrad]		RF gun [MW]	SC cav. [MV/m]	Main Solenoid : Main/Backing	UV Laser	Charge [pC]	Energy [MeV/C]
	Vertical	Horizontal						
13/June	0.79	1.3	3.5	14.5, 24.0	306.23 / 100.73	φ1mm	15-25	39.1

Beam Line Layout

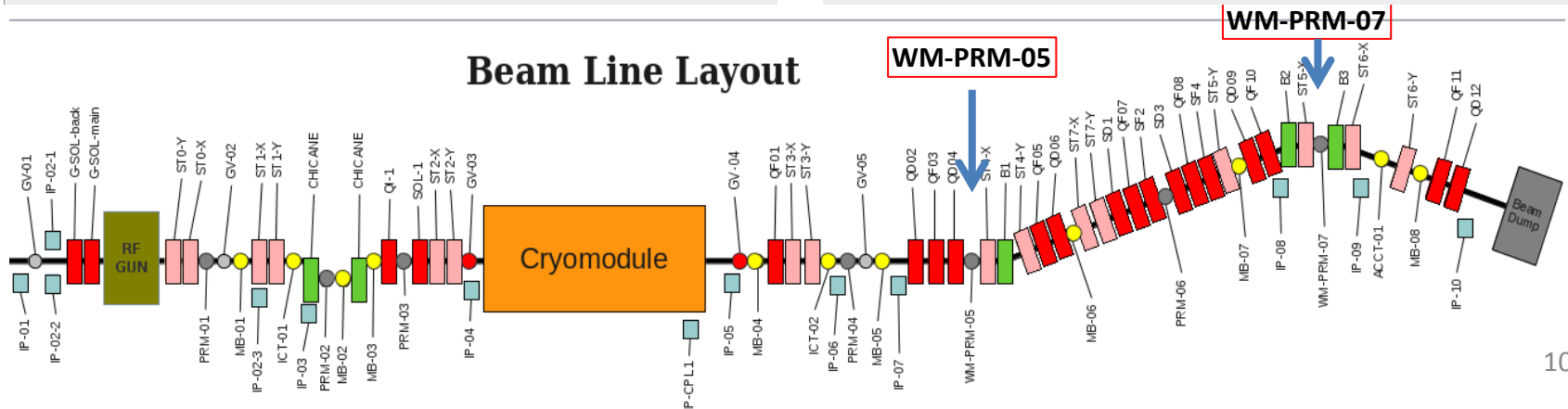
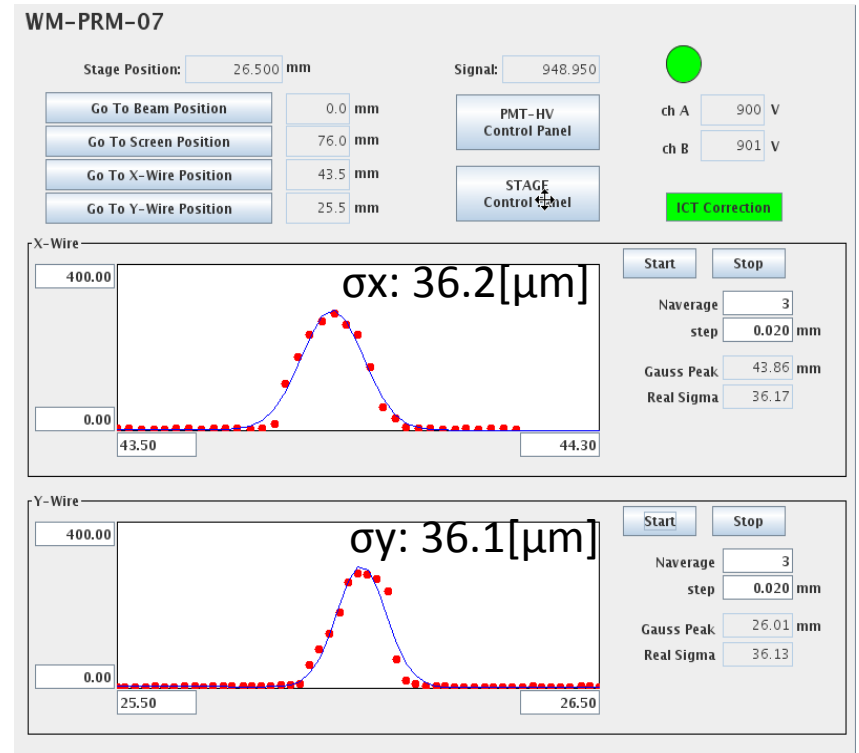
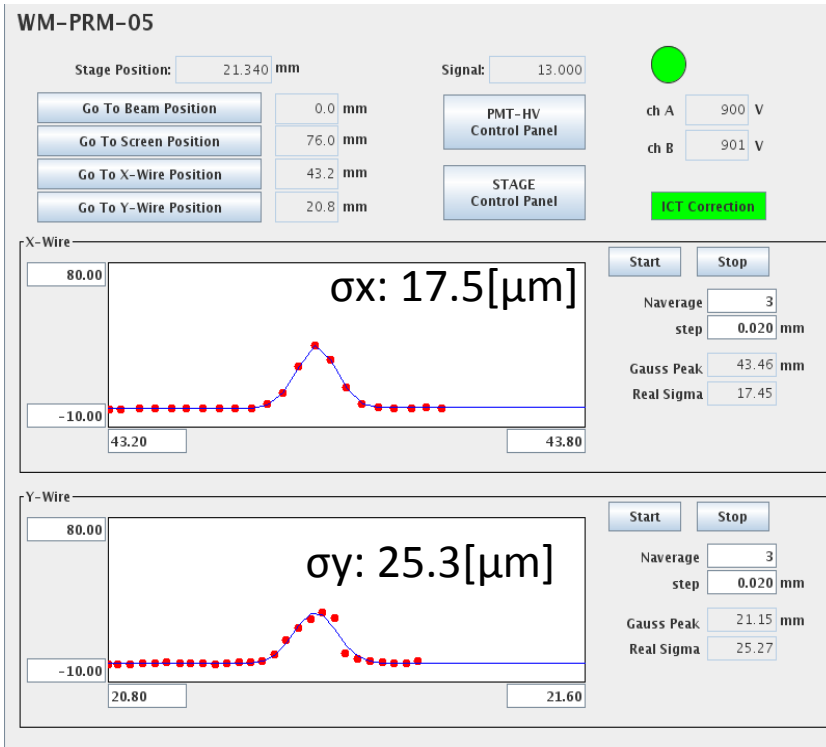


Achieved beam performance (2)

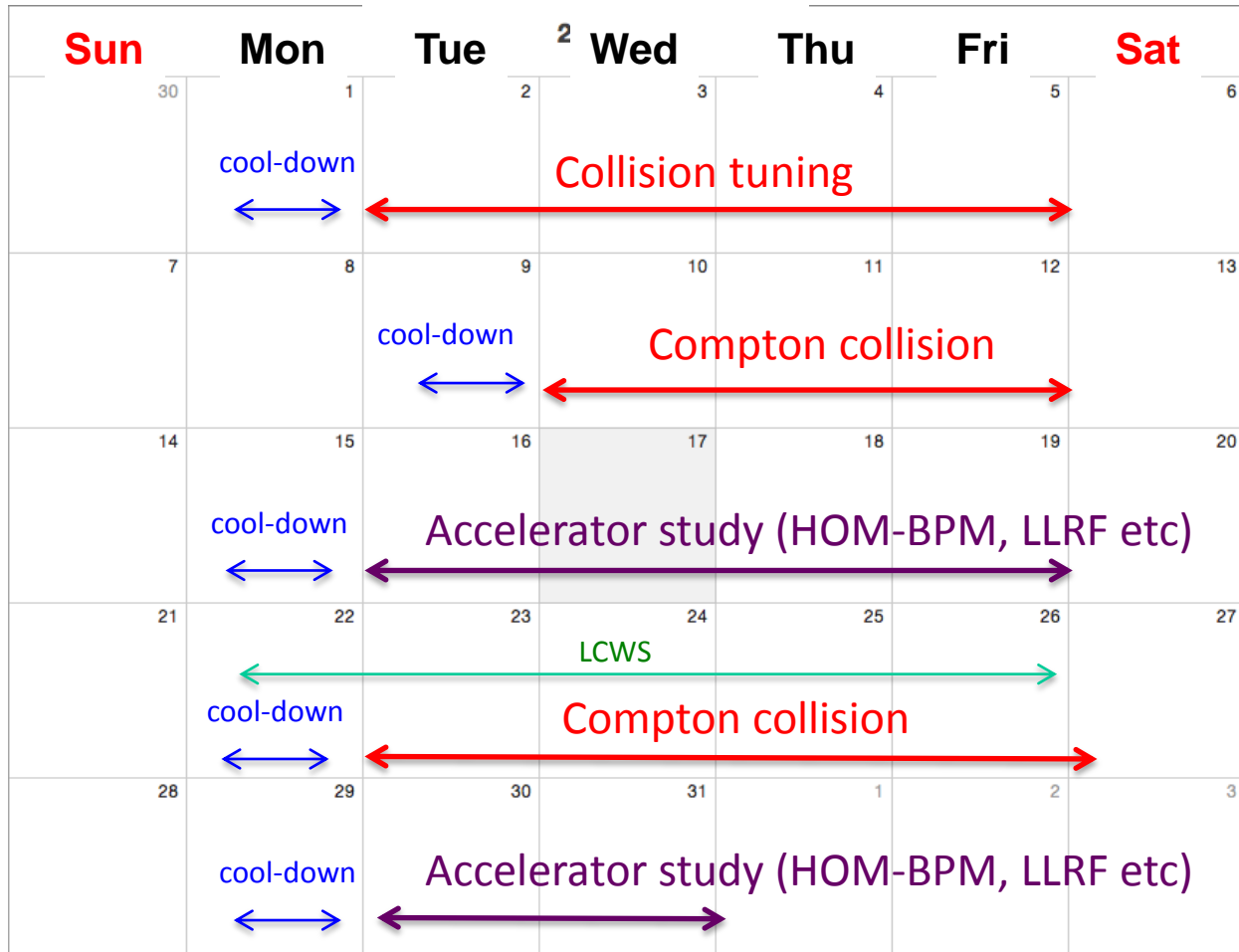
Target beam size: 10 μ m

Minimum beam size @ WM-PRM-05

Minimum beam size @ WM-PRM-07



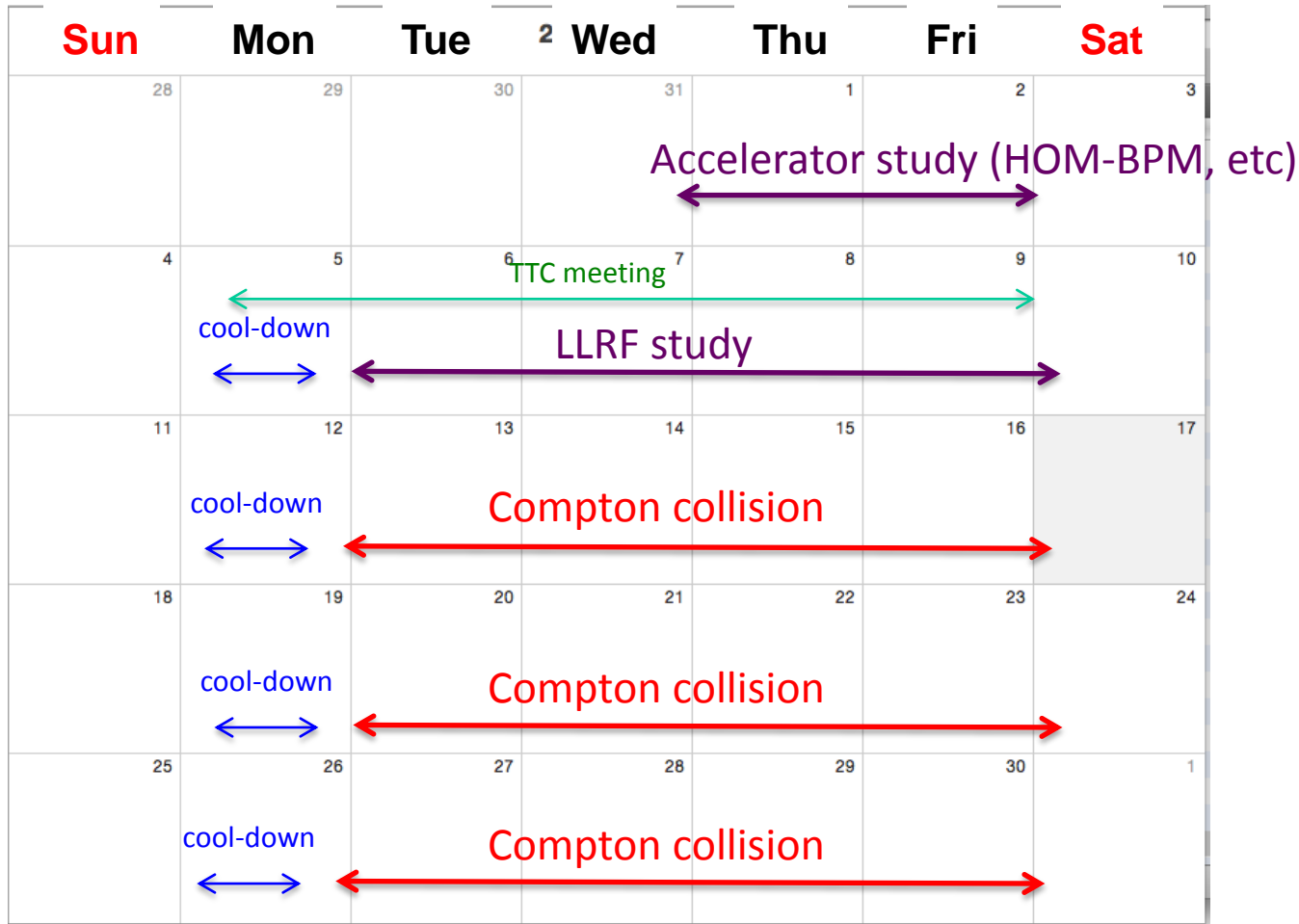
October 2012



STF operation fall 2012

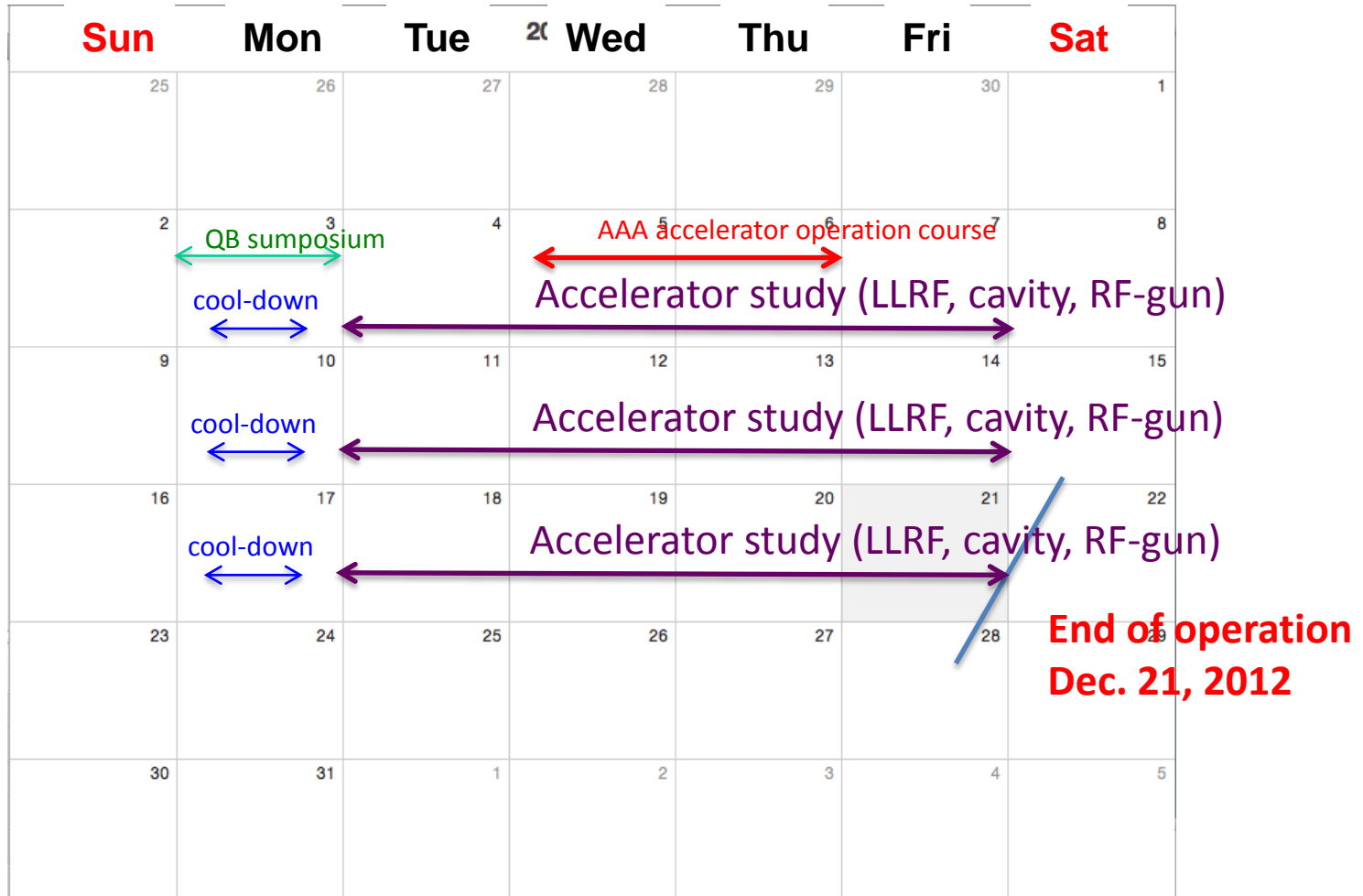
Target: Accelerator tuning and machine study
Preparation for High flux X-ray generation

November 2012



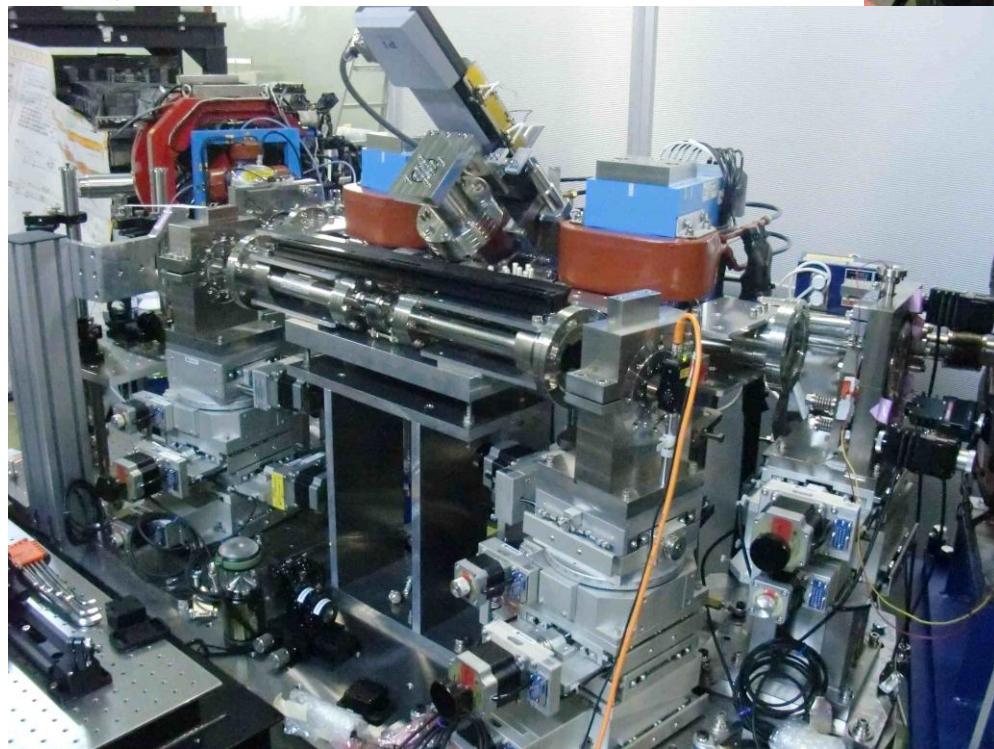
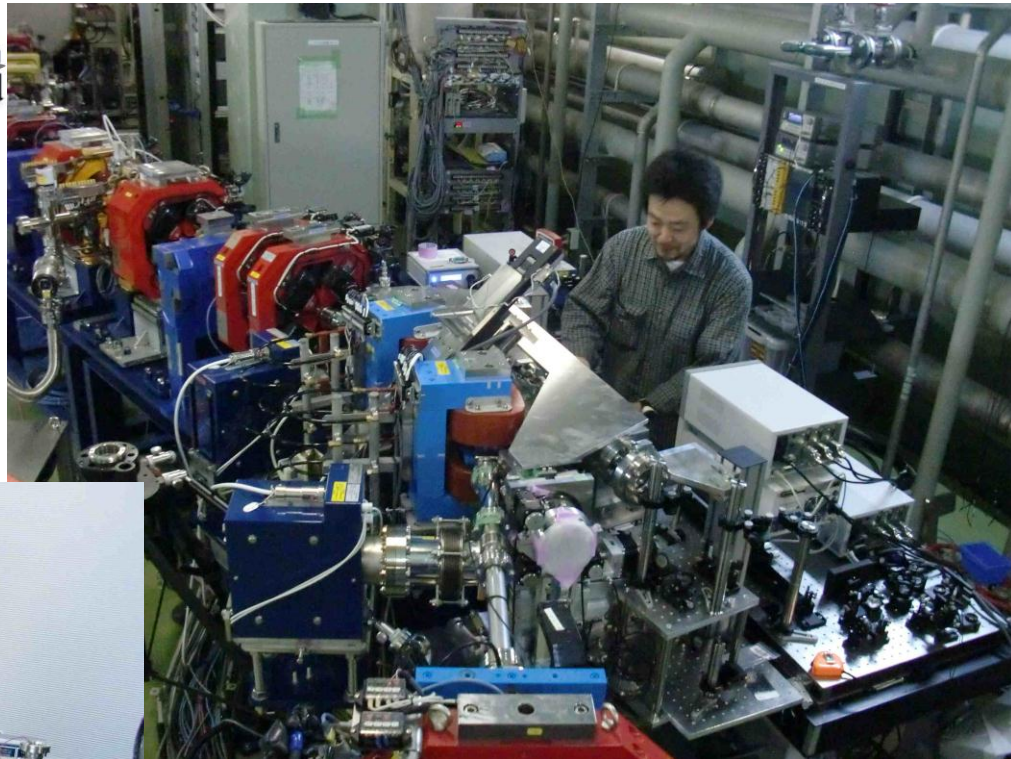
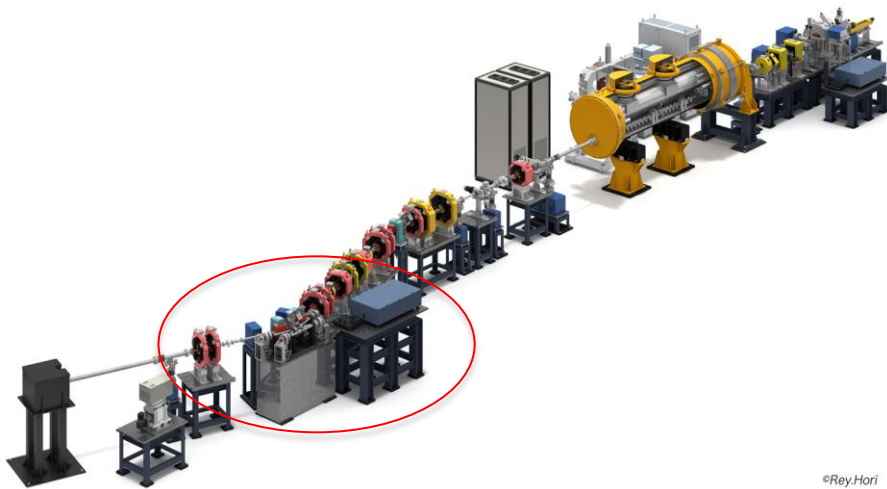
Target: High flux X-ray generation

December 2012



Accelerator Study: 10mA beam acceleration, high gradient operation, etc

4 mirror laser accumulator is under preparation

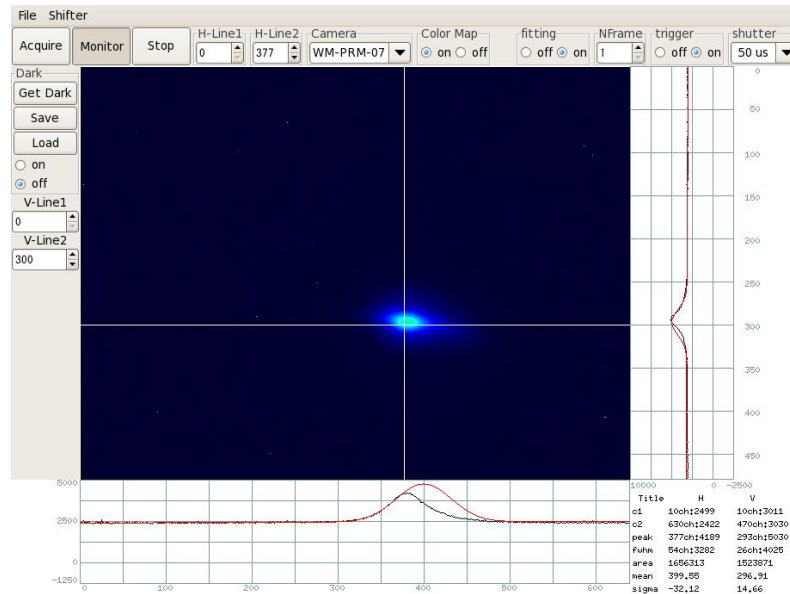


2012/Sep/28 H. Shimizu

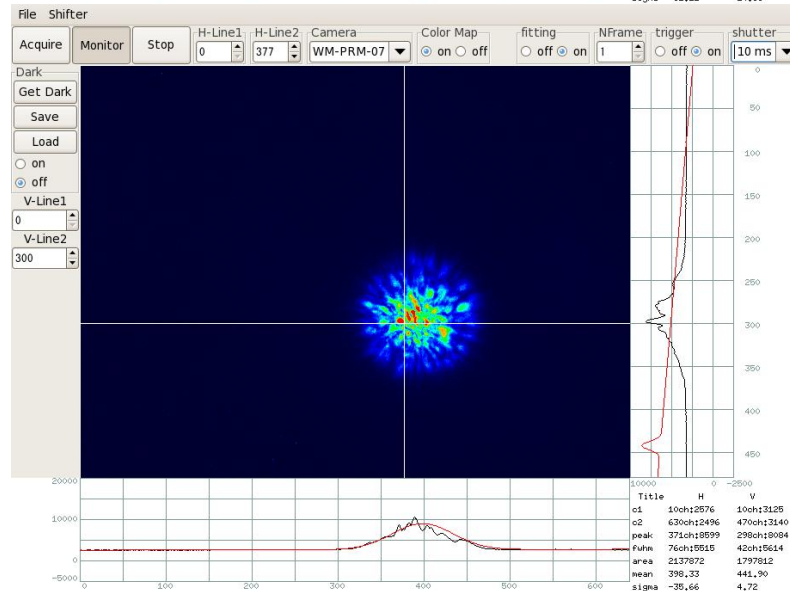
Laser accumulation was confirmed.
Phase-lock to accelerator reference,
Laser intensity increase is on a way.

Screen monitor images at collision point; Spatial alignment of electron beam and laser beam was checked.

Spatial positions
were aligned.
(Oct. 17,2012)



Electron beam
(40bunch)



Laser beam
(injected laser, not circulating)

Status of Superconducting Cavities


(1) STF cryomodule CM-1 cavities are;

MHI-014: 3-rd VT: 36MV/m (finished)


MHI-015: 4-th VT: 35.7MV/m (finished)

MHI-016: 2-nd VT: 34MV/m (finished)

MHI-017: 1-st VT: 38MV/m (finished)

 MHI-018: 3-rd VT: 30MV/m

MHI-019: 2-nd VT: 37MV/m (finished)

 MHI-020: 2-nd VT: 28.5MV/m

MHI-021: 1-st VT: 38.9MV/m (finished)

MHI-022: 2-nd VT: 35.8MV/m (finished)

All recent 9 cavities were within 35MV/m +/- 20%(TDR) (will be installed to CM-1)

MHI-018 and 020 will be processed one more cycle

(2) New bender/KEK cavities;

TOS-02(w/o HOM): 1-st VT: 31.2MV/m, 2-nd VT: 32.7MV/m

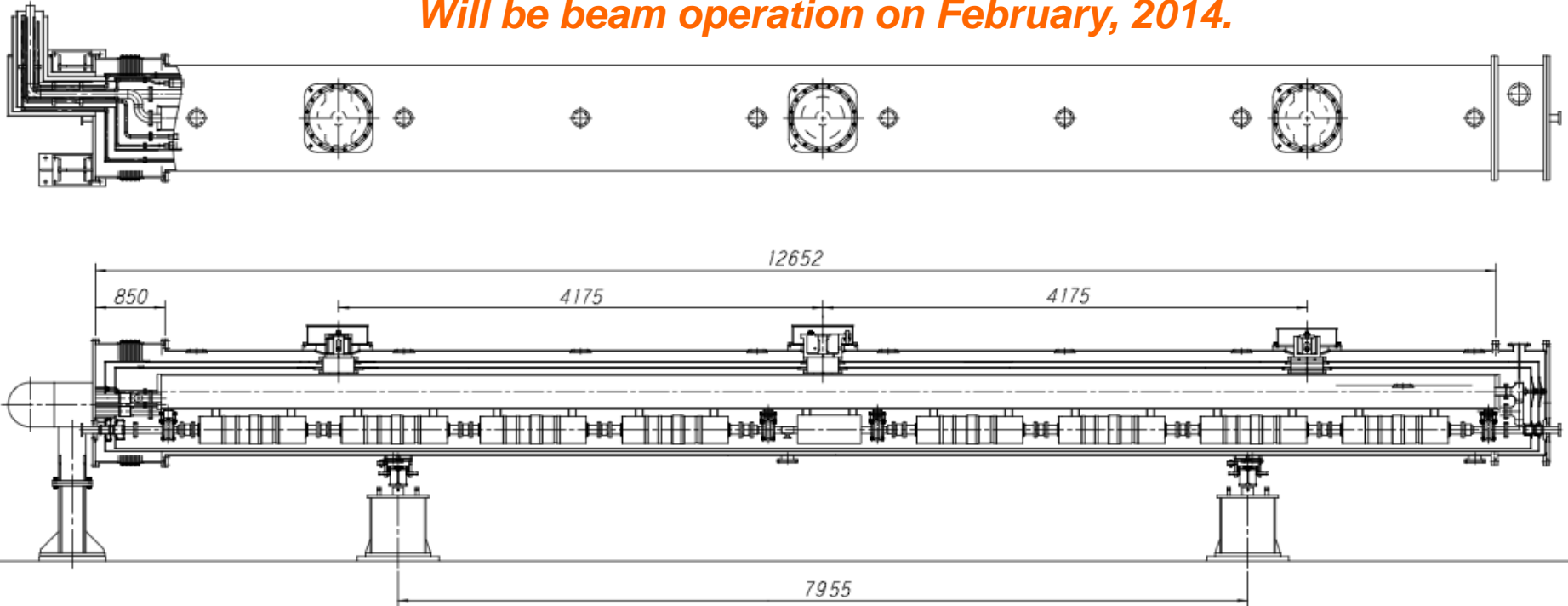
HIT-02(with HOM): 1-st VT: 35.2MV/m, 2-nd VT: 40.9MV/m, 3-rd VT: 33MV/m

KEK-00(w/o HOM): 1-st VT: 26MV/m, 2-nd VT: 29MV/m, 3-rd VT: 24MV/m, 4-th: 20MV/m

KEK-01(with HOM): under fabrication

ILC design cryomodule : CM-1

*The fabrication started in this month.
Will be completed till June, 2013.
Will be installed in tunnel till December, 2013.
Will be beam operation on February, 2014.*

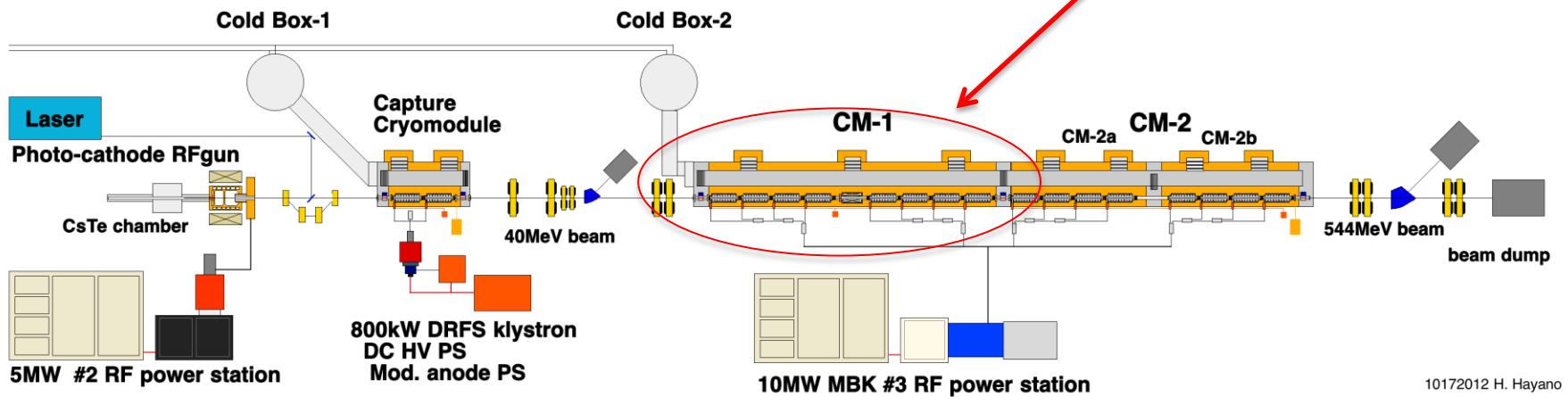


8 Cavities + dummy quad
4 cavities : slide-jack tuner in center
4 cavities : slide-jack tuner in end

STF phase 2

CM-1 cryomodule

STF Phase-2 Accelerator Plan



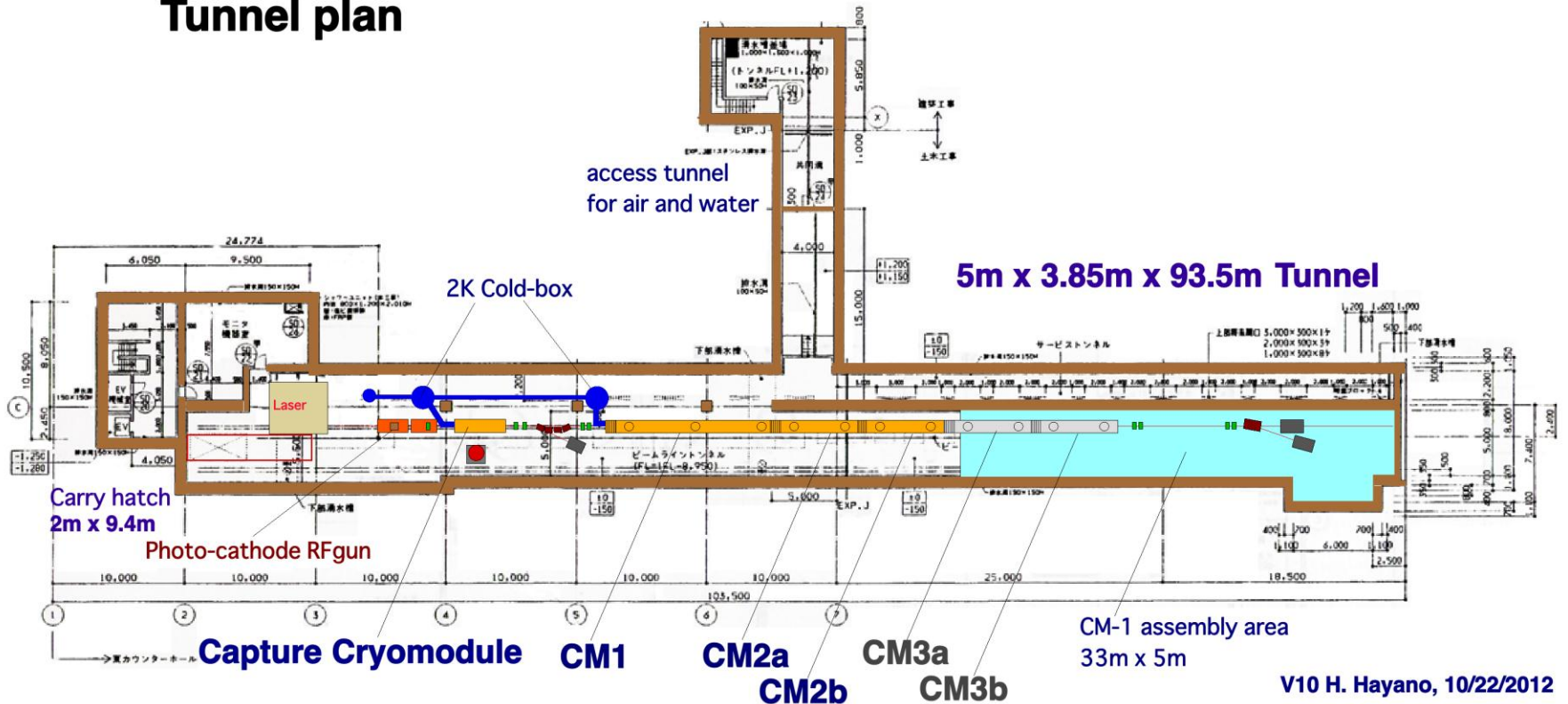
10172012 H. Hayano

Cryomodule: CM-1 is ILC cryomodule,
CM-2a, CM-2b, ... will be half-size cryomodule
utilizing existing infra-structure

Half-size cryomodule can be assembled in parallel to CM-1 beam operation.

STF phase2.0 accelerator : Tunnel Layout

STF Phase-2 Tunnel plan



Use blue-area for CM-1 assembly in 2013,
Later on, CM-2a, CM-2b, ..., assembly will be done in surface facility.

STF phase2.0 Cryomodule assembly in tunnel

必要作業領域 33m

Connected in local-cleanroom

4空洞搬入治具は取り去る

4空洞搬入治具は取り去る

GRPをぶら下げておく

4 cavities

4 cavities

GRP hang on in tunnel

32900

クライオスタットを設置する

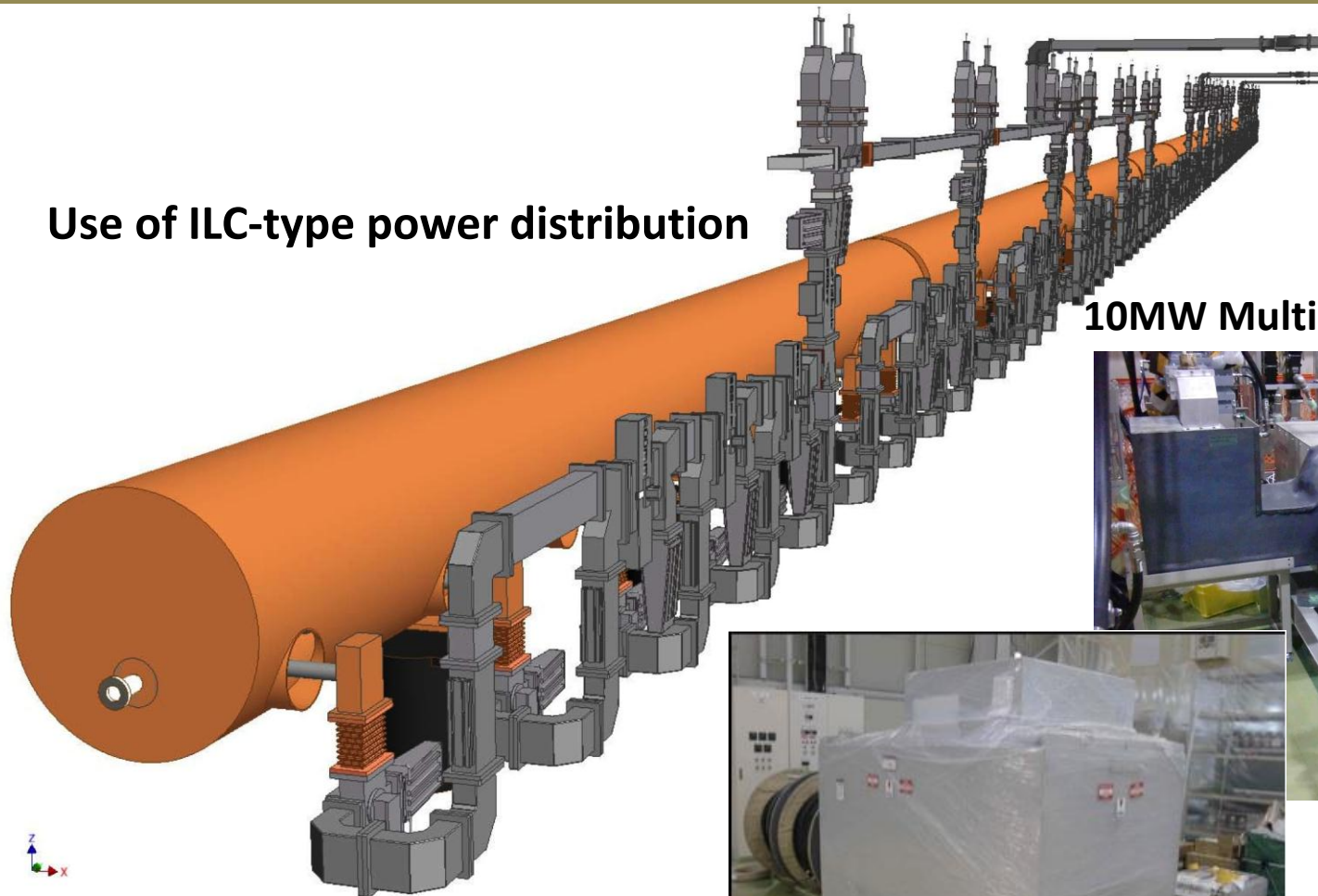
Cold-mass insertion into cryostat

コールドマスをクライオスタット内に吊り下げる。

クライオジュールの移動と加速器への設置はピシャモンとジャッキの人力で。

RF power distribution for STF cryomodules

Use of ILC-type power distribution

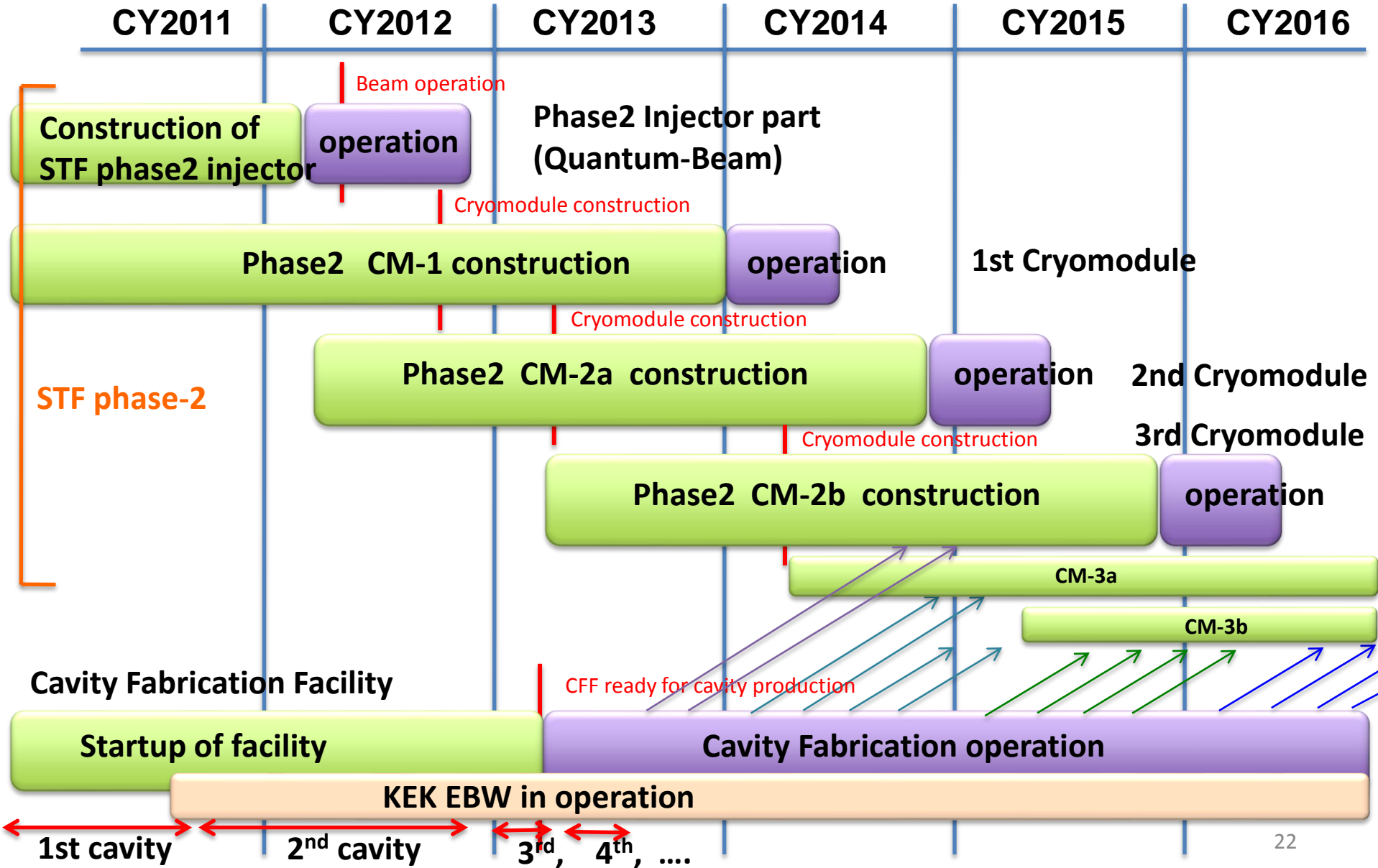


10MW Multi-beam klystron (MBK)



MBK is powered by Marx Modulator

STF future Plans



End of slide