

***STF Quantum-Beam Accelerator
commissioning status***

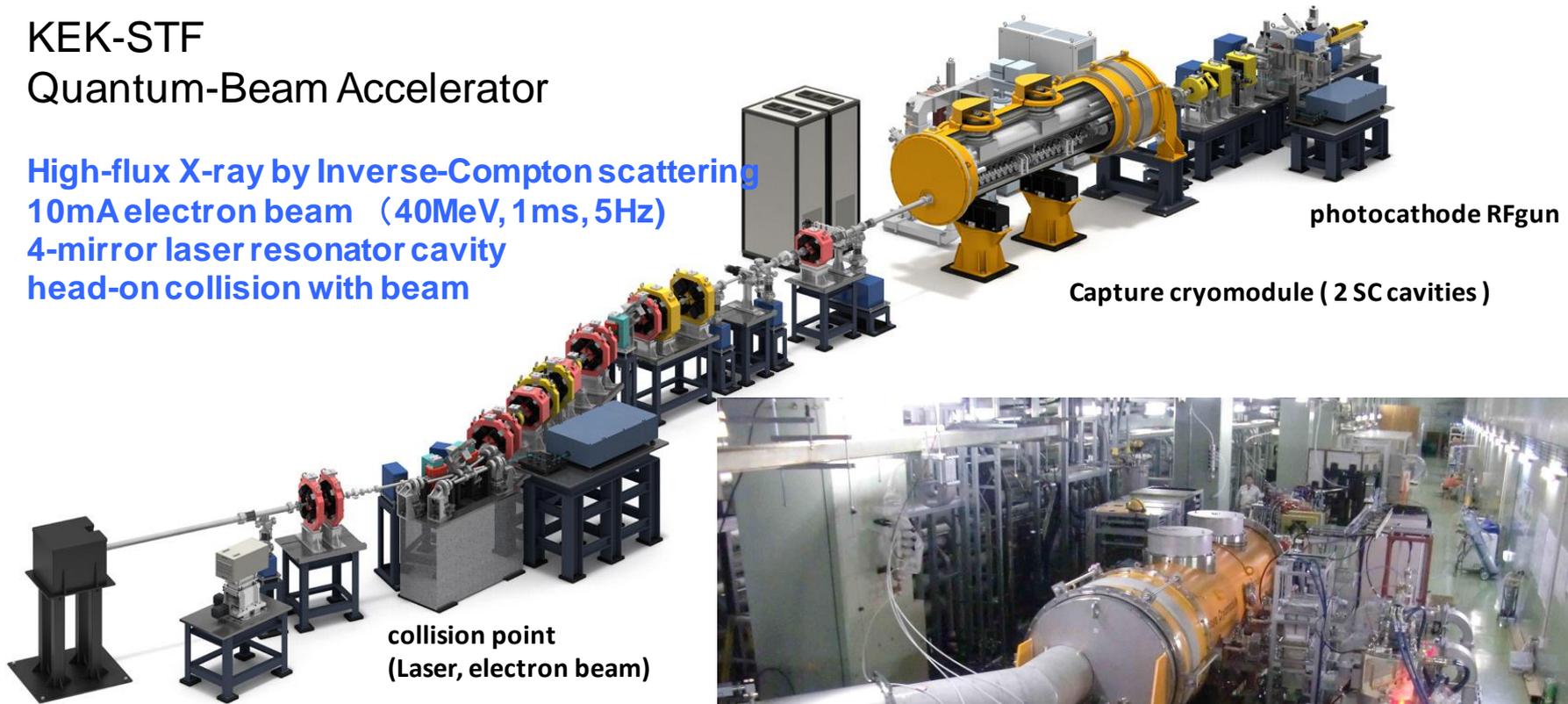
H. Hayano, KEK, 05292012

STF Quantum-Beam experiment

KEK-STF

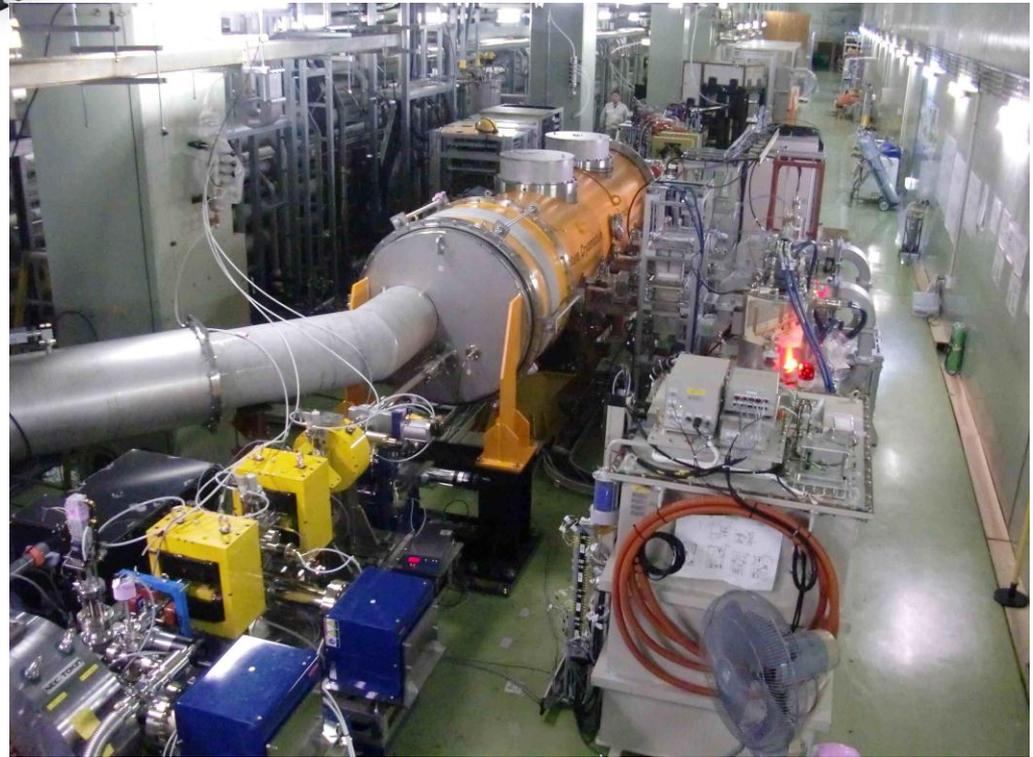
Quantum-Beam Accelerator

High-flux X-ray by Inverse-Compton scattering
10mA electron beam (40MeV, 1ms, 5Hz)
4-mirror laser resonator cavity
head-on collision with beam



Target: 1.3×10^{10} photons/sec 1%bandwidth
30KeV X-ray

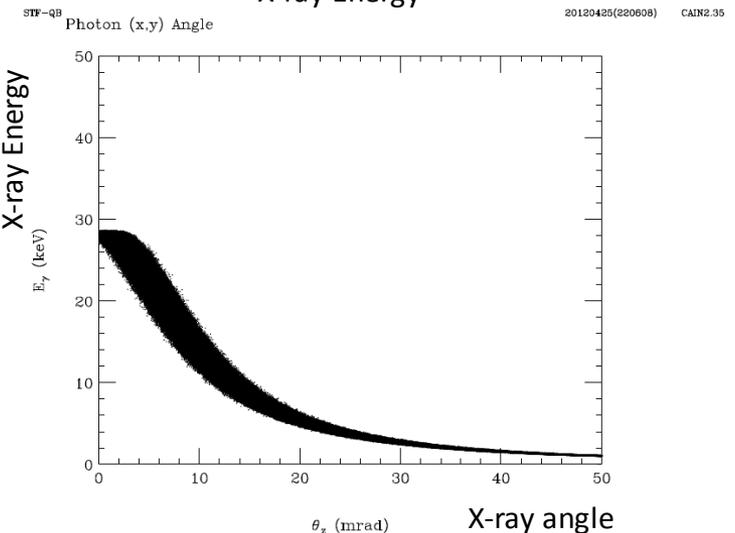
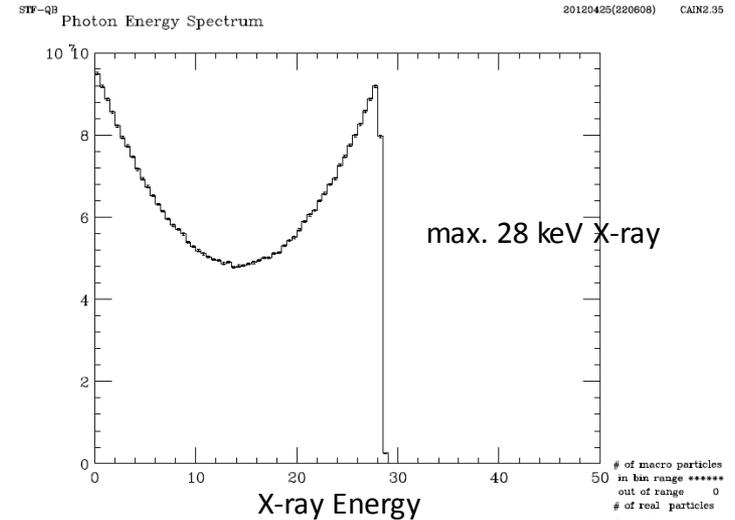
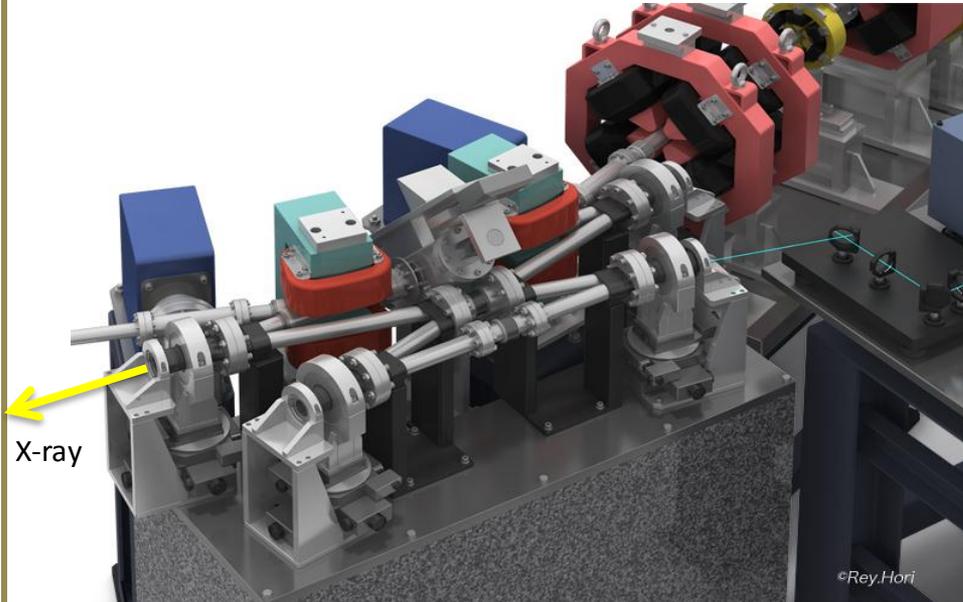
2012. Feb : cool-down started,
April : beam acceleration
experiment: June run,
October run



Plan of X-ray generation by Inverse-compton scattering

4-mirror laser accumulation, head-on with e-beam

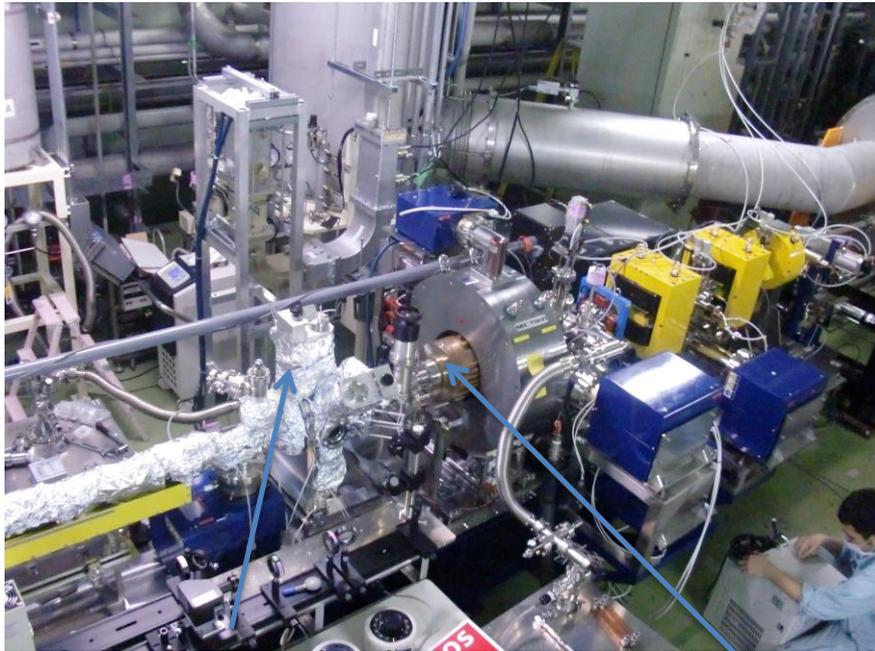
40MeV, head-on collision



	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 Photo-cathode RF-gun



Cs₂Te photocathode
Preparation chamber

RFgun cavity



Cs₂Te
Photocathode
Preparation
Chamber



Molybdenum cathode-block



Quantum efficiency of photo-cathode
0.5 – 1.5%

dark-current (peak)
~300 μ A

emittance:
reliable measurement was not yet done

Accelerated beam (April 13,2012)

Energy : 40MeV、

Beam charge : 41pC/bunch、 28bunches

repetition : 5Hz

RFgun cavity power : 2.2MW

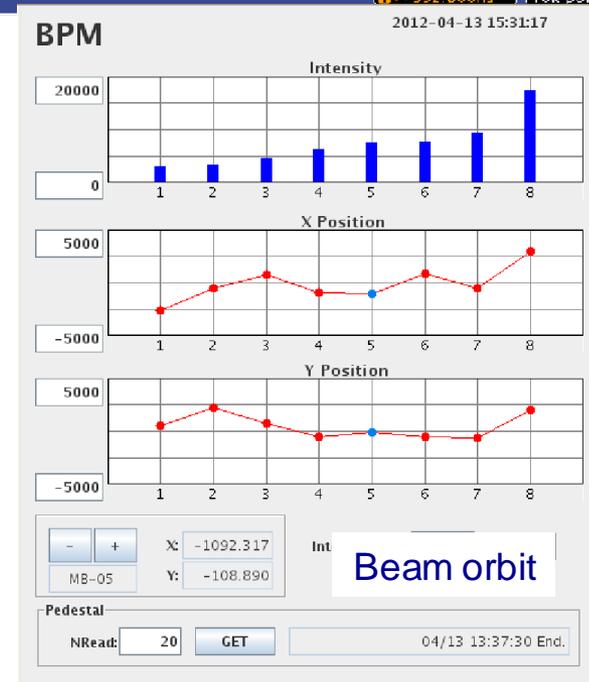
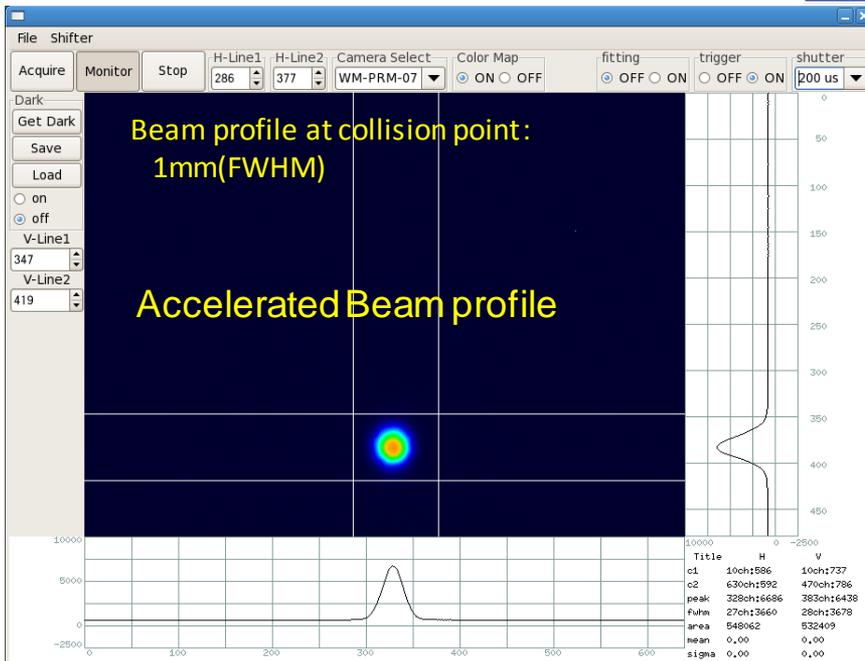
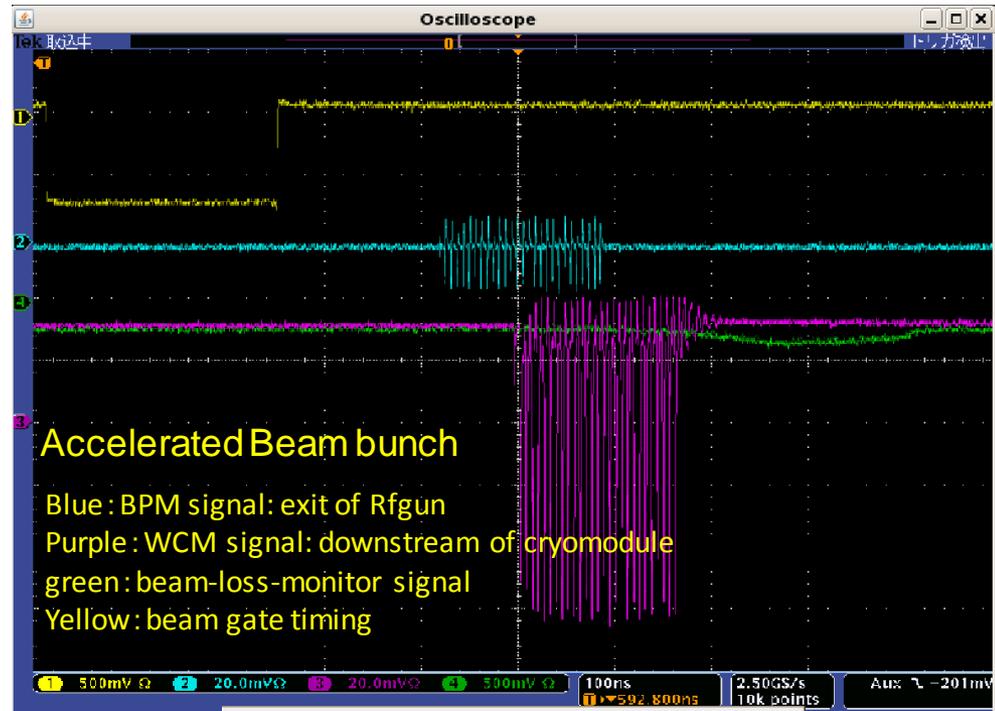
(34.6MV/m cathode field)

Beam energy from RFgun : 3.3MeV/c

SC cavity voltage ;

MHI-012:20.15MV/m (40MV/m in VT)

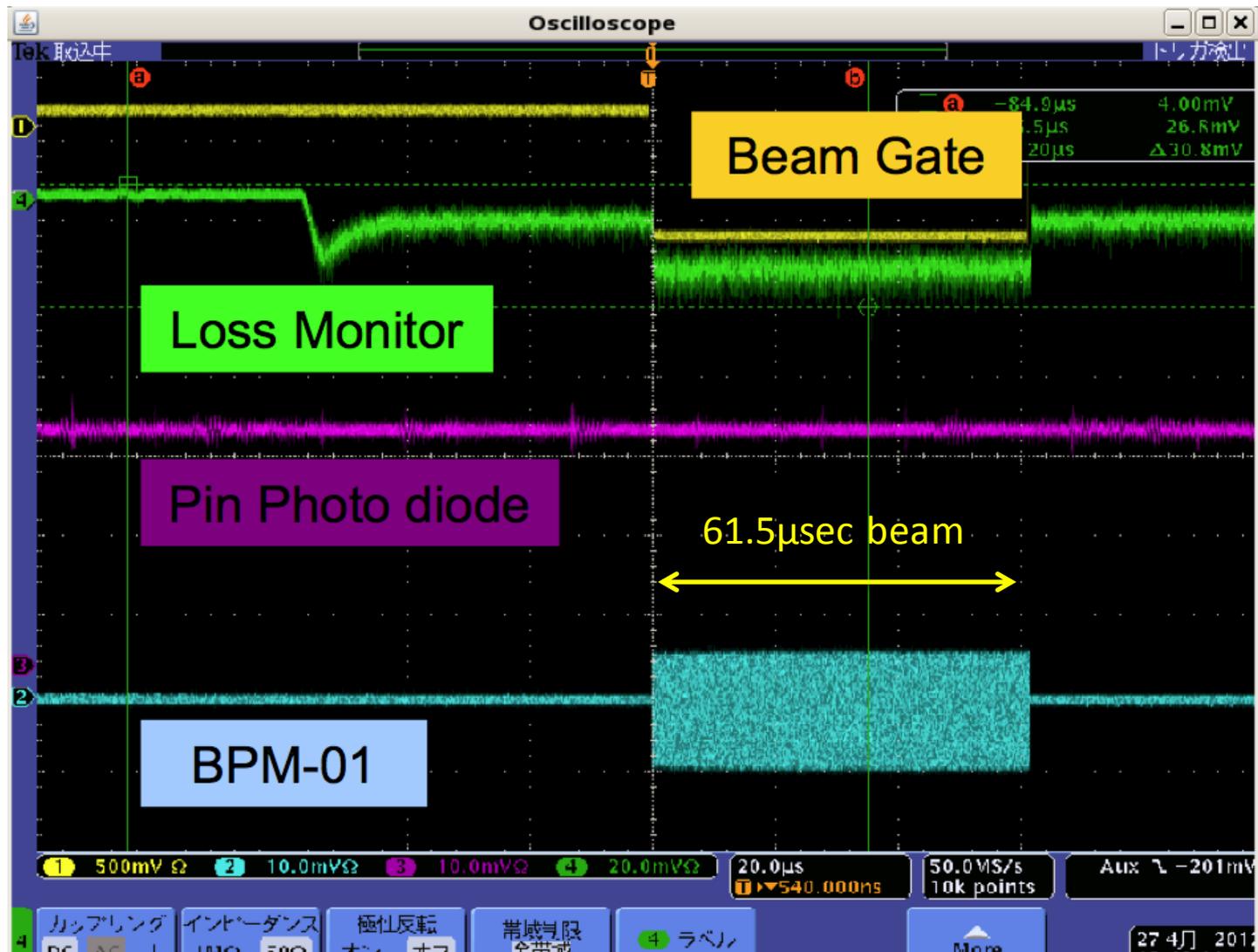
MHI-013:21.5 MV/m (33MV/m in VT)



X orbit

Y orbit

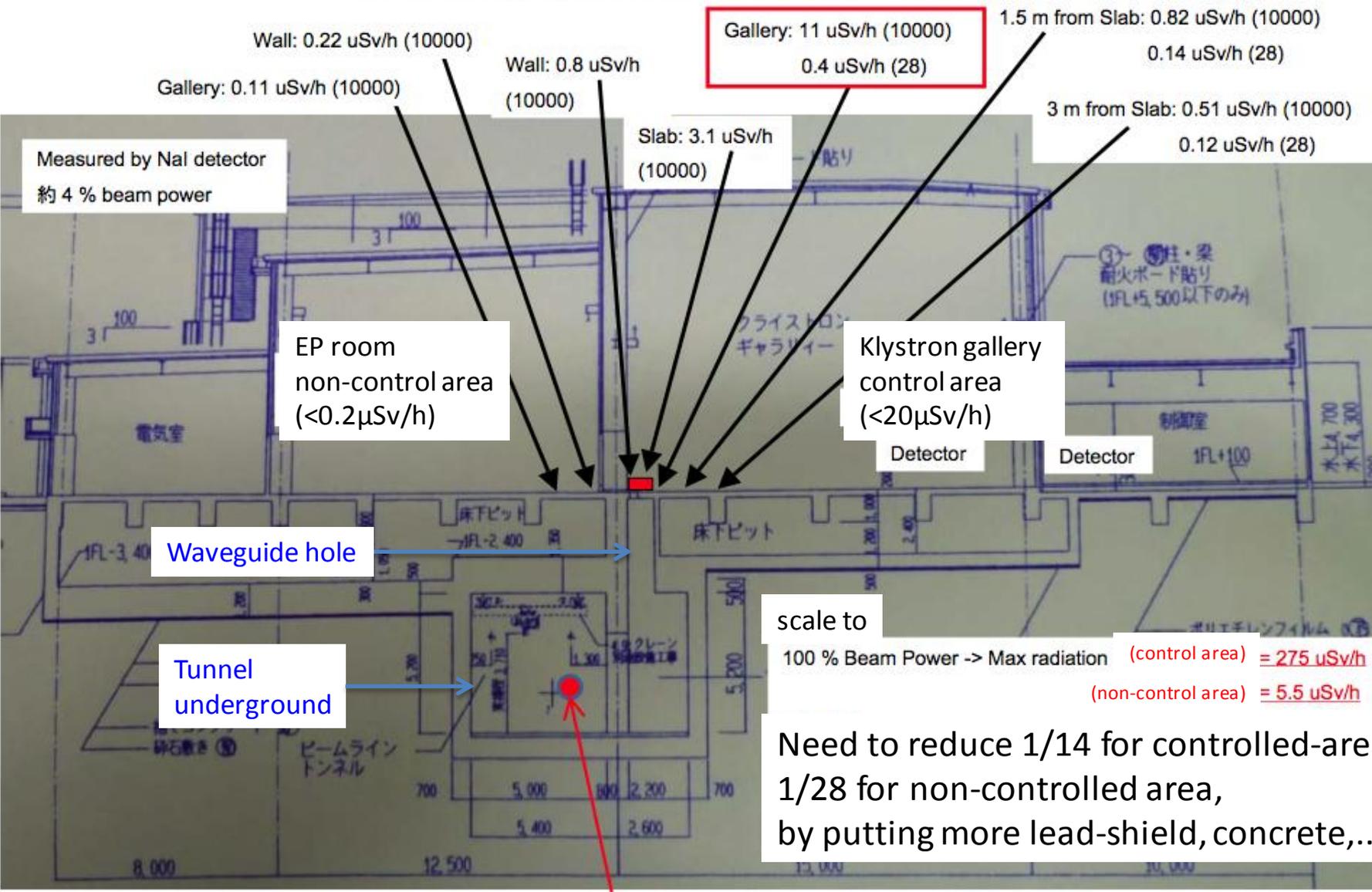
162.5MHz 10,000 bunches (61.5 μ sec) acceleration



4% of Design maximum Beam Power

STF Building cross-section

Radiation leakage to STF surface building (4% of design beam power)



scale to
 100 % Beam Power -> Max radiation (control area) = 275 uSv/h
 (non-control area) = 5.5 uSv/h

Need to reduce 1/14 for controlled-area
 1/28 for non-controlled area,
 by putting more lead-shield, concrete,...

beam dump

concrete shield

More shield were installed

lead-block were placed in front of dump



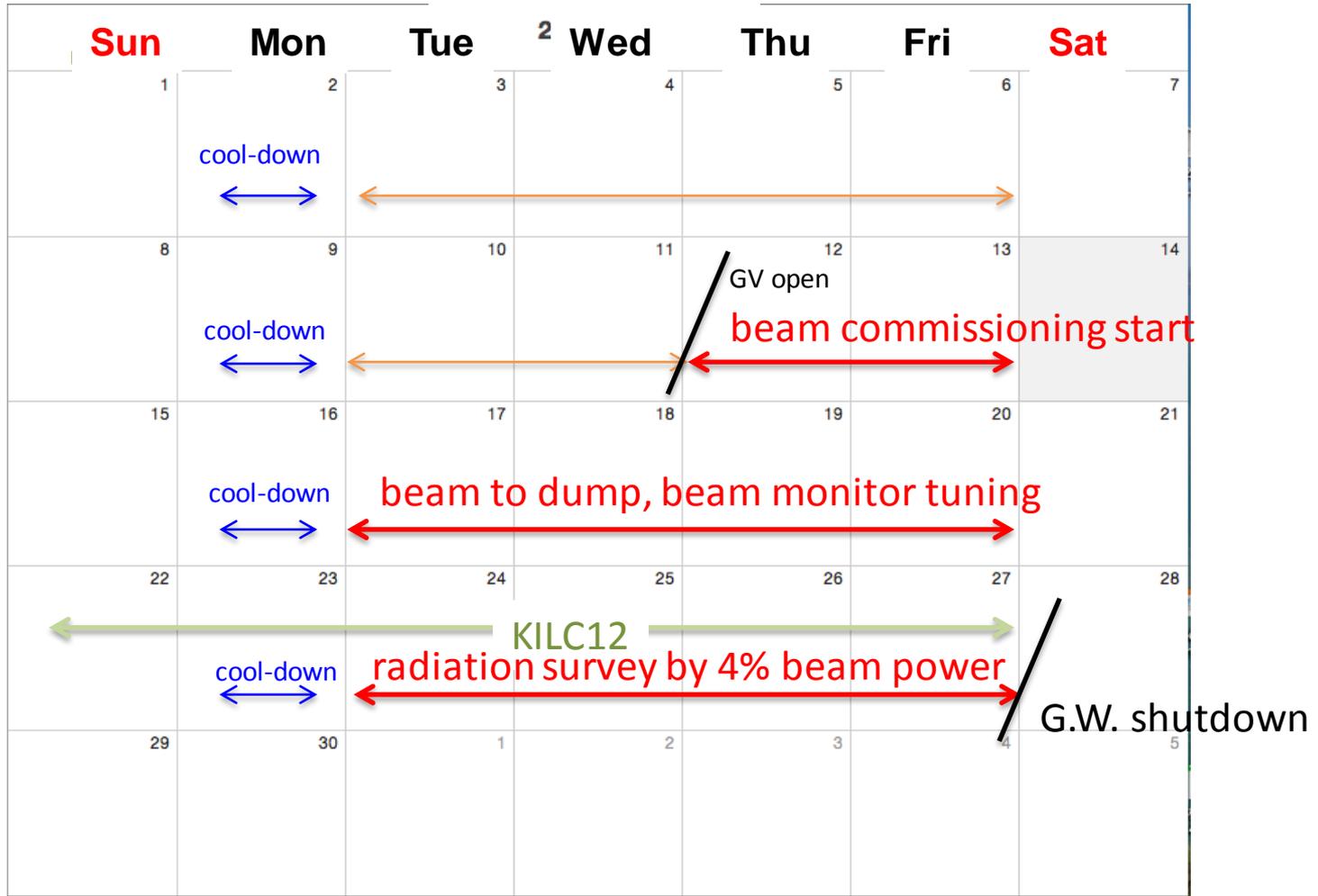
STF accelerator beam dump.
Beam goes from left to right.

lead-shield were installed in the WG-hole



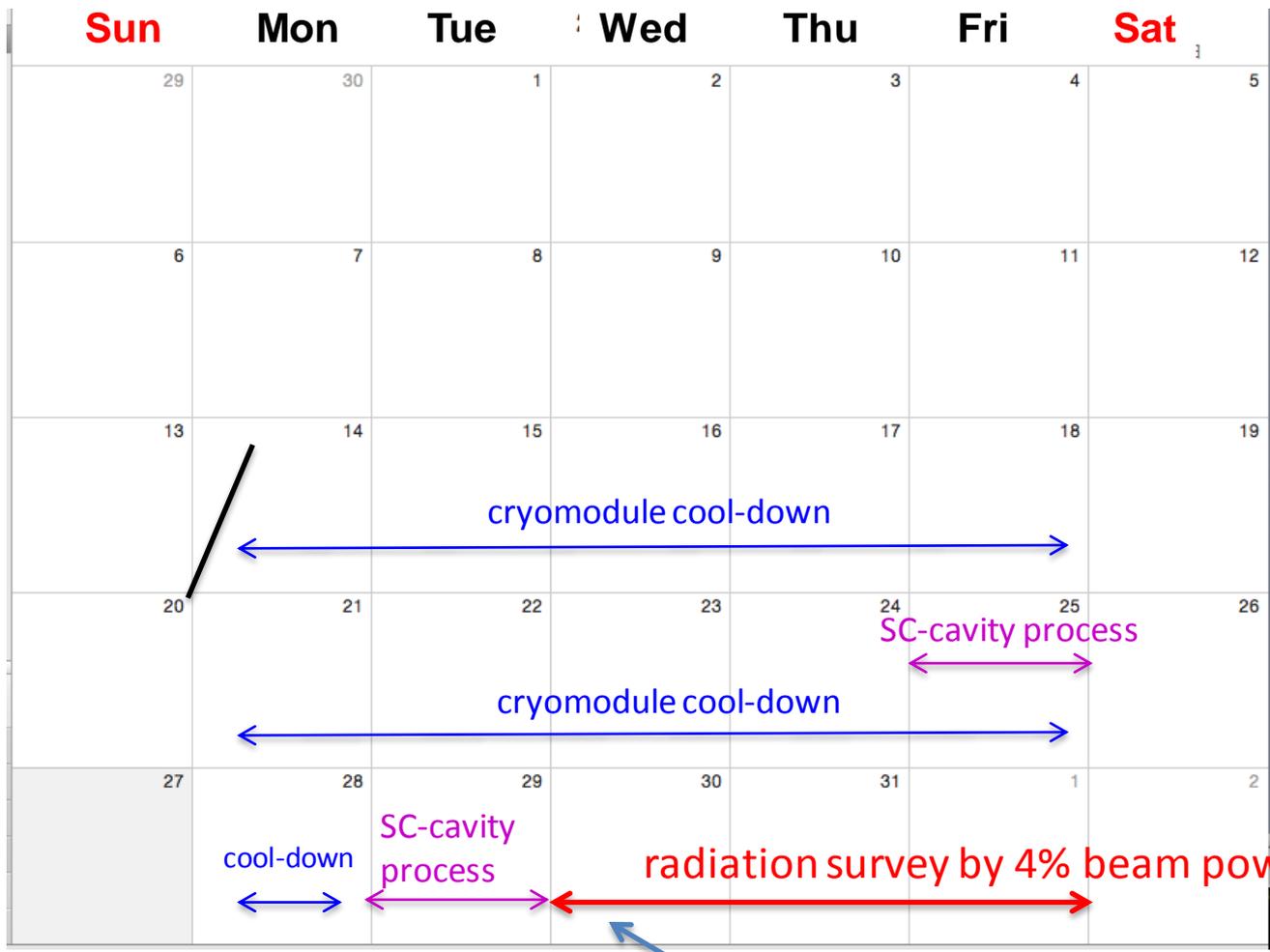
Waveguide access hole between tunnel
and Klystron gallery.
(looking up from tunnel)

April 2012



Schedule

May 2012



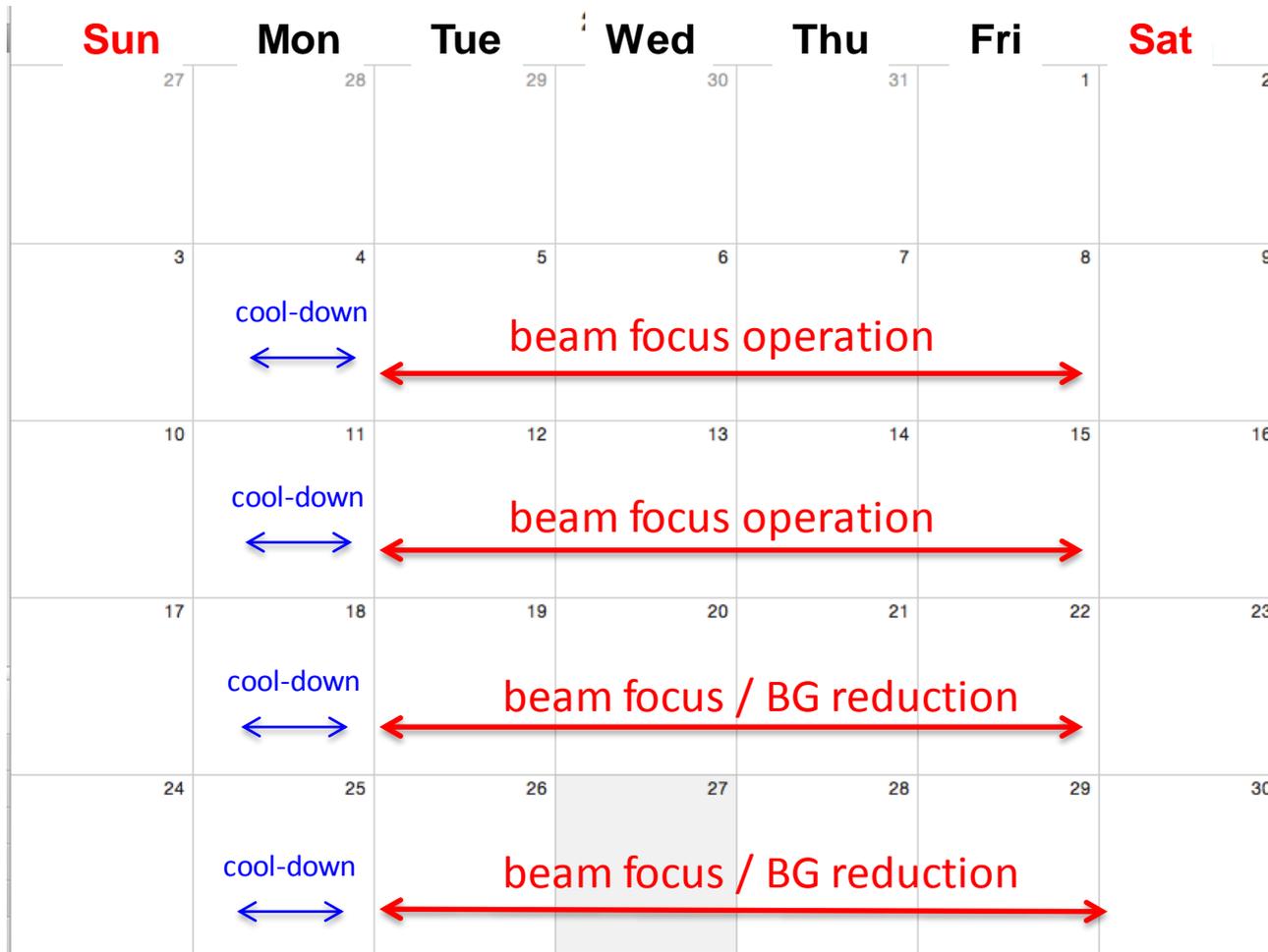
↑ 4 mirror Laser Accumulation cavity

Lead block shield

RFgun Cooling System improvement ↓

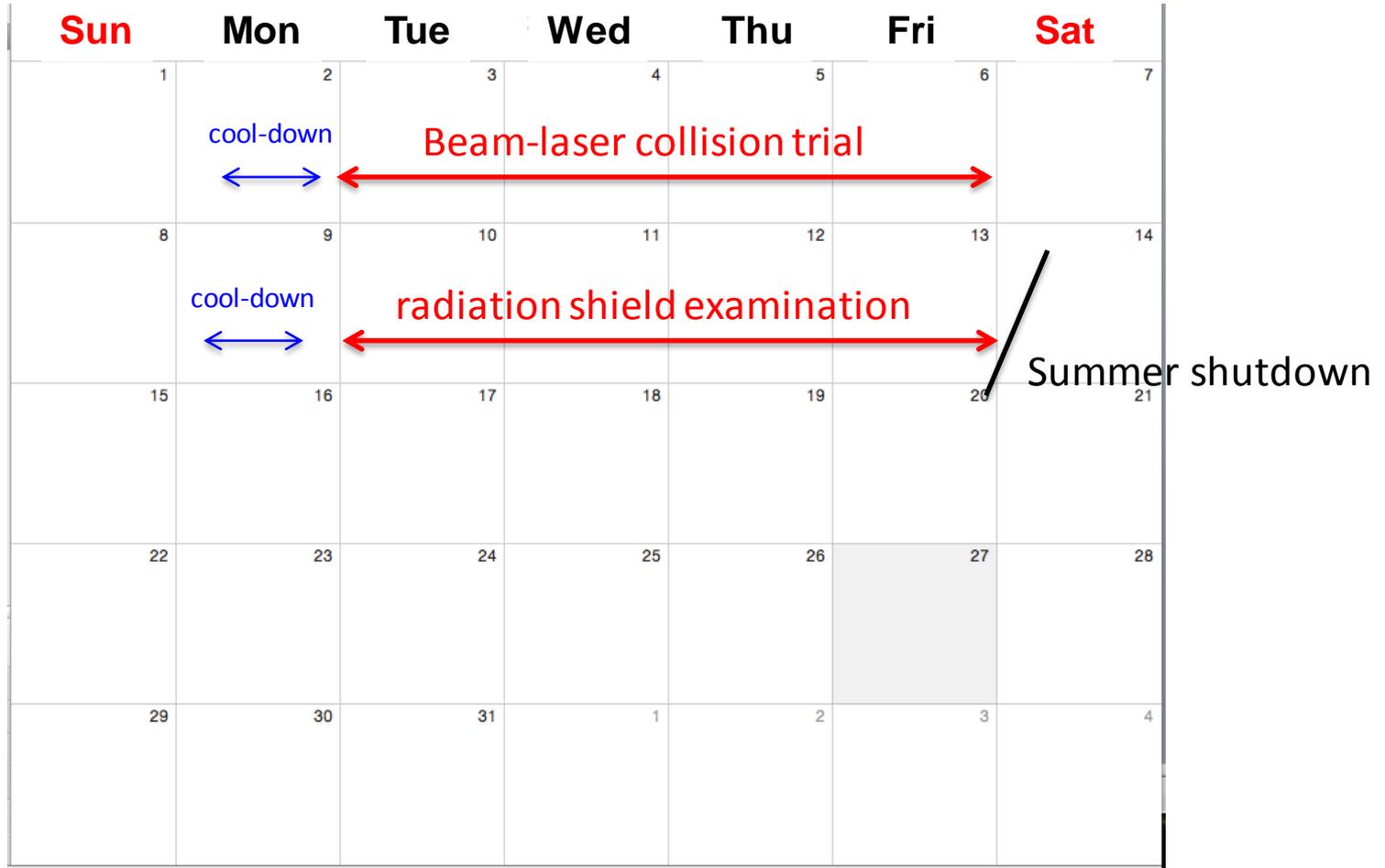
Beam Operation re-start

June 2012



Operation target: Reduce beam emittance, then focus the beam down to 10 μ m size.

July 2012



Operation target: Try to collide electron beam with Laser beam.