Introductions to Taiwan Photon Source and Control System

Vacuum Group
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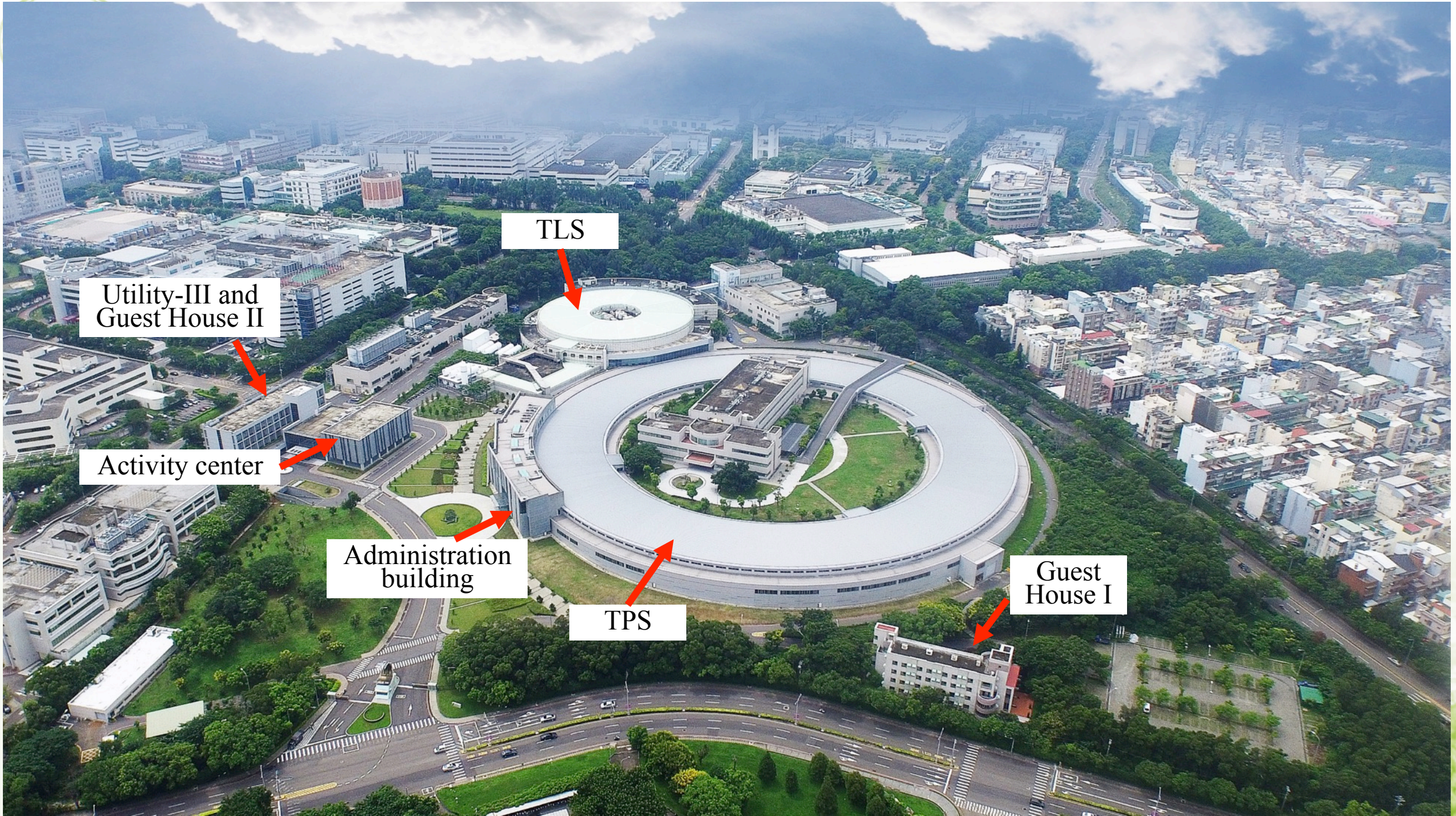
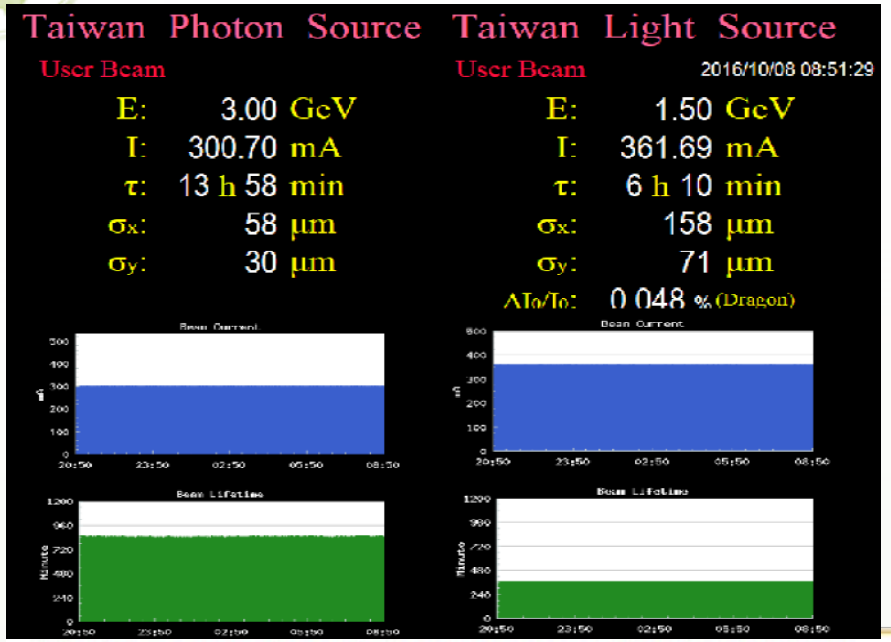
30 Nov. 2016
KEK Tsukuba Japan

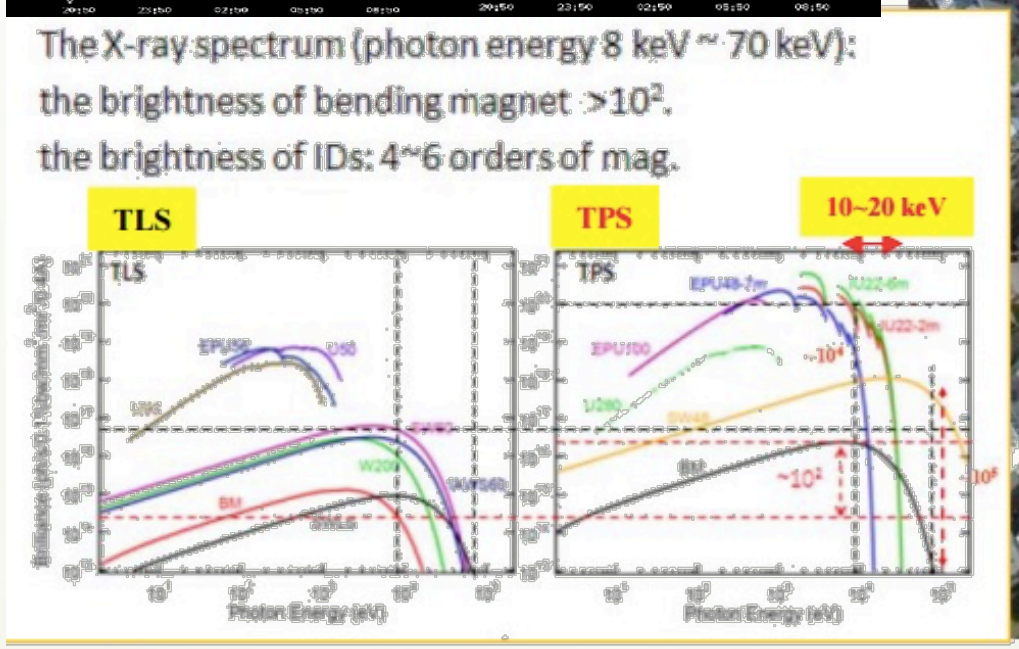
Outline

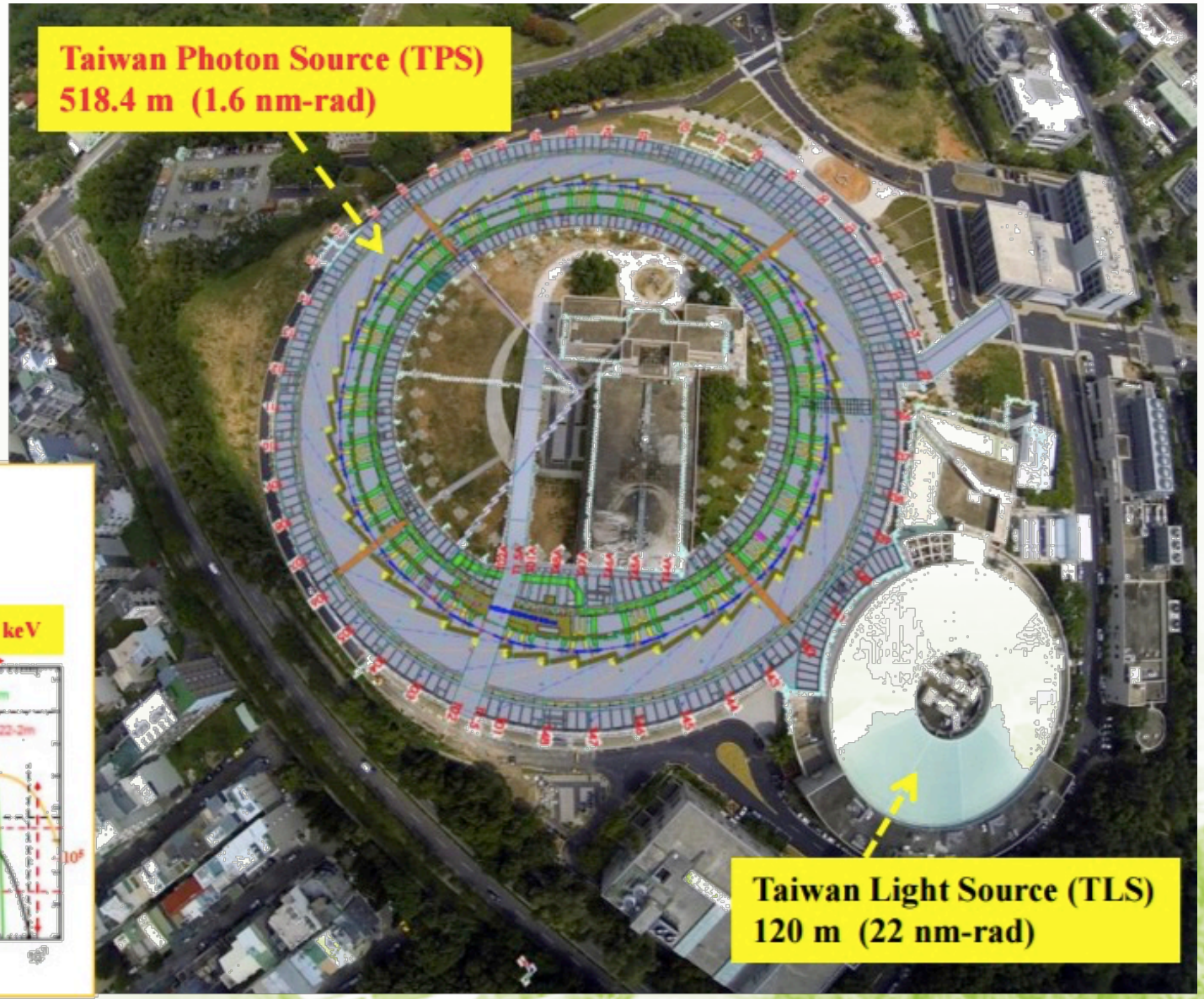
- Introductions to TLS and TPS
- TPS control system
- Front end interlock control system
- Conclusions


TLS
Utility-III and
Guest House II
Activity center
Administration
building
TPS
Guest
House I

The Status of TPS and TLS



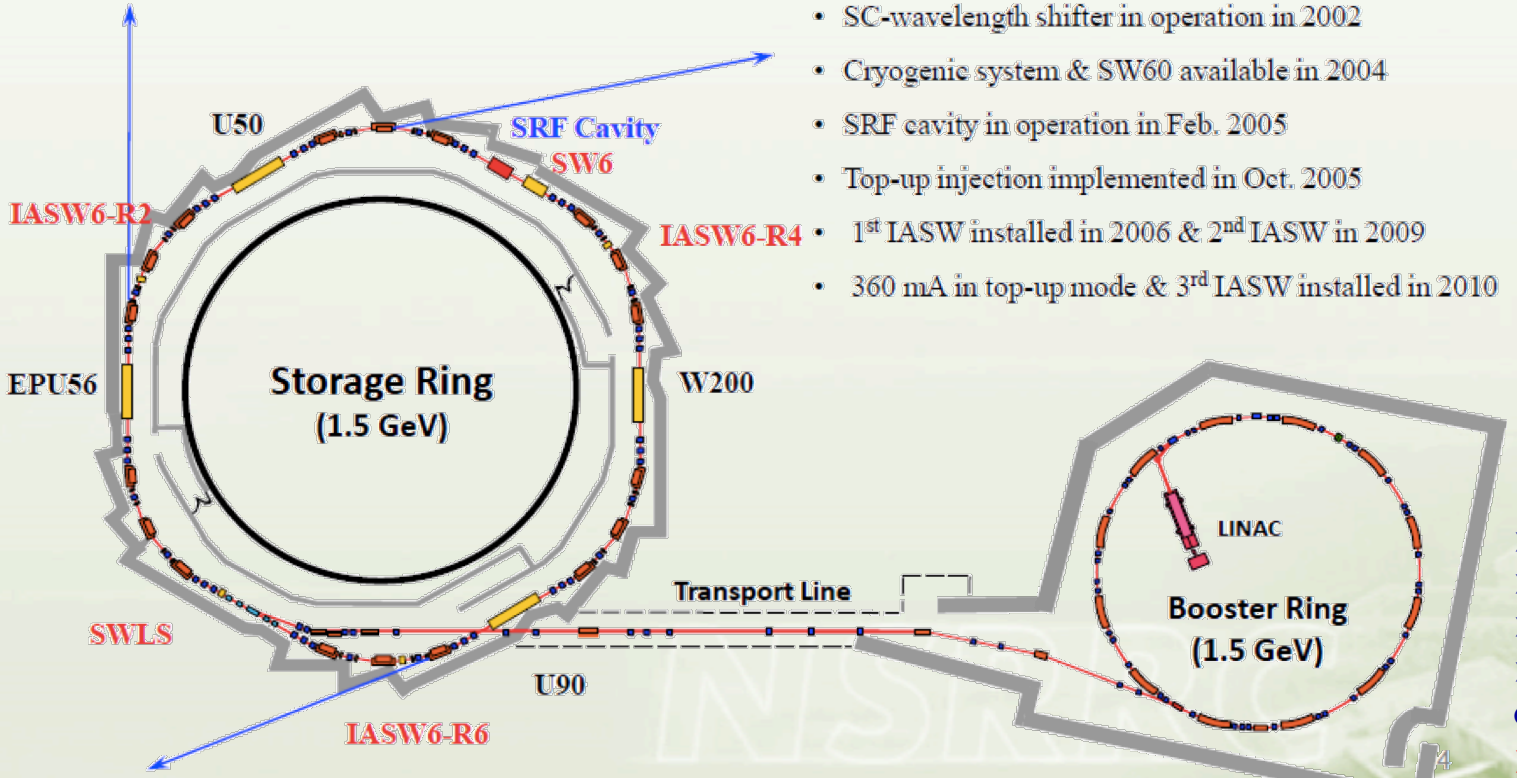


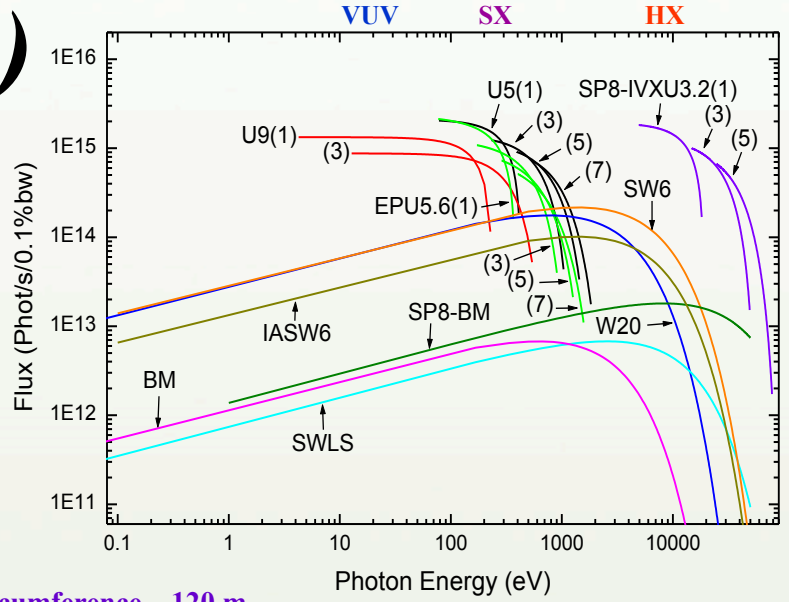


Taiwan Light Source (TLS) is the 2nd third generation light source (1993)

- The 1st 3rd generation LS in Asia (1993)
- The 2nd LS using the SRF cavity (2005)
- The 3rd LS running full time with top-up injection (2005)
- The most densely-packed storage ring with the highest number of superconducting IDs!

- Commissioned in Apr. & opened to users in Oct. 1993
- 1.3 to 1.5 GeV ramping in operation in 1996
- Operational beam current at 240 mA in 1996
- Booster in full energy injection in 2000
- SC-wavelength shifter in operation in 2002
- Cryogenic system & SW60 available in 2004
- SRF cavity in operation in Feb. 2005
- Top-up injection implemented in Oct. 2005
- 1st IASW installed in 2006 & 2nd IASW in 2009
- 360 mA in top-up mode & 3rd IASW installed in 2010





- Circumference – 120 m
- Critical Energy – 2.14 keV
- Natural Emittance – 25 n mrad
- Average Pressure (200 mA) – 0.68 nTorr
- Accumulated Dose > 8000 Ah
- Life Time – 10 h

- 1993 – Operation 1.3 GeV
- 1996 – Ramping to 1.5 GeV
- 2000 – 1.5 GeV Full Energy Injection (200 mA)
- 2004 – Operation with Superconducting RF Cavity
- 2005 – Top-up Injection at 300 mA

ID in operation

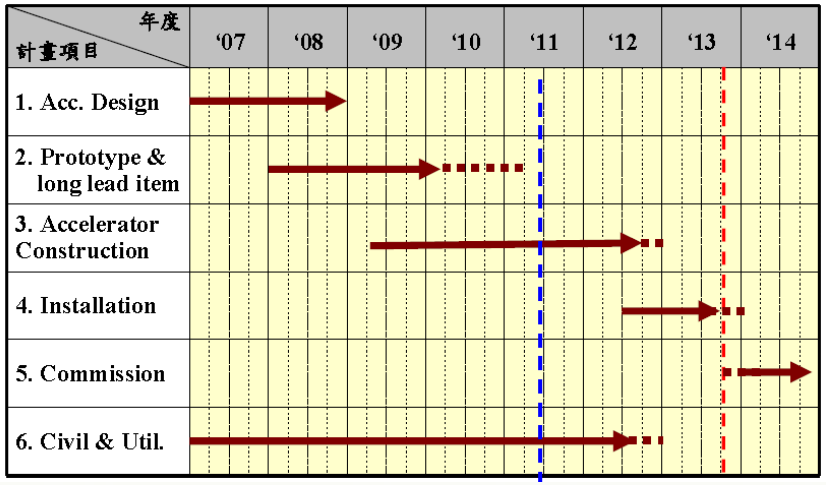
HX	W20	(1995)	4 ~ 15 keV
VUV SX	U10	(1995)	3 ~ 500 eV
VUV SX	U5	(1997)	60 ~ 1500 eV
HX	U9	(1999)	4 ~ 100 eV
HX	EPU5.6	(1999)	60 ~ 1400 eV
HX	SWLS	(2002)	4 ~ 30 keV
HX	SW6	(2004)	6.5 ~ 19 keV
HX	IASW6	(2006)	6.5 ~ 19 keV

New ID in planning

HX	2nd IASW6	(2009)
HX	3rd IASW6	(2010)

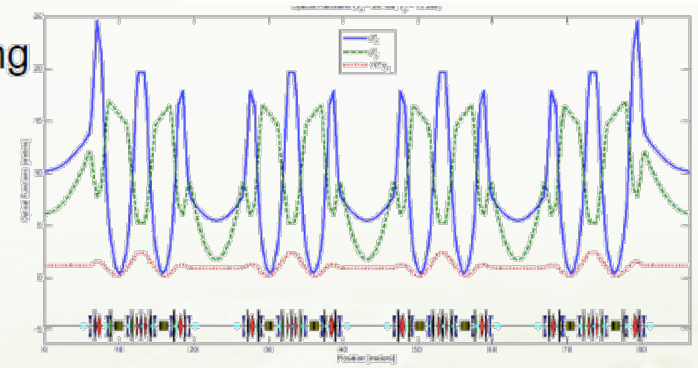
Major Parameters of Taiwan Photon Source

Energy	3 GeV (maximum 3.3 GeV)
Current	500 mA at 3 GeV (Top-up injection)
SR circumference	518.4 m (h = 864 = $2^5 \cdot 3^3$, dia.= 165.0 m)
BR circumference	496.8 m (h = 828 = $2^2 \cdot 3^2 \cdot 23$, dia.= 158.1 m)
Lattice	24-cell DBA
Straight sections	12 m x 6 (σ_v = 12 μm, σ_h = 160 μm) 7 m x 18 (σ_v = 5 μm, σ_h = 120 μm)

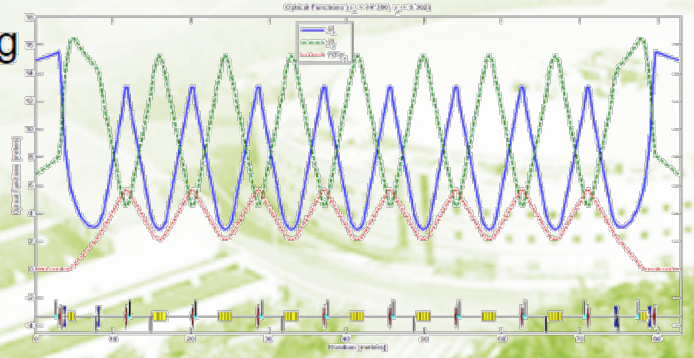


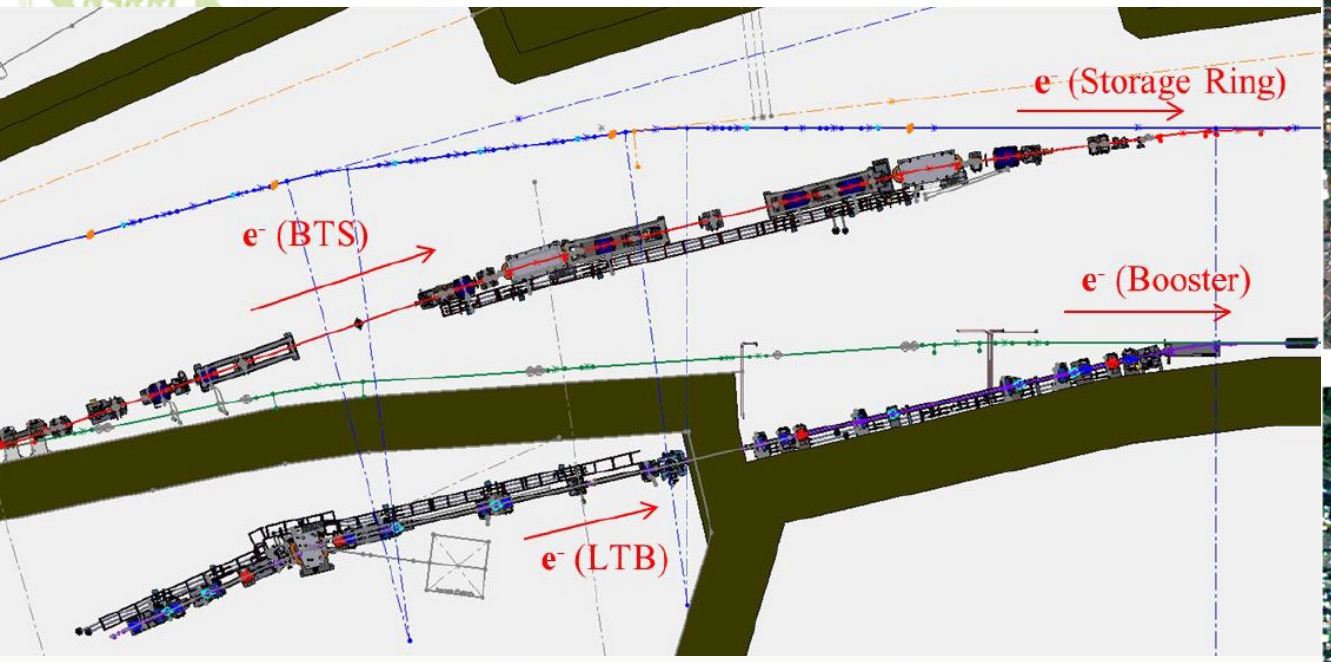
Beamline	ID type	Period [mm]	No. of Period	Effective Field [Tesla]	1st harmonic [eV]
I 05	IVU	22	140	0.79 (1.02)	1684 (1221)
I 09	IVU	22	140	0.74 (0.98)	1813 (1277)
I 09	IVU	22	95	0.72	1852
I 21	IVU+Taper	22	140	0.75 (1.00)	1784 (1258)
I 23	IVU	22	140	0.75 (1.00)	1792 (1265)
I 25	IVU	22	140	0.75 (1.00)	1775 (1243)
I 25	IVU	22	95	0.73	1822
I 41	APPLE-II	48	68	0.84/0.55	484/968
I 41	APPLE-II	48	68	0.83/0.55	494/968
I 45	APPLE-II	46	82	0.78/0.52	592/1118

Storage Ring

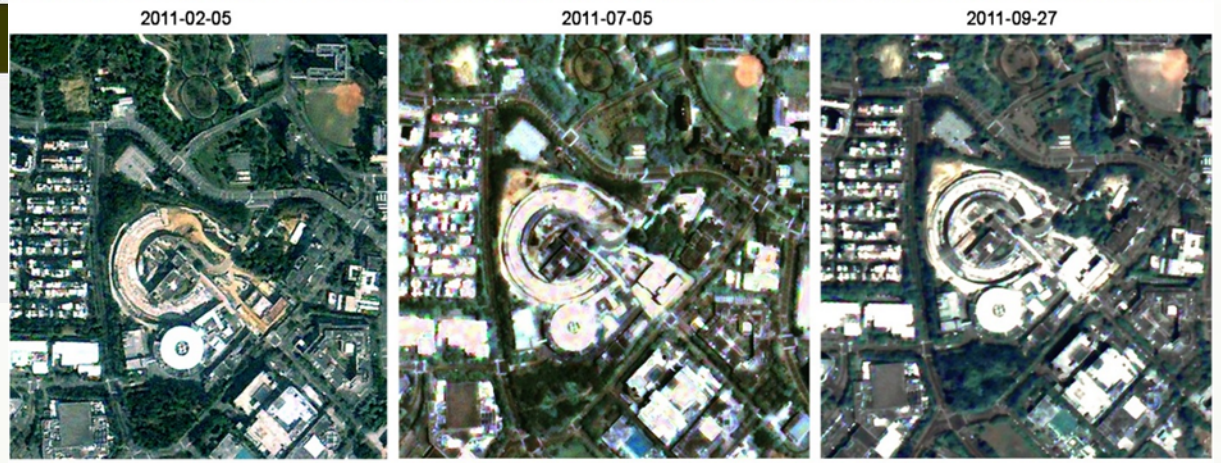


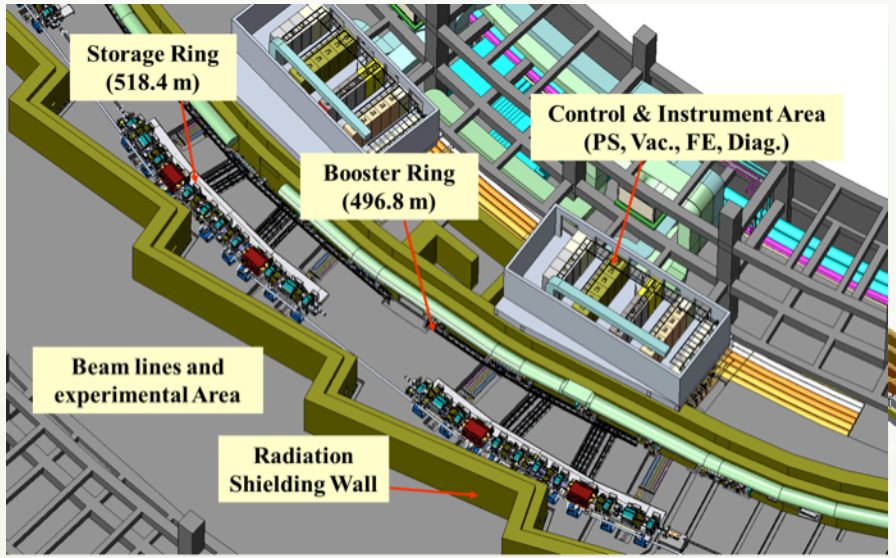
Booster Ring

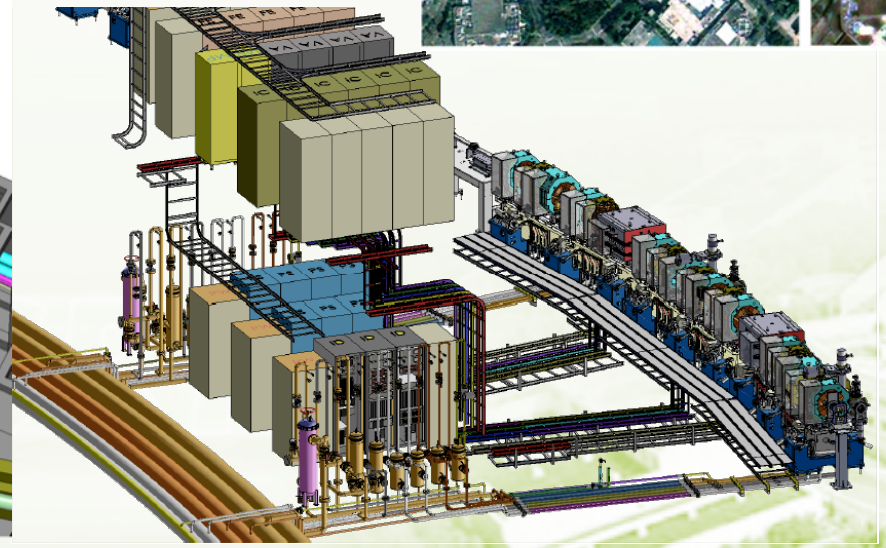


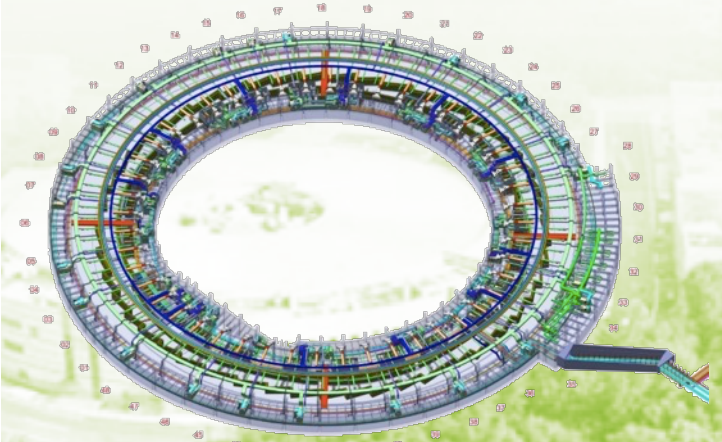

e⁻ (Storage Ring)
e⁻ (BTS)
e⁻ (Booster)
e⁻ (LTB)


2010-02-10
2010-03-21
2010-08-04

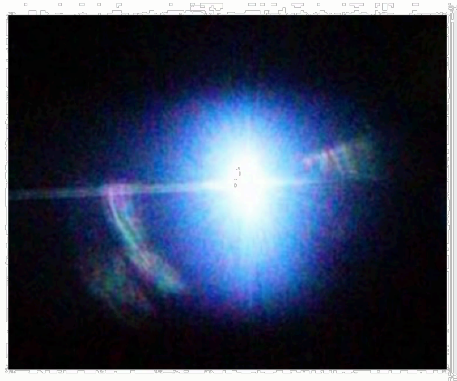

2011-02-05
2011-07-05
2011-09-27

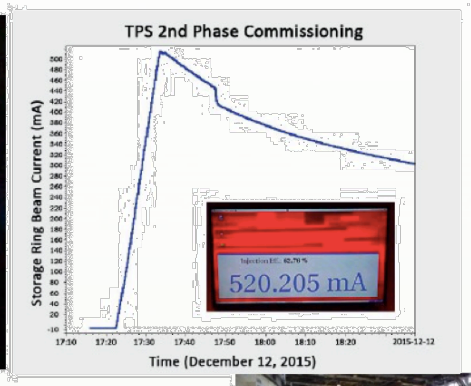

Storage Ring
(518.4 m)
Control & Instrument Area
(PS, Vac., FE, Diag.)
Booster Ring
(496.8 m)
Beam lines and
experimental Area
Radiation
Shielding Wall

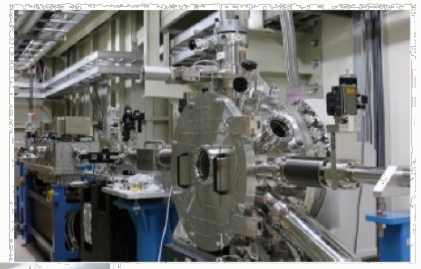


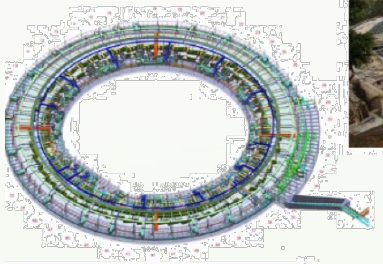


Milestones of Taiwan Photon Source









Available to users

Commissioning

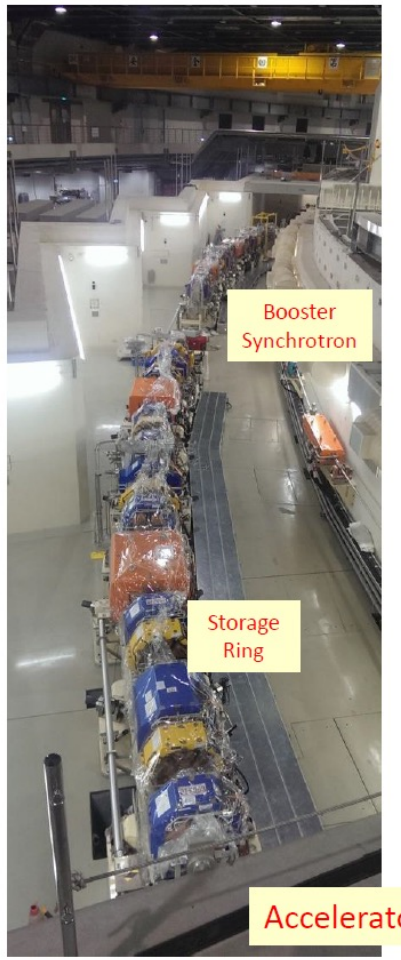
Construction

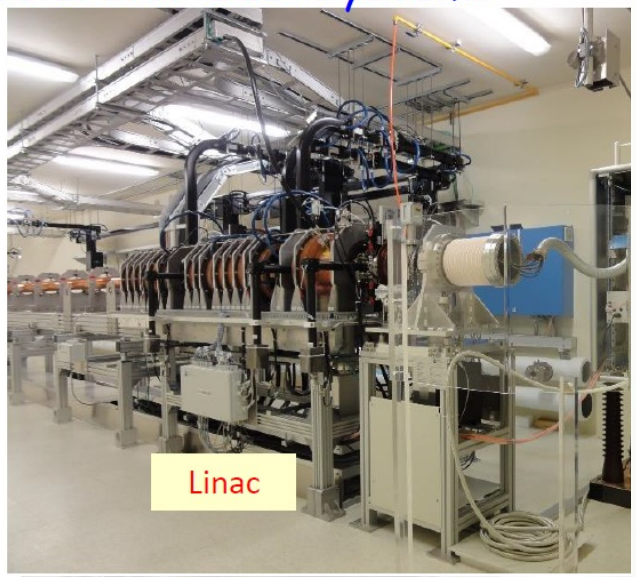
Design

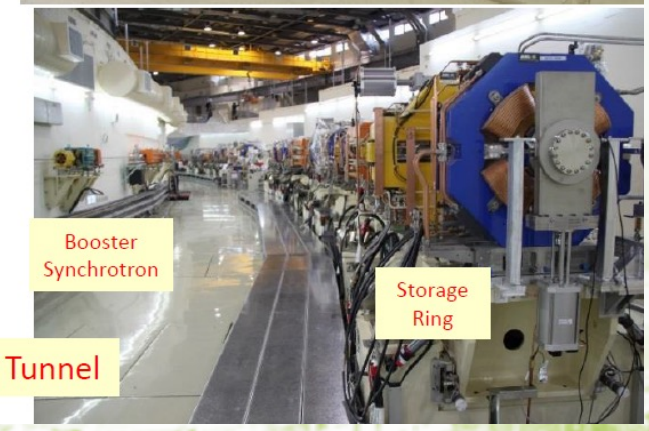
TPS milestones

2007 2010 2014 2016

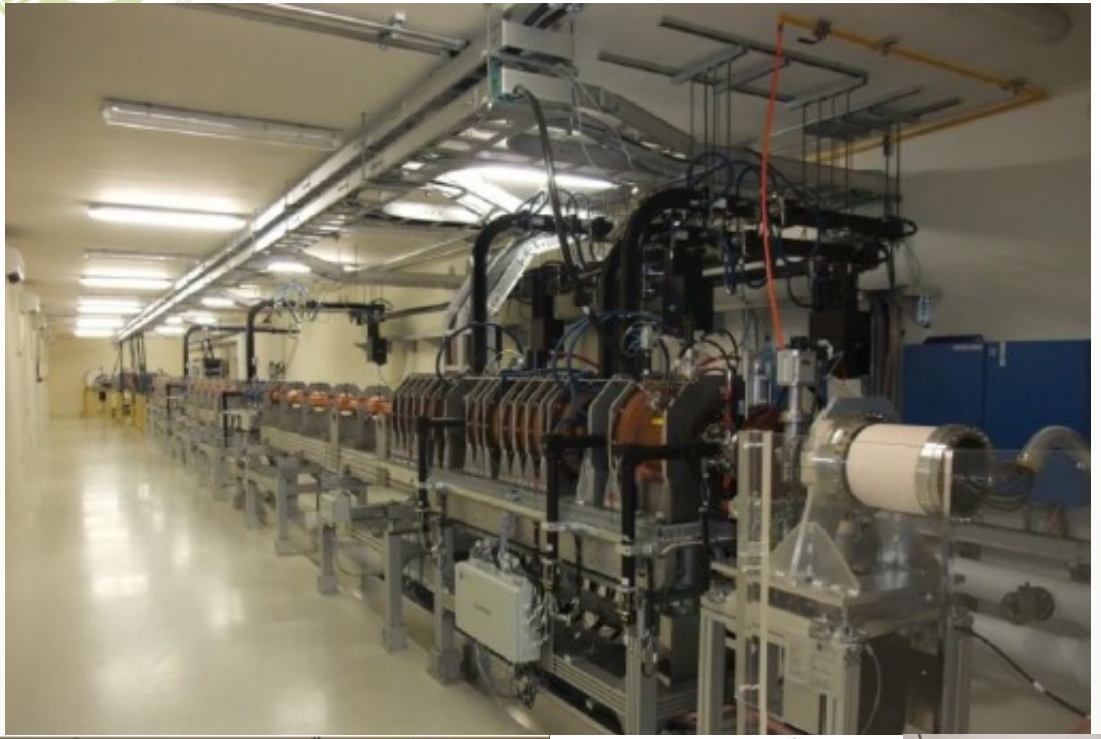
TPS Accelerator Sub-Systems





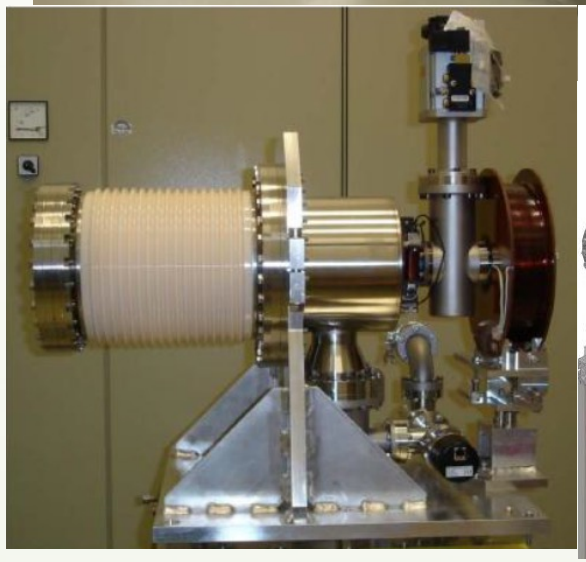


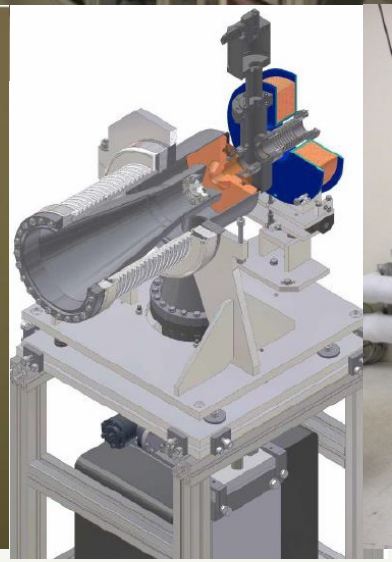
LINAC

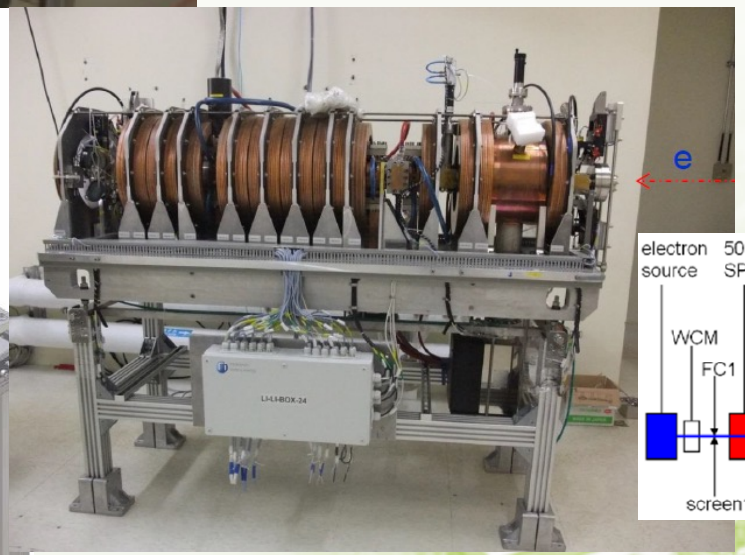


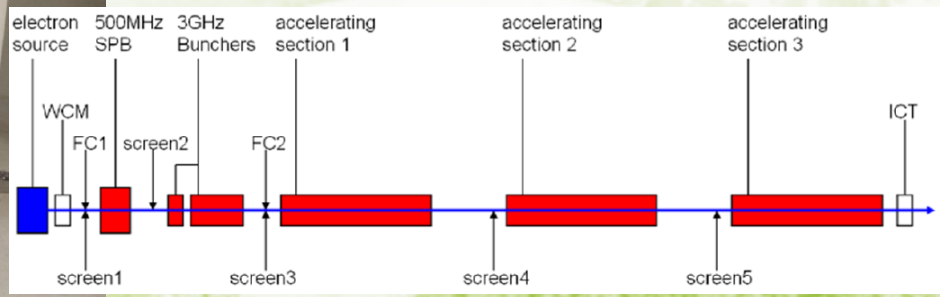
Parameter	Specification
Bunch train length (μs)	0.2 to 1 (LPM); (SPM_FWHM ≤ 1 ns)
Charge in bunch train (nC)	≥ 5 (LPM) (SPM ≥ 1.5 nC)
Energy (MeV)	≥ 150
Pulse to pulse energy variation (%)	≤ 0.25 (rms)
Relative energy spread (%)	≤ 0.5 (rms)
Normalised emittance (1σ) (πmm mrad)	≤ 50 (both planes)
Repetition rate (Hz)	1 to 5, adjustable
Pulse to pulse time jitter (ps)	≤ 100

LPM: long pulse mode; SPM: short pulse mode









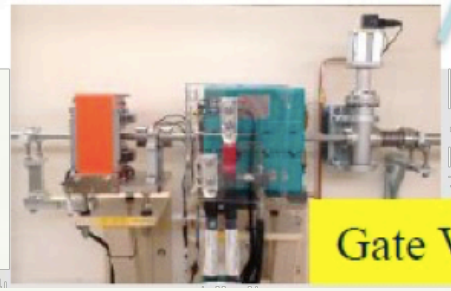
Booster

Inverted Magnetron Gauges

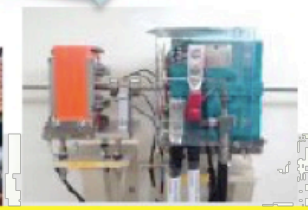
Sputtering Ion Pumps

Correction, Quadrupole, & Sextupole Magnets

Screen Monitor

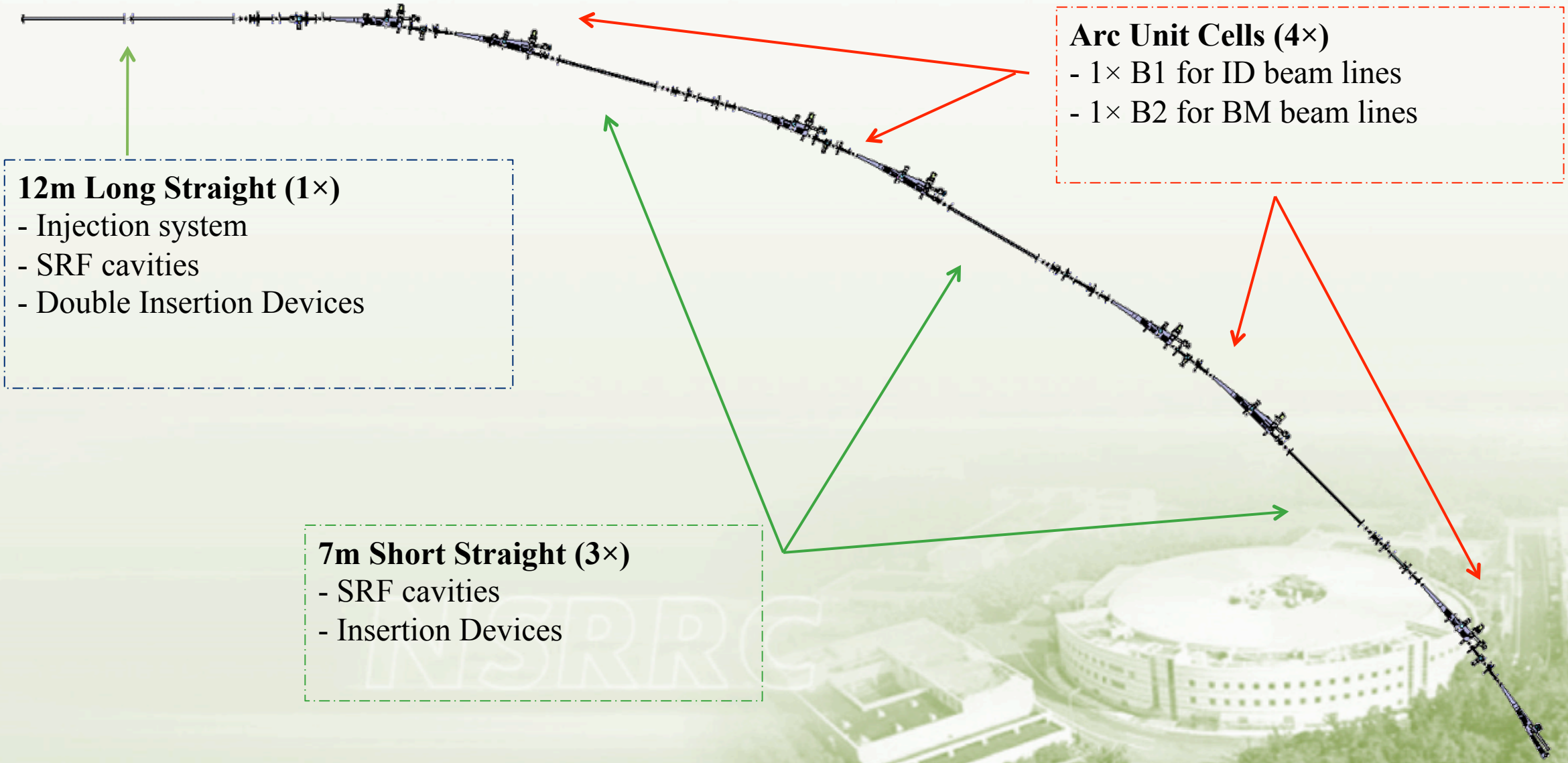


Gate Valve



BPM with Quadrupole Magnet

Layout of 1/6 Super periods (L = 86.4 m) for the Electron Storage Ring Vacuum System

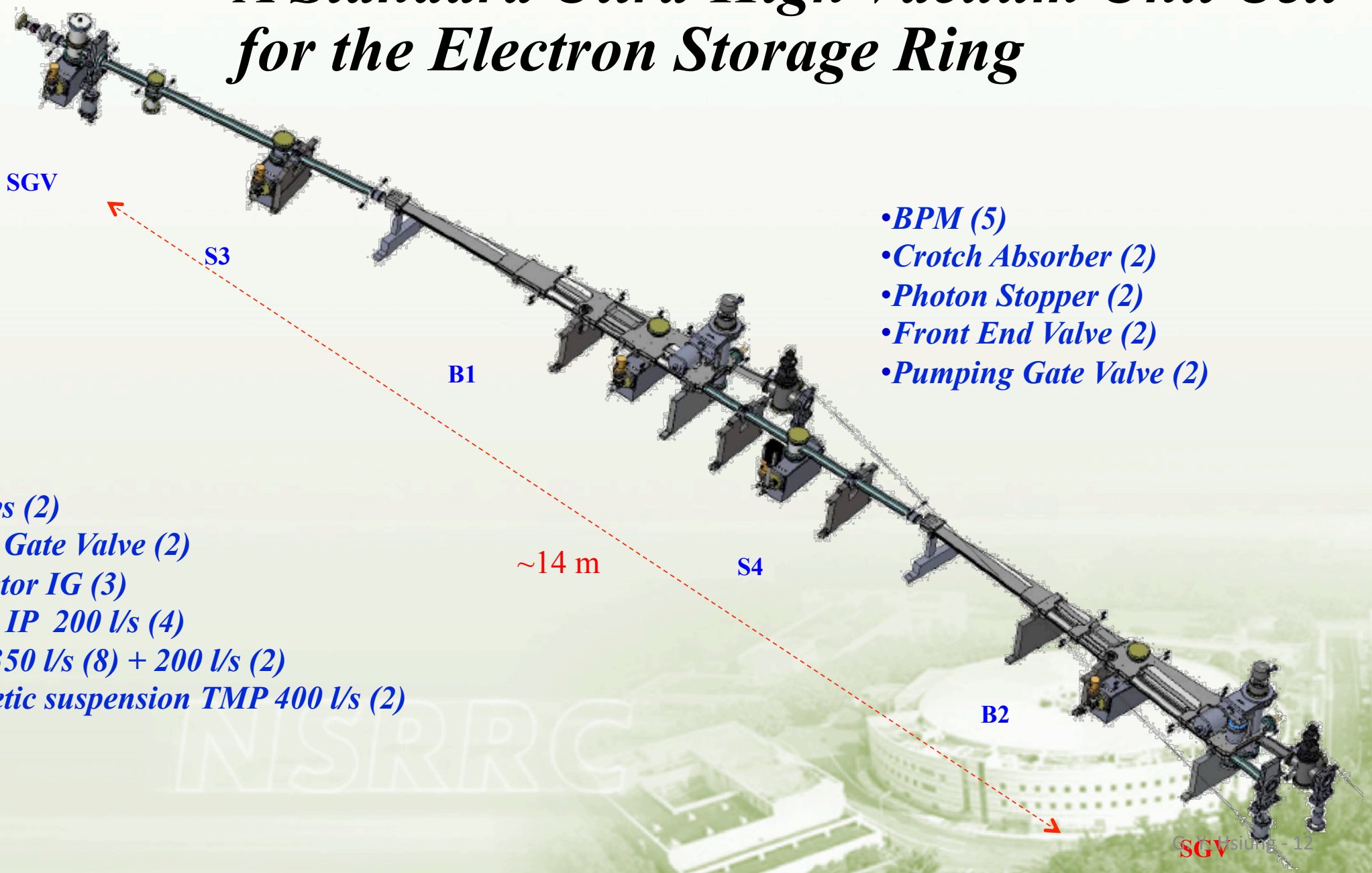


12m Long Straight (1×)
- Injection system
- SRF cavities
- Double Insertion Devices

Arc Unit Cells (4×)
- 1× B1 for ID beam lines
- 1× B2 for BM beam lines

7m Short Straight (3×)
- SRF cavities
- Insertion Devices

A Standard Ultra-High Vacuum Unit Cell for the Electron Storage Ring

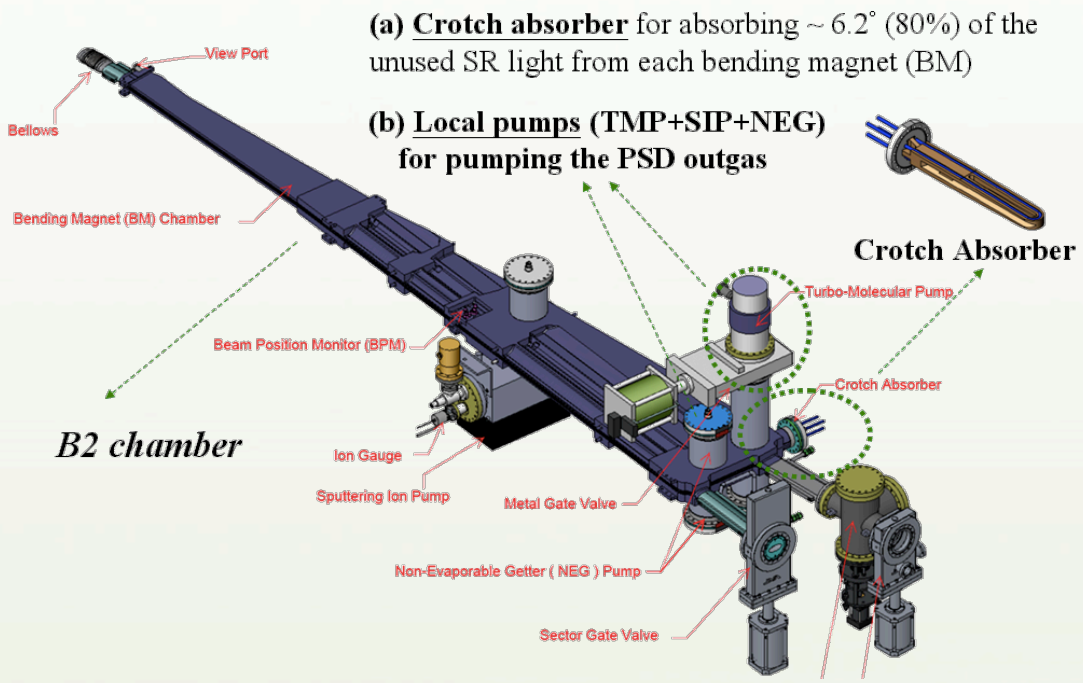


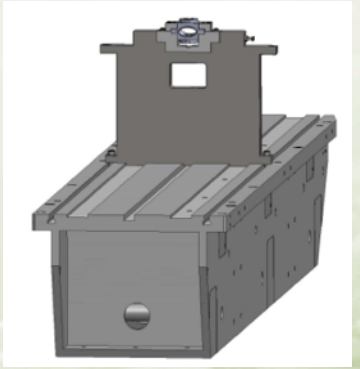
- *BPM (5)*
- *Crotch Absorber (2)*
- *Photon Stopper (2)*
- *Front End Valve (2)*
- *Pumping Gate Valve (2)*

- *Bellows (2)*
- *Sector Gate Valve (2)*
- *Extractor IG (3)*
- *Triode IP 200 l/s (4)*
- *NEG 350 l/s (8) + 200 l/s (2)*
- *Magnetic suspension TMP 400 l/s (2)*

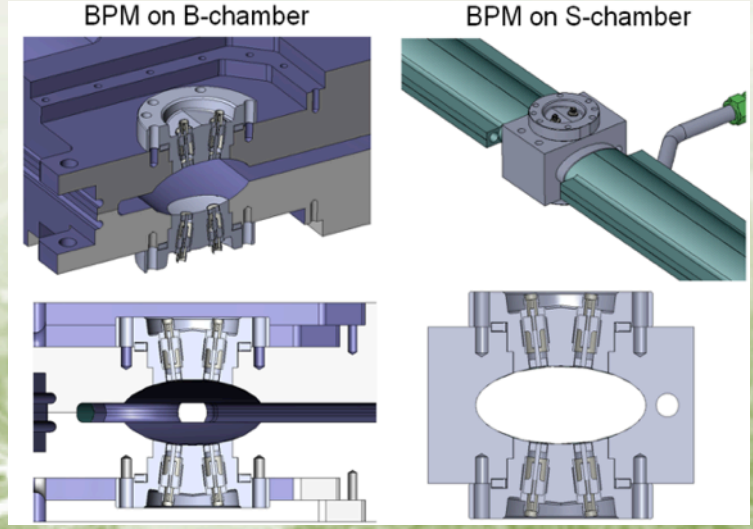
Typical Design of Bending chamber (~ 4m) assembly for Electron Storage Ring

- Simple structure of vacuum beam ducts along the beam channel, no flange, few absorbers, few bellows, for lowering the impedance.
- Completely oil-free and precise CNC machining for the B-chambers and TIG welding in the clean room to obtain a clean surface with lowest surface outgassing rate and the consequent lowest pressure.
- Strong back supports for the BPM fixed on the girders for positioning the BPM precisely and cooling channels drilled through the B-chambers provides an uniform temperature control for assuring the BPM shift < 0.1 micron against the thermal stress.



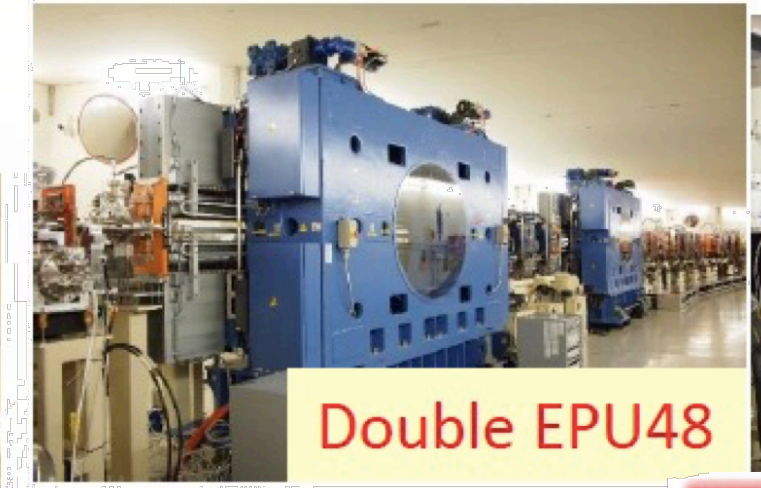


1. Button : φ6.9 mm
2. Gap : 0.3 mm
3. Distance : 17.5 mm
4. Angle : 6.7°



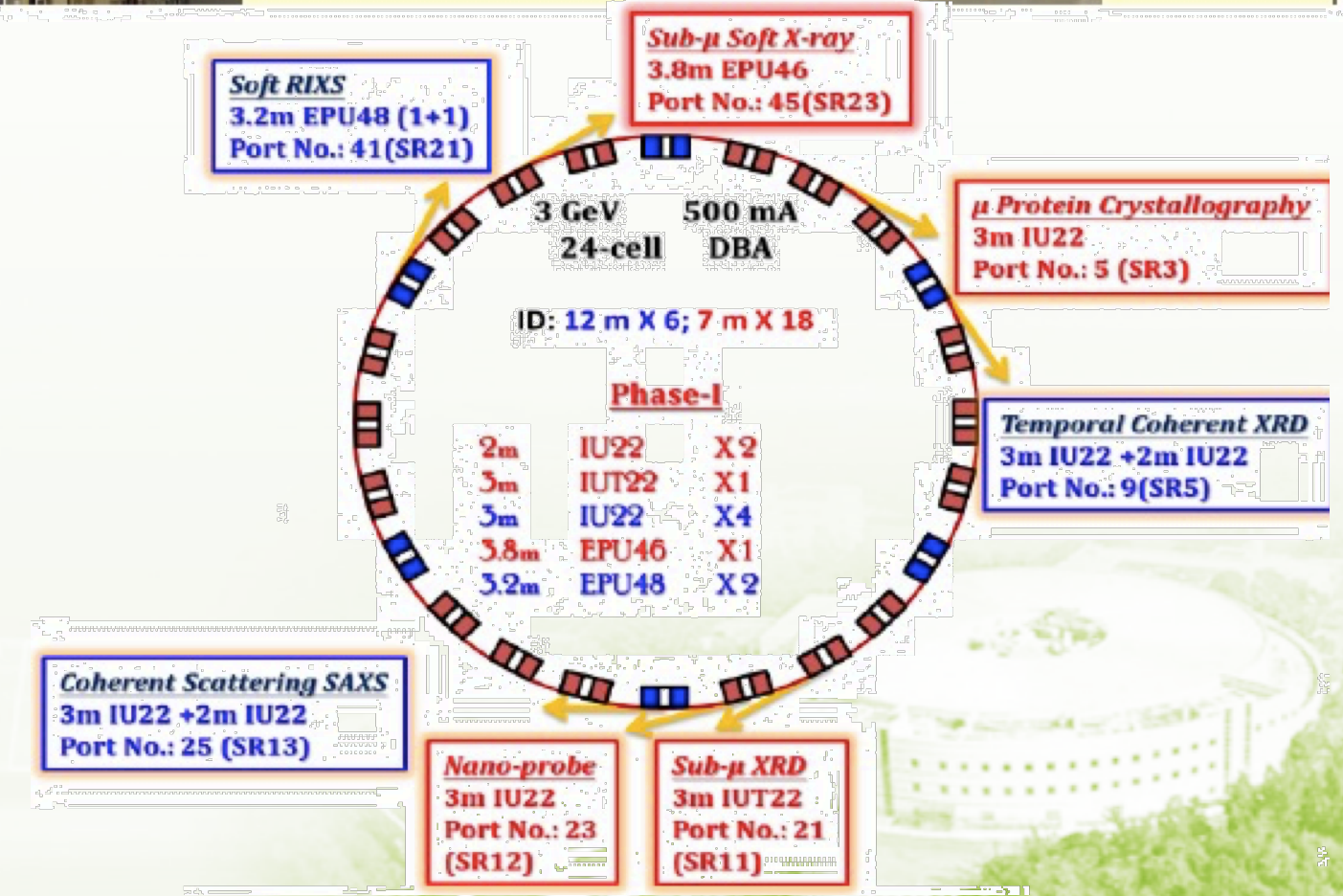
Double IU22

Taper IU22



Double EPU48

EPU46



TPS Phase-I Beamlines

(Open for user service on September 22, 2016)

05A Protein
μ-crystallography

09A Temporally
Coherent XRD

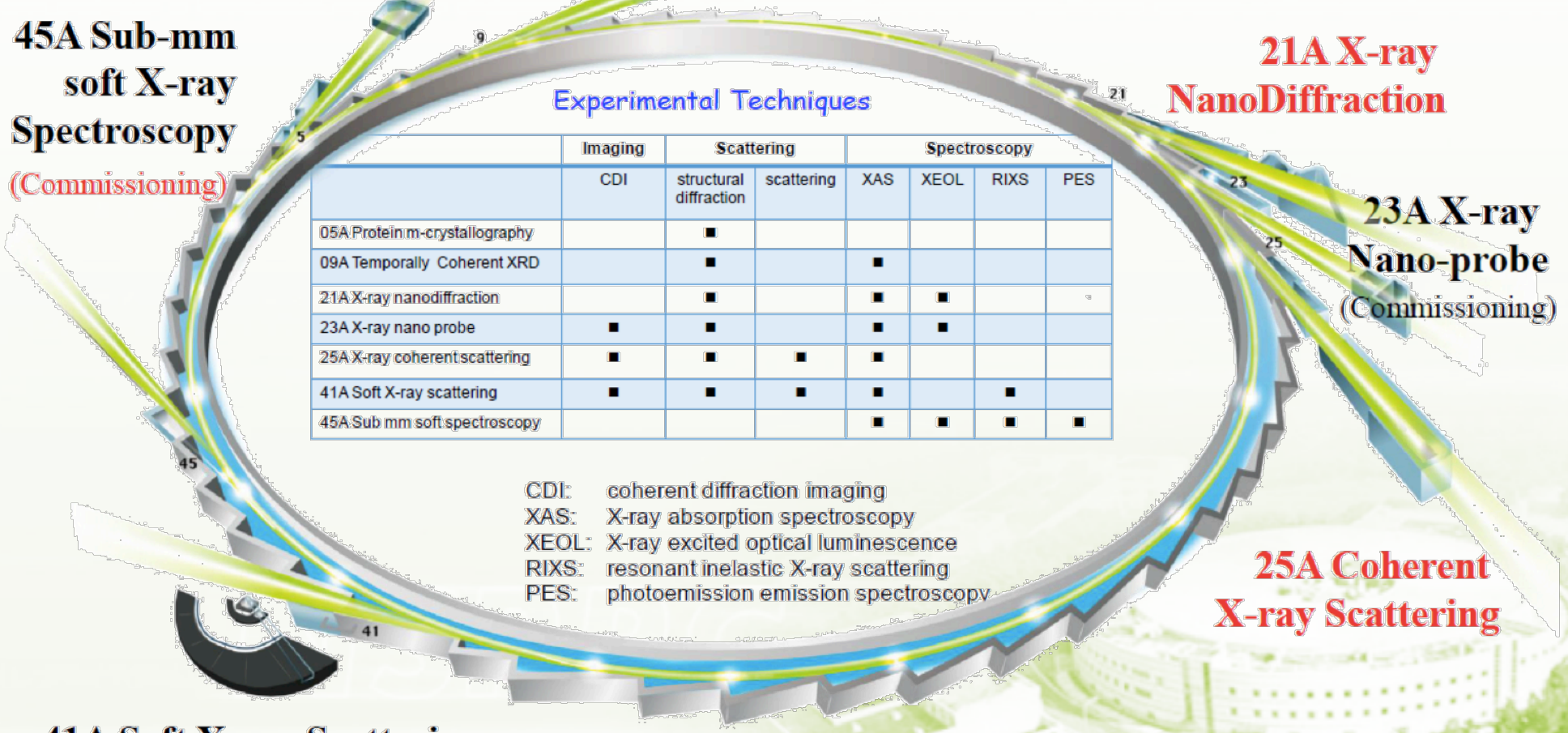
45A Sub-mm
soft X-ray
Spectroscopy
(Commissioning)

21A X-ray
NanoDiffraction

23A X-ray
Nano-probe
(Commissioning)

25A Coherent
X-ray Scattering

41A Soft X-ray Scattering
(Commissioning)



Experimental Techniques

	Imaging	Scattering		Spectroscopy			
	CDI	structural diffraction	scattering	XAS	XEOL	RIXS	PES
05A Protein m-crystallography		■					
09A Temporally Coherent XRD		■		■			
21A X-ray nanodiffraction		■		■	■		
23A X-ray nano probe	■	■		■	■		
25A X-ray coherent scattering	■	■	■	■			
41A Soft X-ray scattering	■	■	■	■		■	
45A Sub mm soft spectroscopy				■	■	■	■

CDI: coherent diffraction imaging
XAS: X-ray absorption spectroscopy
XEOL: X-ray excited optical luminescence
RIXS: resonant inelastic X-ray scattering
PES: photoemission emission spectroscopy

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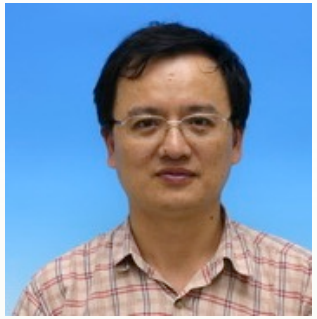
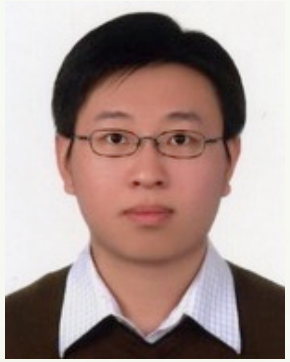
- Front end interlock control system
- Conclusions





EPICS/OPI

Consoles and Servers

File and Name Server, Gateway, Archivers, Beam Physics Server (Modeling System), Display Managers, Database Server, Alarm Server, AP Server, Boot Server, Monitoring Services, Storage Server … etc.

PC/Linux

Intranet

Router

Control Ethernet

EPICS IOC (Input Output Controller)

cPCI EPICS IOCs

Miscellaneous EPICS IOCs

PLC-IOC

Beamline Network, Network Attached EPICS Devices (e.g. EPICS Oscilloscope, … etc.)

Standard cPCI EPICS IOCs
- Intel CPU/Linux (fully preemptive kernel)
- High volume I/O
- High speed serial connection (GbE, … etc.)

Miscellaneous EPICS IOCs
- Pentium/XScale/ARM/PPC Linux
- Soft real-time system
- RS-232/422/485 Devices
- CCD camera server
- PLC (safety type system)
- Bunch-by-bunch feedback system interface
- Special applications

Safety Type System

Signal Conditioning

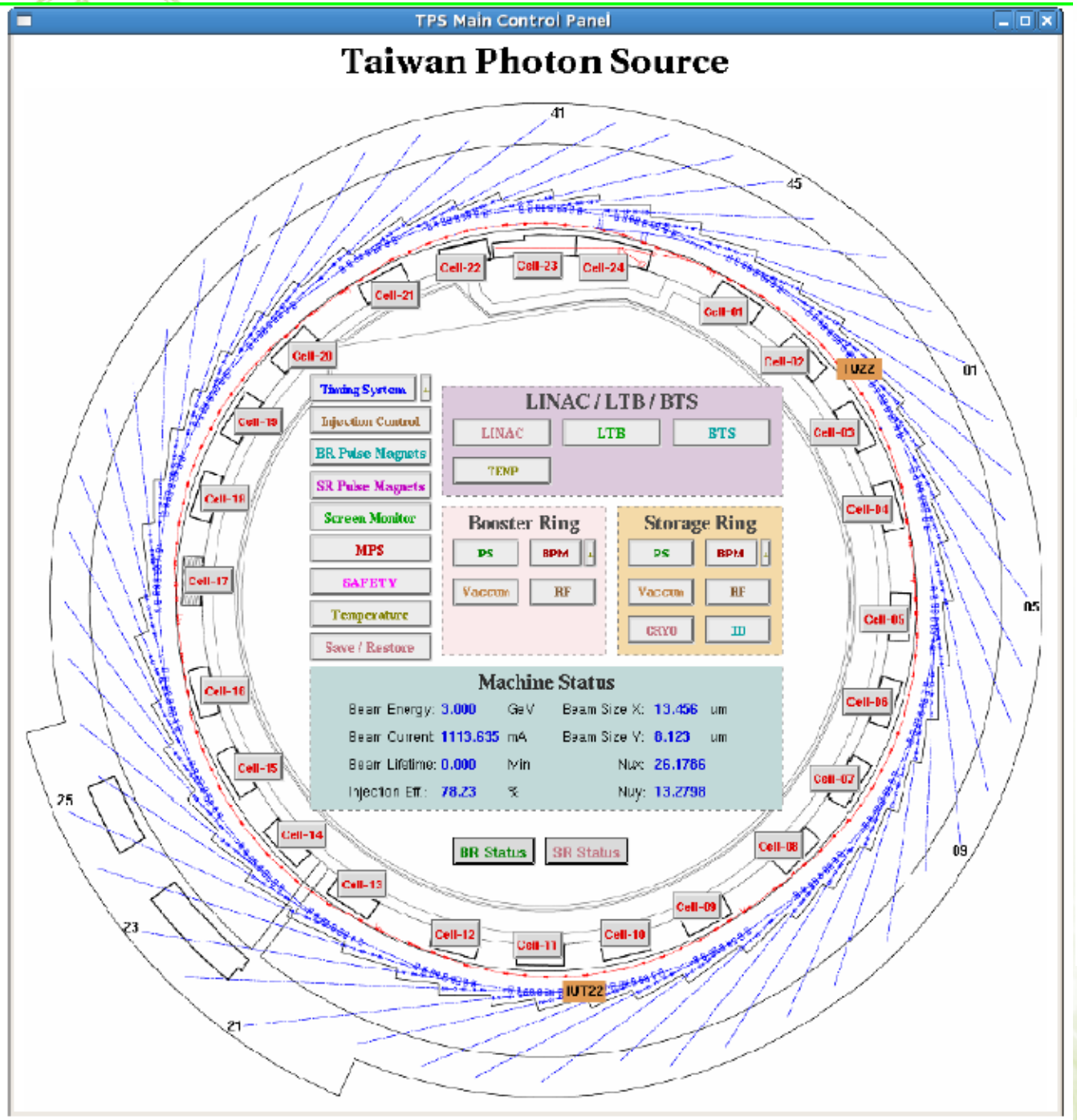
Private Ethernet

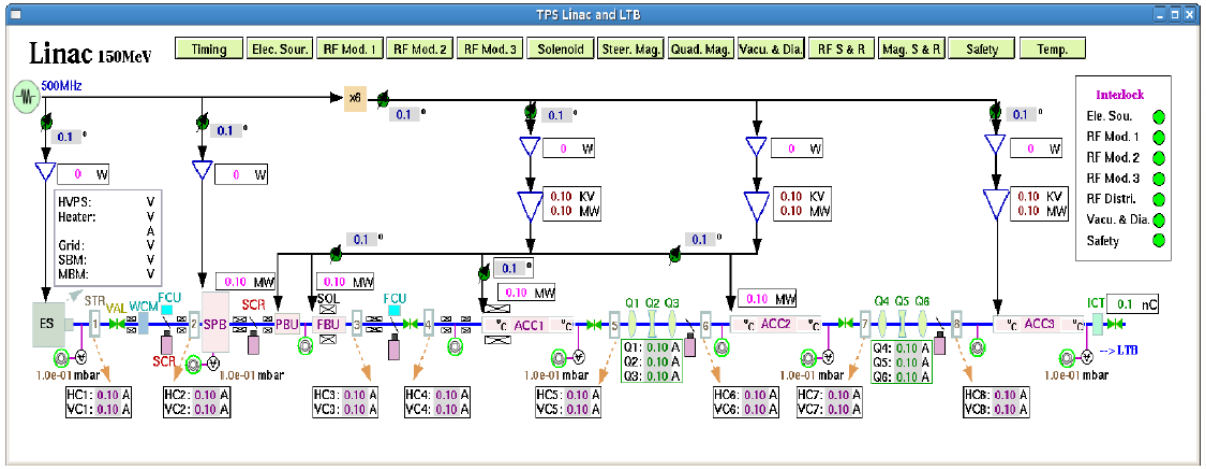
Timing

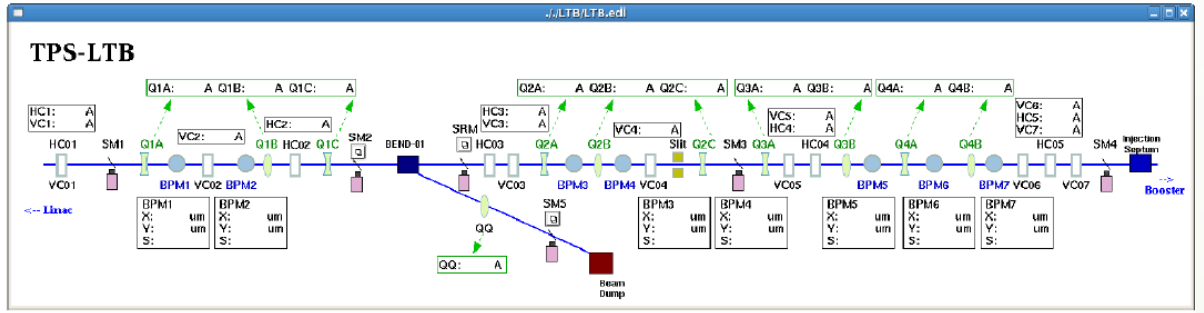
Field Devices
(Power Supply, Motion Controller, LXI Instruments … etc.)

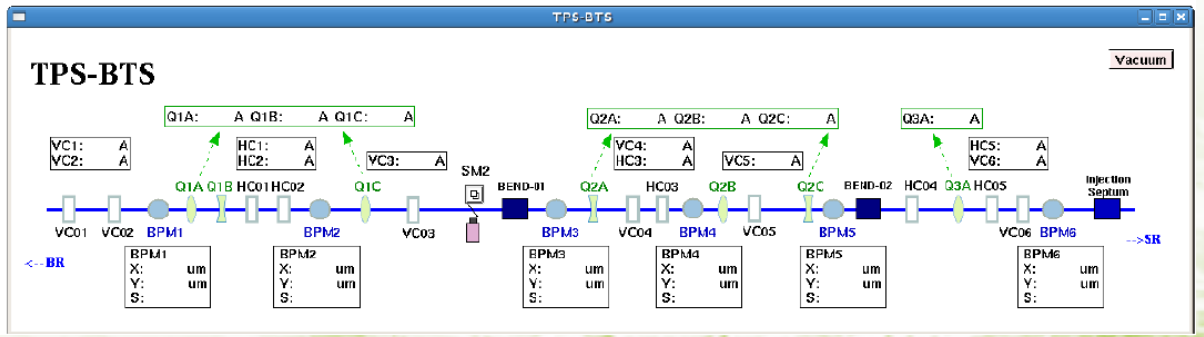
Software Versions

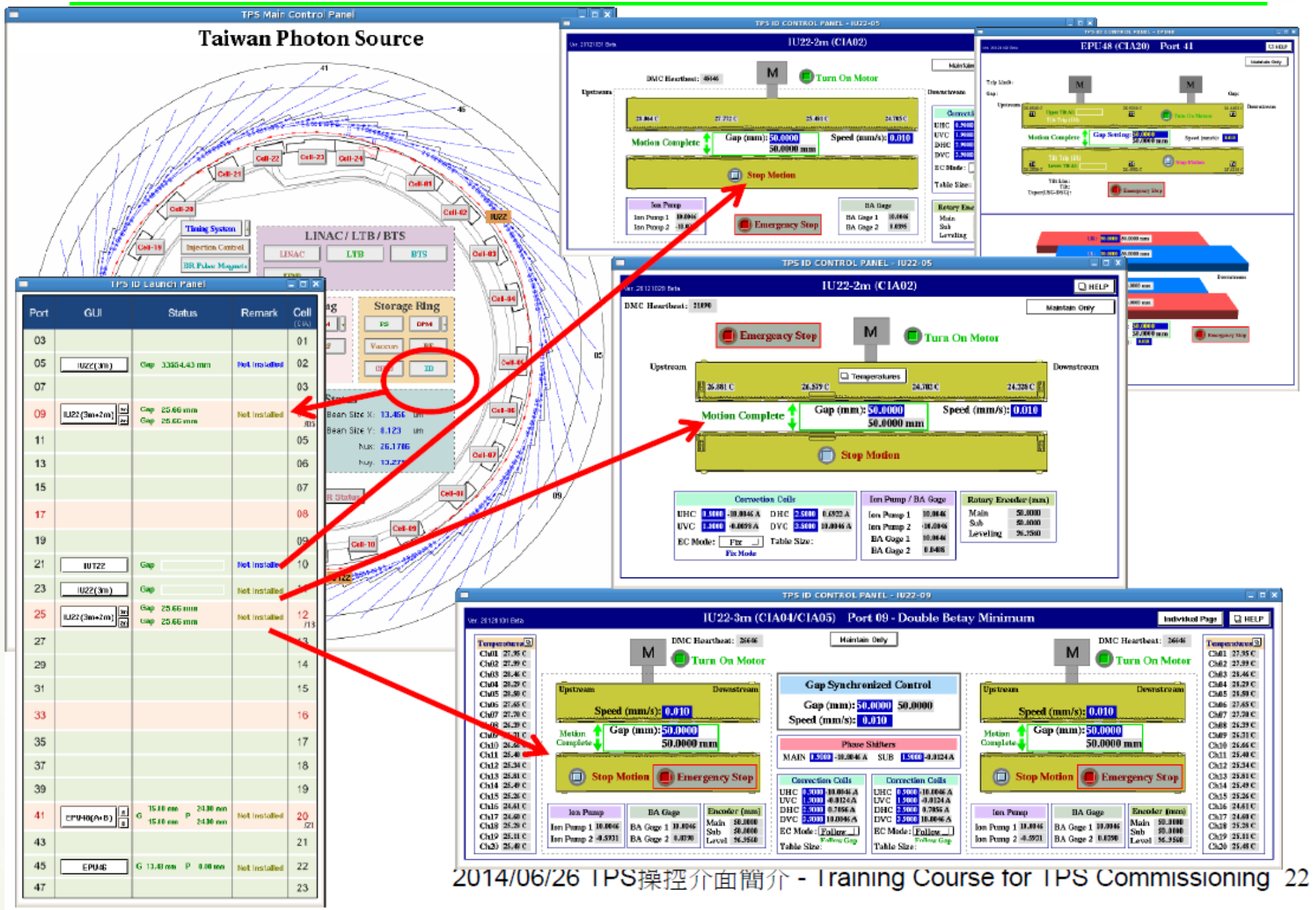
Platform	OS	EPICS
Server (NFS, DHCP, tFTP, Web)	RHEL 5 (32-bit) MySQL	
Server (OLog, CFS, MASAR)	Debian 7 (64-bit) MySQL, SQLite	
Storage Server (Archiver)	RHEL 6 (64-bit) PostgreSQL	
cPCI EPICS IOC	Fedora Core 11 (32-bit) Kernel: 2.6.29	base-3.14.12.4
Miscellaneous EPICS IOC	RHEL 5 (32-bit) Kernel: 2.6.18	base-3.14.12.x
Control Console	RHEL 5 (32-bit)	base-3.14.12 edm-1.12.xx Control System Studio-3.2.13a


TPS Main Control Panel
Taiwan Photon Source
Timing System
Injection Control
BR Pulse Magnets
SR Pulse Magnets
Screen Monitor
MPS
SAFETY
Temperature
Save / Restore
LINAC / LTB / BTS
LINAC
LTB
BTS
TENP
Booster Ring
PS
BPM
Vacuum
RF
Storage Ring
PS
BPM
Vacuum
RF
CSYO
ID
Machine Status
Beam Energy: 3.000 GeV
Beam Current 1113.635 mA
Beam Lifetime: 0.000 Min
Injection Eff: 78.23 %
Beam Size X: 13.456 um
Beam Size Y: 0.123 um
Nux: 26.1786
Nuy: 13.2798
BR Status
SR Status
IUT22
IUZ2
Cell-01
Cell-02
Cell-03
Cell-04
Cell-05
Cell-06
Cell-07
Cell-08
Cell-09
Cell-10
Cell-11
Cell-12
Cell-13
Cell-14
Cell-15
Cell-16
Cell-17
Cell-18
Cell-19
Cell-20
Cell-21
Cell-22
Cell-23
Cell-24
01
05
09
13
17
21
25
29
33
37
41
45


TPS Linac and LTB
Linac 150MeV
Timing
Elec. Sour.
RF Mod. 1
RF Mod. 2
RF Mod. 3
Solenoid
Steer. Mag.
Quad. Mag.
Vacu. & Dia.
RF S & R
Mag. S & R
Safety
Temp.
500MHz
Interlock
Ele. Sou.
RF Mod. 1
RF Mod. 2
RF Mod. 3
RF Distri.
Vacu. & Dia.
Safety
HVPS:
Heater:
Grid:
SBM:
MBM:
ES
STR
VAL
WCM
FCU
SCR
SPB
PBU
FBU
SOL
ACC1
ACC2
ACC3
ICT
LTB
HC1: 0.10 A
VC1: 0.10 A
HC2: 0.10 A
VC2: 0.10 A
HC3: 0.10 A
VC3: 0.10 A
HC4: 0.10 A
VC4: 0.10 A
HC5: 0.10 A
VC5: 0.10 A
HC6: 0.10 A
VC6: 0.10 A
HC7: 0.10 A
VC7: 0.10 A
HC8: 0.10 A
VC8: 0.10 A


./../LTB/LTB.edl
TPS-LTB
<-- Linac
BPM1
BPM2
BPM3
BPM4
BPM5
BPM6
BPM7
SM1
SM2
SM3
SM4
SM5
SRM
BEND-01
Slit
QQ
Beam Dump
Injection Septum
Booster


TPS-BTS
TPS-BTS
Vacuum
<-- BR
BPM1
BPM2
BPM3
BPM4
BPM5
BPM6
SM2
BEND-01
BEND-02
Injection Septum
-->SR


TPS Main Control Panel
Taiwan Photon Source
LINAC / LTB / BTS
Storage Ring
Timing System
Injection Control
BR Pulse Magnets
TPS ID Launch Panel
Port
GUI
Status
Remark
Cell
Not Installed
TPS ID CONTROL PANEL - IU22-05
IU22-2m (CIA02)
Turn On Motor
Motion Complete
Gap (mm): 50.0000
50.0000 mm
Speed (mm/s): 0.010
Stop Motion
Emergency Stop
Ion Pump
BA Gage
Correction Coils
Rotary Encoder (mm)
EPU48 (CIA20) Port 41
TPS ID CONTROL PANEL - IU22-09
IU22-3m (CIA04/CIA05) Port 09 - Double Betay Minimum
Gap Synchronized Control
Phase Shifters
Encoder (mm)

TPS Operational Handover Information v1.0

2016/11/25 14:08:18

SR Status

Mode	Top-Up
Beam Current(mA	301.274
Beam Lifetime(min)	564.204
Beamsize X(um)	57.18
Beamsize Y(um)	33.39
Tune X(from BPM)	0.1468
2016\11\25 14:06:33	
Tune Y(from BPM)	0.226
NuX(from BBF)	0.1672
NuY(from BBF)	0.2525
Bucket Start	100
Bucket Last	630
Bucket Step	10

Pulse Mag

BR inj. sep.	105.2
BR inj. kicker	16.4
BR ext. kicker1	18.37
BR ext. kicker2	17.67
BR ext. sep.1	318.84
BR ext. sep.2	444.5
SR inj. sep.1	419.34
SR inj. sep.2	417
SR kicker1	8.4
SR kicker2	8.31
SR kicker3	8.31
SR kicker4	8.25

Changeliang@BD.NSRRC

LINAC

Gun mode	MBM
Grid volt.(S)	33
Gun volt.(S)	23.5
Width count	30
2ns step	0
10ps delay	100
Mod.3 HV(S)	35.58

Feedback

FOFB H: On

FOFB V: On

BBF H

BBF V

Orbit ILK(P)

RF Status

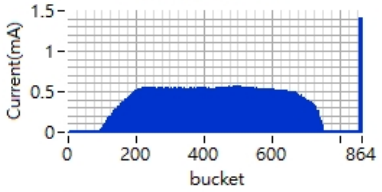
499654714.3 Hz

RF2 remote		RF3 remote	
RF2 OP mode		RF3 OP mode	
RF2 gap volt.(S)	1400	RF3 gap volt.(S)	1400
RF2 phase.(S)	-60	RF3 phase.(S)	155

Lattice Files in using

Linac	Linac2016_1005_0935.data
LTB	LTB_JT_2016_1005_1200.data
BR	Booster_JT_2016_1005_1200.data
BTS	BTS_2016_1123_0900.data
SR	SR_DMB_2016_1102_1124LOCO.data

SR Fill Pattern

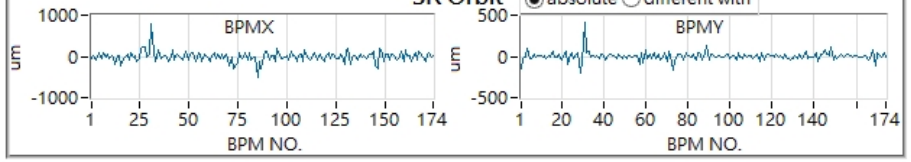


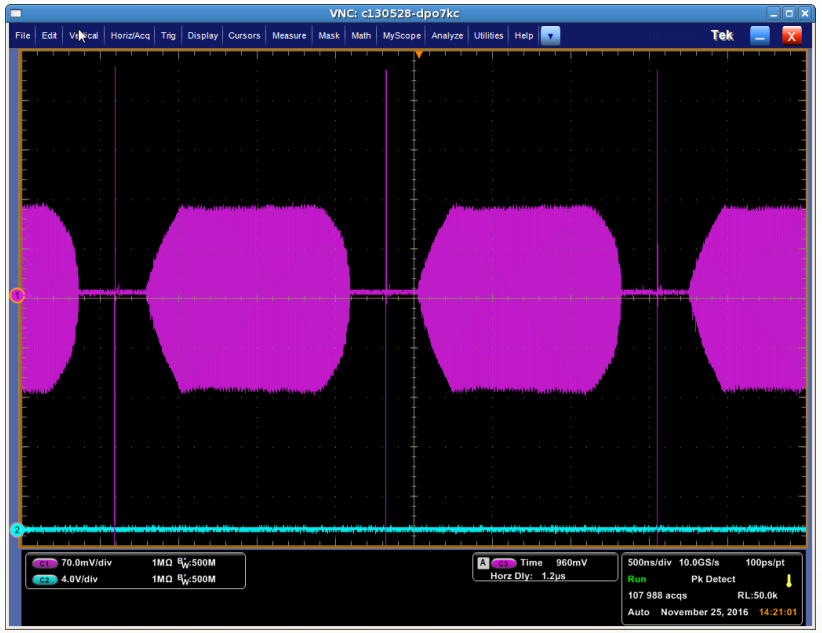
ID &Beamline (R)

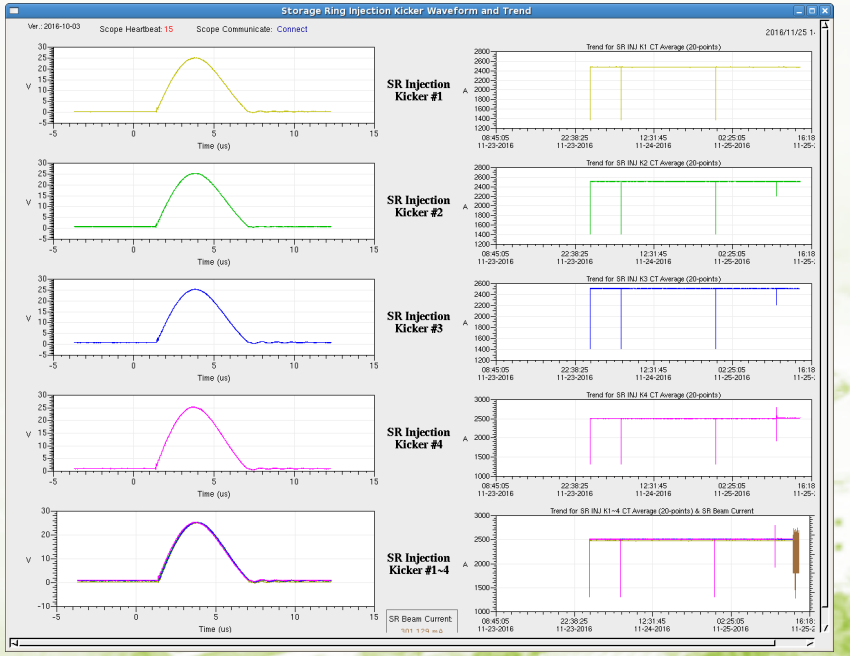
	Gap mm	Motor	Phase	FE/Hutch	phase shifter	Taper	XBPM1X um	XBPM1Y um
05	7.29						122.46	-62.96
09	9.665						441.76	32.17
	40.001							
21	7					1.09	623.1	-37.33
23	11						-23.91	-68.46
25	7						375.83	272.58
	40							
41	64.9999		0.0001		130.001		369.93	-84.12
	65.0042		0.0006					
45	44.9999		0.0016				-139.29	-62.78

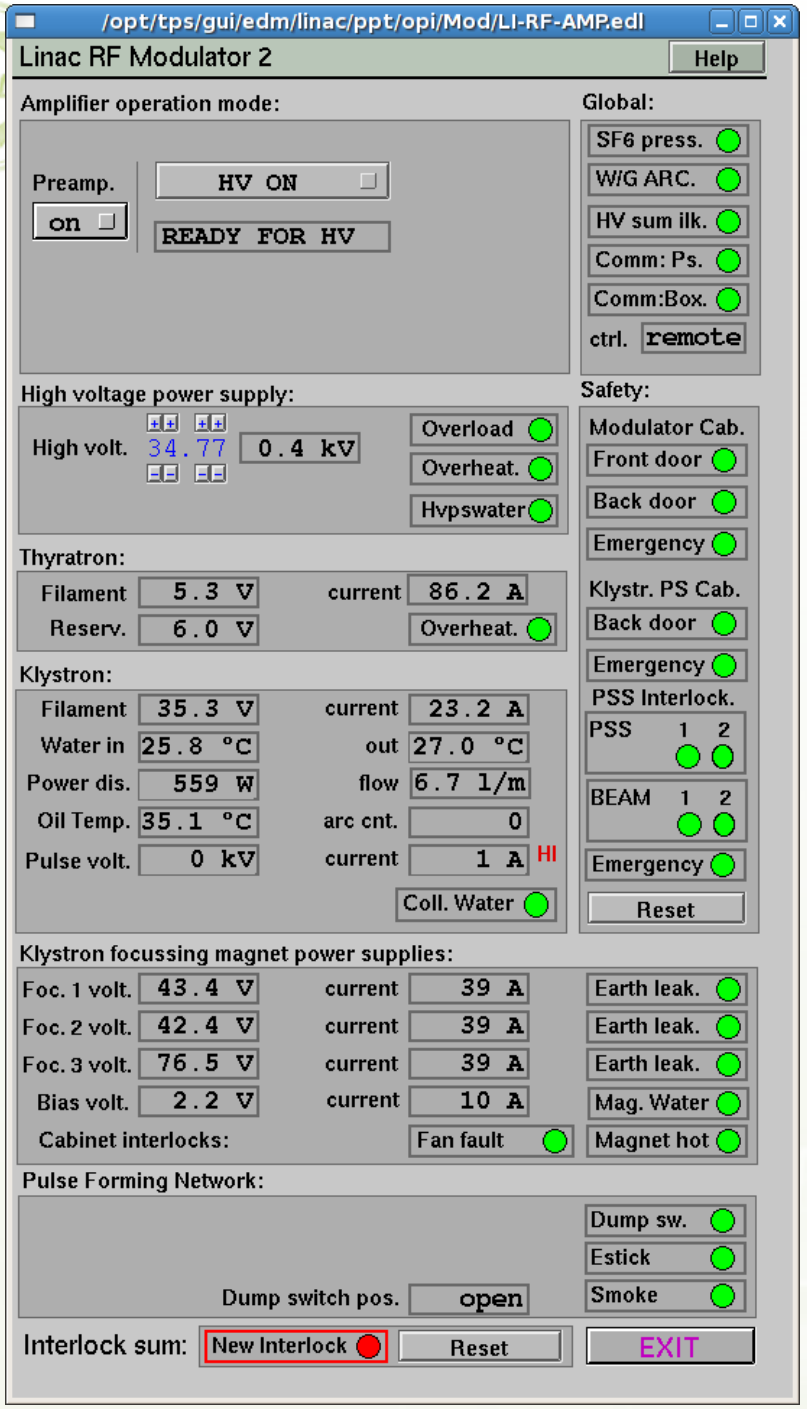
SR Orbit

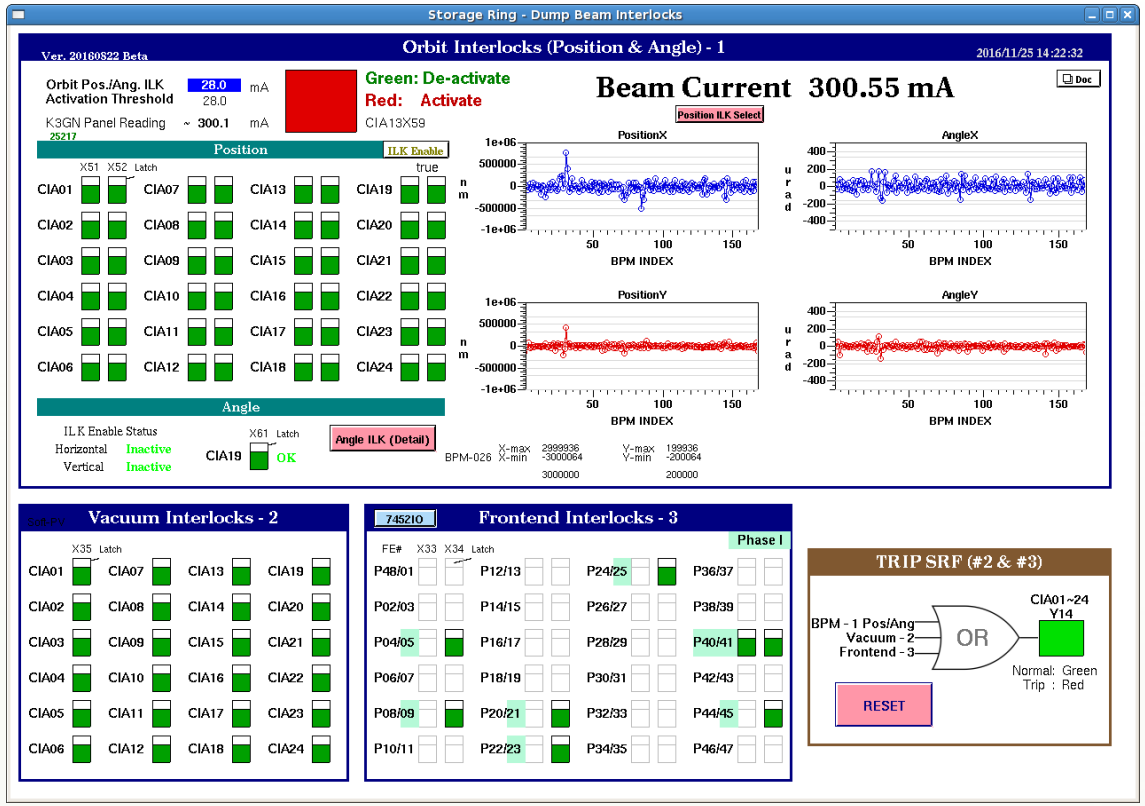
absolute different with

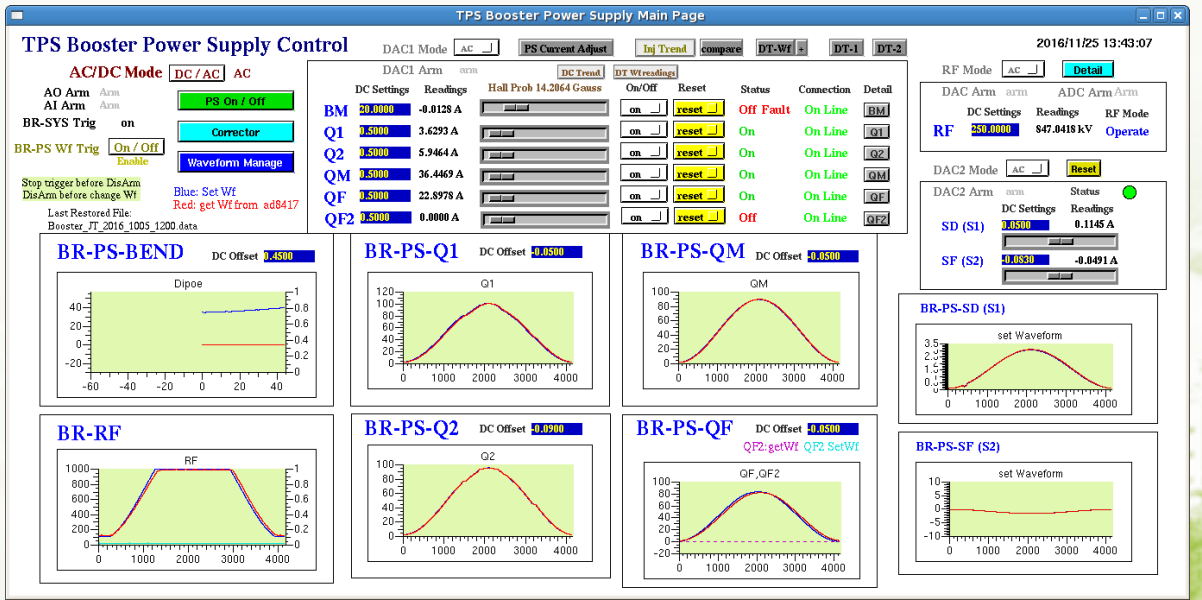


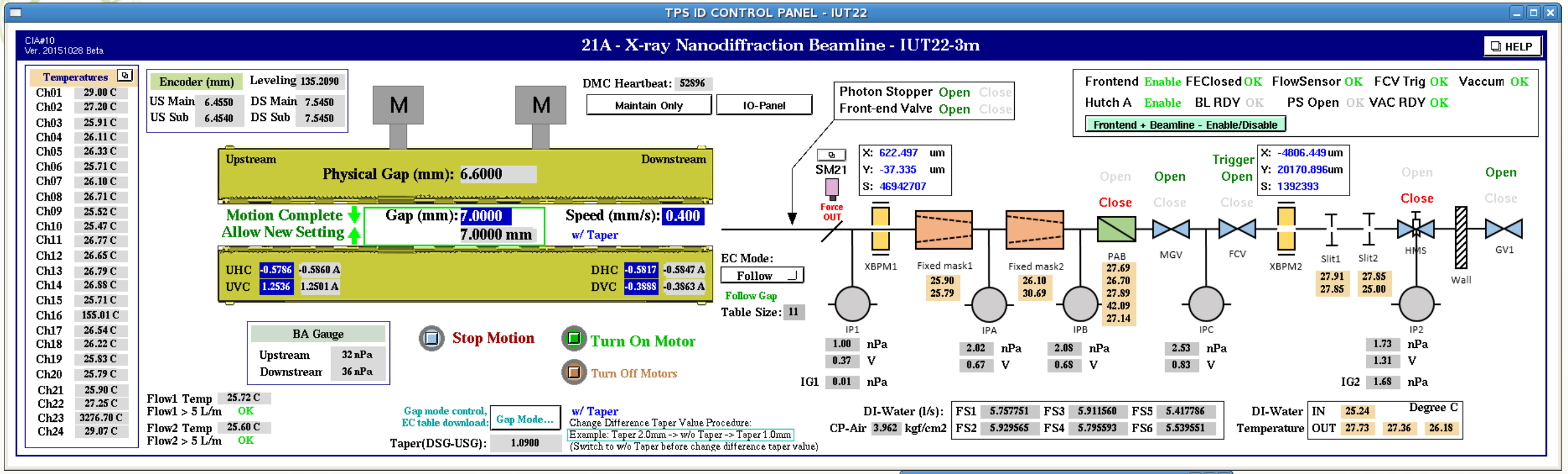


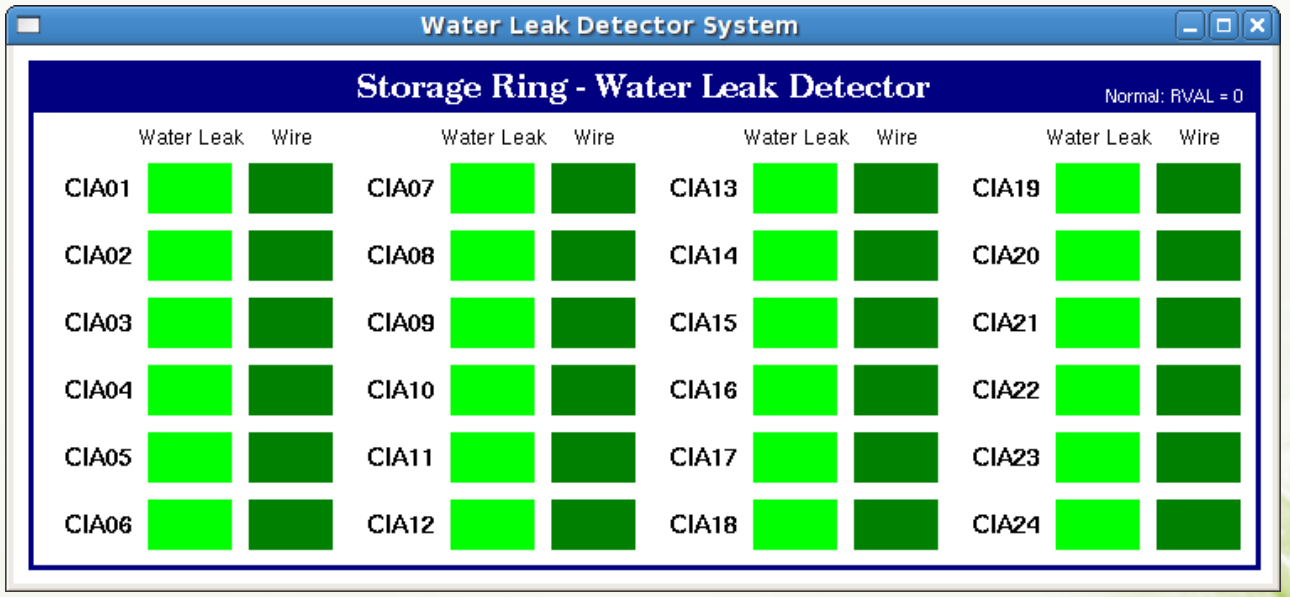


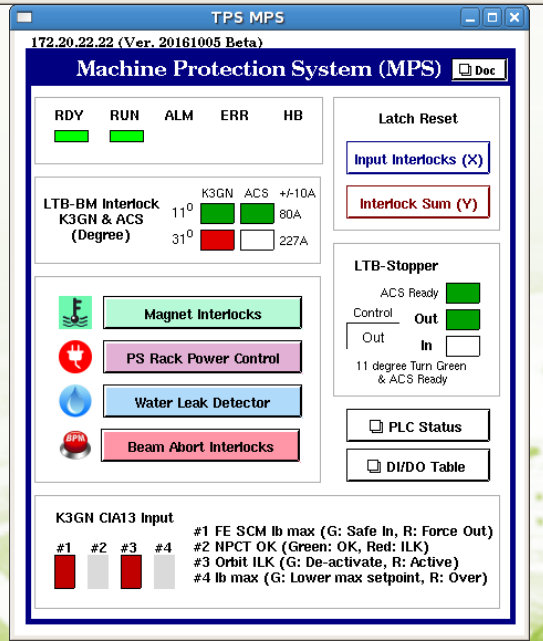

/opt/tps/gui/edm/linac/ppt/opi/Mod/LI-RF-AMP.edl
Linac RF Modulator 2
Help
Amplifier operation mode:
Preamp.
on
HV ON
READY FOR HV
Global:
SF6 press.
W/G ARC.
HV sum ilk.
Comm: Ps.
Comm:Box.
ctrl.
remote
High voltage power supply:
High volt.
34.77
0.4 kV
Overload
Overheat.
Hvpswater
Safety:
Modulator Cab.
Front door
Back door
Emergency
Thyratron:
Filament
5.3 V
current
86.2 A
Reserv.
6.0 V
Overheat.
Klystr. PS Cab.
Back door
Emergency
Klystron:
Filament
35.3 V
current
23.2 A
Water in
25.8 °C
out
27.0 °C
Power dis.
559 W
flow
6.7 l/m
Oil Temp.
35.1 °C
arc cnt.
0
Pulse volt.
0 kV
current
1 A
HI
Coll. Water
PSS Interlock.
PSS 1 2
BEAM 1 2
Emergency
Reset
Klystron focussing magnet power supplies:
Foc. 1 volt.
43.4 V
current
39 A
Earth leak.
Foc. 2 volt.
42.4 V
current
39 A
Earth leak.
Foc. 3 volt.
76.5 V
current
39 A
Earth leak.
Bias volt.
2.2 V
current
10 A
Mag. Water
Cabinet interlocks:
Fan fault
Magnet hot
Pulse Forming Network:
Dump sw.
Estick
Dump switch pos.
open
Smoke
Interlock sum:
New Interlock
Reset
EXIT


Storage Ring - Dump Beam Interlocks
Orbit Interlocks (Position & Angle) - 1
Ver. 20160822 Beta
2016/11/25 14:22:32
Orbit Pos./Ang. ILK Activation Threshold
28.0
28.0
mA
K3GN Panel Reading
~ 300.1
mA
25217
Green: De-activate
Red: Activate
CIA13X59
Beam Current 300.55 mA
Position ILK Select
Doc
Position
ILK Enable
true
X51 X52 Latch
CIA01 CIA07 CIA13 CIA19
CIA02 CIA08 CIA14 CIA20
CIA03 CIA09 CIA15 CIA21
CIA04 CIA10 CIA16 CIA22
CIA05 CIA11 CIA17 CIA23
CIA06 CIA12 CIA18 CIA24
PositionX
AngleX
PositionY
AngleY
BPM INDEX
Angle
ILK Enable Status
Horizontal Inactive
Vertical Inactive
X61 Latch
CIA19
OK
Angle ILK (Detail)
BPM-026
Vacuum Interlocks - 2
X35 Latch
Frontend Interlocks - 3
745210
Phase I
FE# X33 X34 Latch
P48/01 P12/13 P24/25 P36/37
P02/03 P14/15 P26/27 P38/39
P04/05 P16/17 P28/29 P40/41
P06/07 P18/19 P30/31 P42/43
P08/09 P20/21 P32/33 P44/45
P10/11 P22/23 P34/35 P46/47
TRIP SRF (#2 & #3)
BPM - 1 Pos/Ang
Vacuum - 2
Frontend - 3
OR
CIA01~24
Y14
Normal: Green
Trip : Red
RESET


TPS Booster Power Supply Main Page
TPS Booster Power Supply Control
2016/11/25 13:43:07
AC/DC Mode
DC / AC
AC
DAC1 Mode
PS Current Adjust
Inj Trend
compare
DT-1
DT-2
DAC1 Arm
DC Settings
Readings
Hall Prob 14.2064 Gauss
On/Off
Reset
Status
Connection
Detail
BM
Q1
Q2
QM
QF
QF2
Off Fault
On Line
PS On / Off
Corrector
Waveform Manage
BR-SYS Trig on
BR-PS Wf Trig
On / Off
Enable
Blue: Set Wf
Red: get Wf from ad8417
Last Restored File:
Booster_JT_2016_1005_1200.data
RF Mode
Detail
DAC Arm
ADC Arm
RF
Operate
DAC2 Mode
Reset
DAC2 Arm
SD (S1)
SF (S2)
BR-PS-BEND
DC Offset
Dipole
BR-PS-Q1
Q1
BR-PS-QM
QM
BR-PS-SD (S1)
set Waveform
BR-RF
RF
BR-PS-Q2
Q2
BR-PS-QF
QF2: getWf
QF2 SetWf
QF,QF2
BR-PS-SF (S2)


TPS ID CONTROL PANEL - IUT22
CIA#10
Ver. 20151028 Beta
21A - X-ray Nanodiffraction Beamline - IUT22-3m
HELP
Temperatures
Ch01 29.00 C
Ch02 27.20 C
Ch03 25.91 C
Ch04 26.11 C
Ch05 26.33 C
Ch06 25.71 C
Ch07 26.10 C
Ch08 26.71 C
Ch09 25.52 C
Ch10 25.47 C
Ch11 26.77 C
Ch12 26.65 C
Ch13 26.79 C
Ch14 26.88 C
Ch15 25.71 C
Ch16 155.01 C
Ch17 26.54 C
Ch18 26.22 C
Ch19 25.83 C
Ch20 25.79 C
Ch21 25.90 C
Ch22 27.25 C
Ch23 3276.70 C
Ch24 29.07 C
Encoder (mm)
Leveling 135.2090
US Main 6.4550
DS Main 7.5450
US Sub 6.4540
DS Sub 7.5450
M
M
Upstream
Downstream
Physical Gap (mm): 6.6000
Motion Complete
Allow New Setting
Gap (mm): 7.0000
7.0000 mm
Speed (mm/s): 0.400
w/ Taper
UHC -0.5786 -0.5860 A
UVC 1.2536 1.2501 A
DHC -0.5817 -0.5847 A
DVC -0.3888 -0.3863 A
DMC Heartbeat: 52896
Maintain Only
IO-Panel
Photon Stopper Open Close
Front-end Valve Open Close
Frontend Enable FEClosed OK FlowSensor OK FCV Trig OK Vaccum OK
Hutch A Enable BL RDY OK PS Open OK VAC RDY OK
Frontend + Beamline - Enable/Disable
SM21
Force OUT
X: 622.497 um
Y: -37.335 um
S: 46942707
X: -4806.449 um
Y: 20170.896 um
S: 1392393
Trigger
Open
Close
XBPM1
Fixed mask1
Fixed mask2
PAB
MGV
FCV
XBPM2
Slit1
Slit2
HMS
Wall
GV1
EC Mode:
Follow
Follow Gap
Table Size: 11
IP1
IPA
IPB
IPC
IP2
1.00 nPa
0.37 V
IG1 0.01 nPa
2.02 nPa
0.67 V
2.08 nPa
0.68 V
2.53 nPa
0.83 V
1.73 nPa
1.31 V
IG2 1.68 nPa
BA Gauge
Upstream 32 nPa
Downstream 36 nPa
Stop Motion
Turn On Motor
Turn Off Motors
Flow1 Temp 25.72 C
Flow1 > 5 L/m OK
Flow2 Temp 25.60 C
Flow2 > 5 L/m OK
Gap mode control,
EC table download:
Gap Mode...
w/ Taper
Change Difference Taper Value Procedure:
Example: Taper 2.0mm -> w/o Taper -> Taper 1.0mm
(Switch to w/o Taper before change difference taper value)
Taper(DSG-USG): 1.0900
DI-Water (l/s): FS1 5.757751 FS3 5.911560 FS5 5.417786
CP-Air 3.962 kgf/cm2 FS2 5.929565 FS4 5.795593 FS6 5.539551
DI-Water Temperature IN 25.24 OUT 27.73 27.36 26.18 Degree C

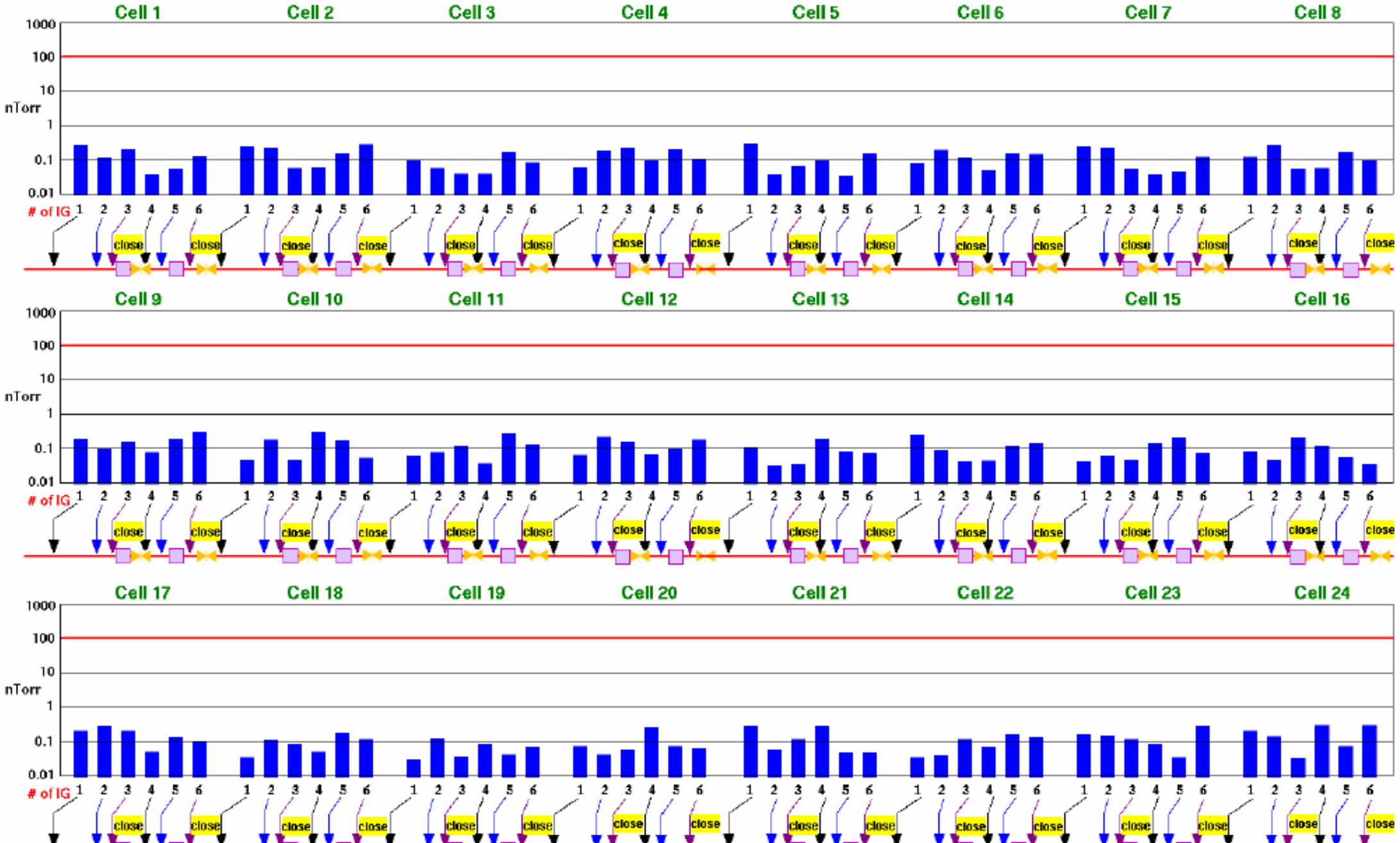

Water Leak Detector System
Storage Ring - Water Leak Detector
Normal: RVAL = 0
Water Leak Wire
CIA01 CIA07 CIA13 CIA19
CIA02 CIA08 CIA14 CIA20
CIA03 CIA09 CIA15 CIA21
CIA04 CIA10 CIA16 CIA22
CIA05 CIA11 CIA17 CIA23
CIA06 CIA12 CIA18 CIA24

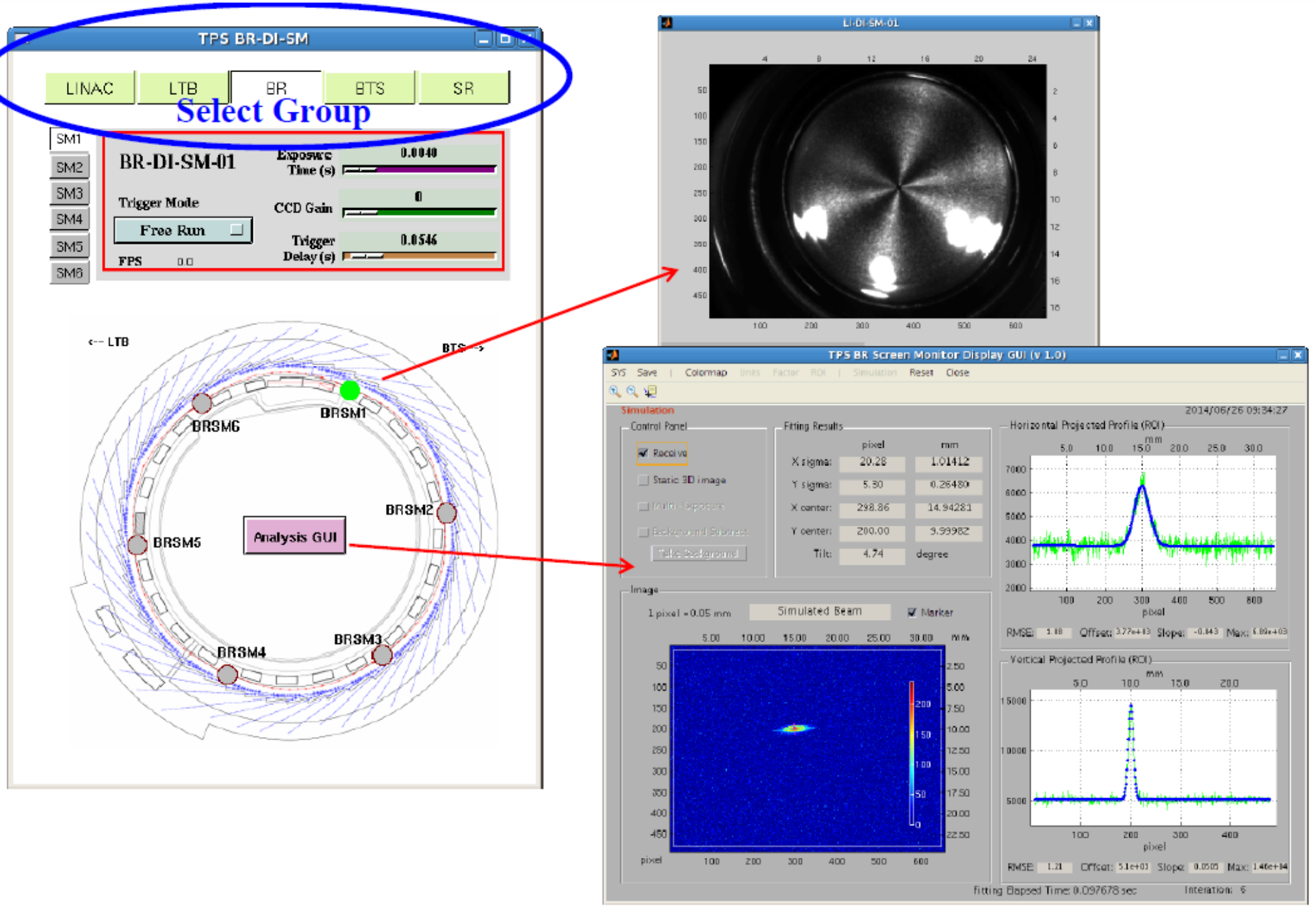

TPS MPS
172.20.22.22 (Ver. 20161005 Beta)
Machine Protection System (MPS)
Doc
RDY RUN ALM ERR HB
Latch Reset
Input Interlocks (X)
Interlock Sum (Y)
LTB-BM Interlock K3GN & ACS (Degree)
K3GN ACS +/-10A
11° 80A
31° 227A
LTB-Stopper
ACS Ready
Control Out
Out In
11 degree Turn Green & ACS Ready
Magnet Interlocks
PS Rack Power Control
Water Leak Detector
Beam Abort Interlocks
PLC Status
DI/DO Table
K3GN CIA13 Input
#1 #2 #3 #4
#1 FE SCM Ib max (G: Safe In, R: Force Out)
#2 NPCT OK (Green: OK, Red: ILK)
#3 Orbit ILK (G: De-activate, R: Active)
#4 Ib max (G: Lower max setpoint, R: Over)

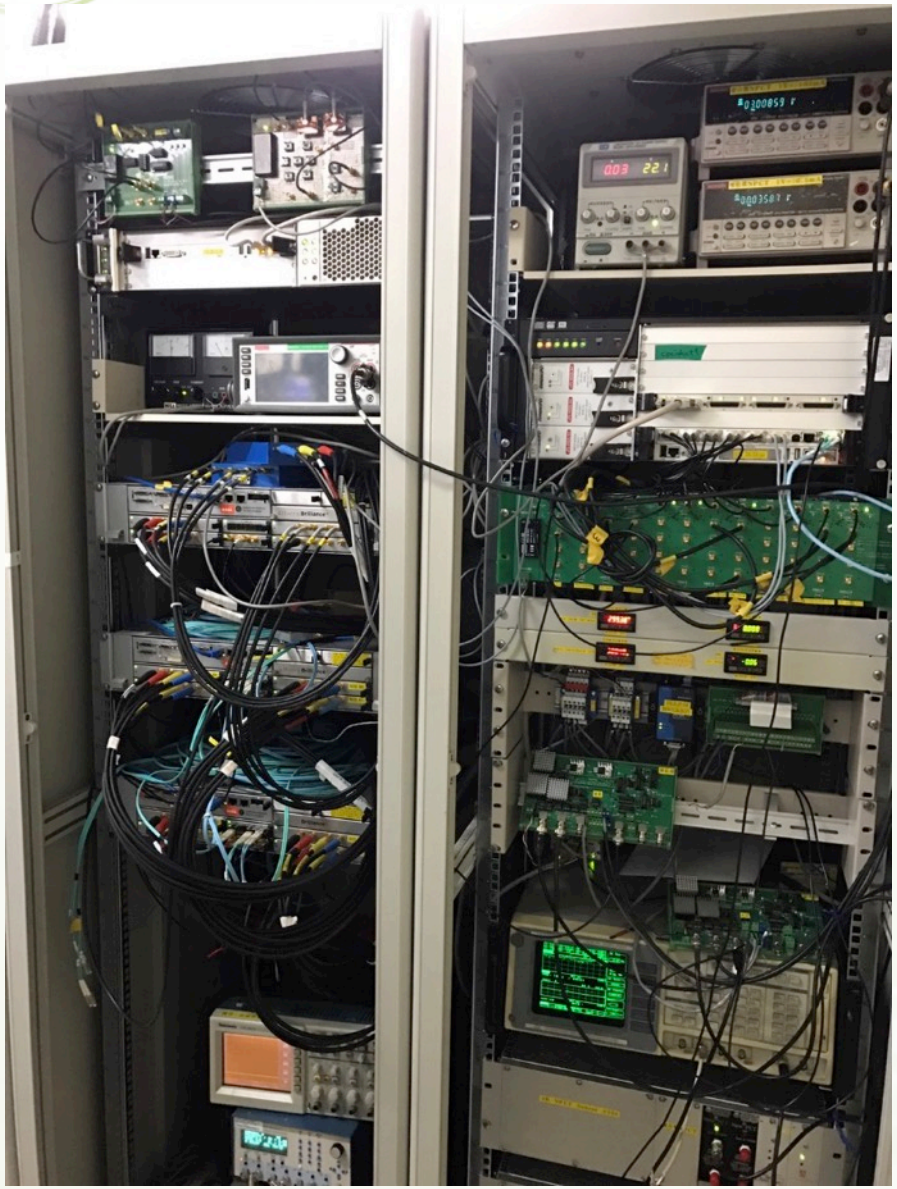
TOP

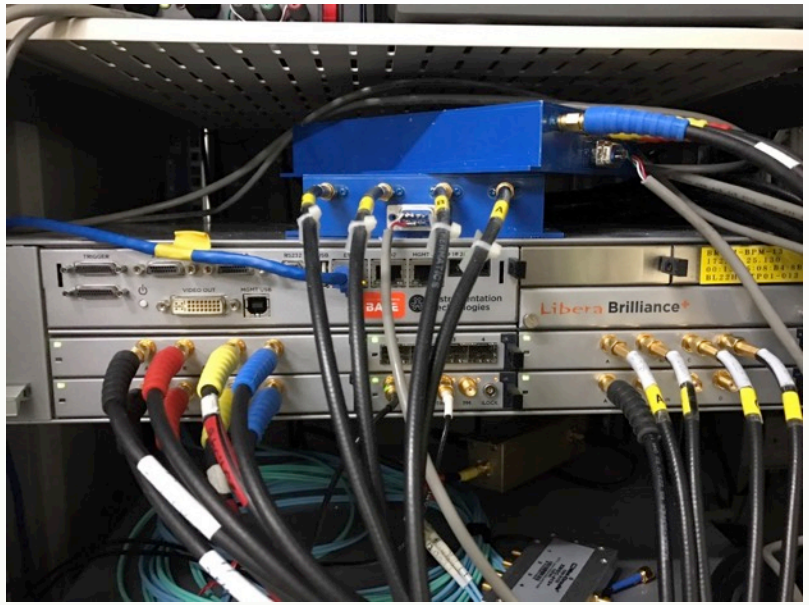
Storage Ring Vacuum Pressure

Detail




TPS BR-DI-SM
LINAC
LTB
BR
BTS
SR
Select Group
SM1
SM2
SM3
SM4
SM5
SM6
BR-DI-SM-01
Exposure Time (s)
0.0040
Trigger Mode
Free Run
CCD Gain
0
Trigger Delay (s)
0.0546
FPS
0.0
<-- LTB
BTS -->
BRSM6
BRSM1
BRSM2
BRSM5
Analysis GUI
BRSM4
BRSM3
LI-DI-SM-01
TPS BR Screen Monitor Display GUI (v 1.0)
SYS
Save
Colormap
Reset
Close
Simulation
2014/06/26 09:34:27
Control Panel
Receive
Static 3D image
Multi-Exposure
Background Subtract
Take Background
Fitting Results
pixel
mm
X sigma:
20.28
1.01412
Y sigma:
5.30
0.26480
X center:
298.86
14.94281
Y center:
200.00
9.99982
Tilt:
4.74
degree
Image
1 pixel = 0.05 mm
Simulated Beam
Marker
Horizontal Projected Profile (ROI)
Vertical Projected Profile (ROI)
RMSE:
Offset:
Slope:
Max:
Fitting Elapsed Time: 0.097678 sec
Interation: 6




Libera Brilliance+


TPS
TLS

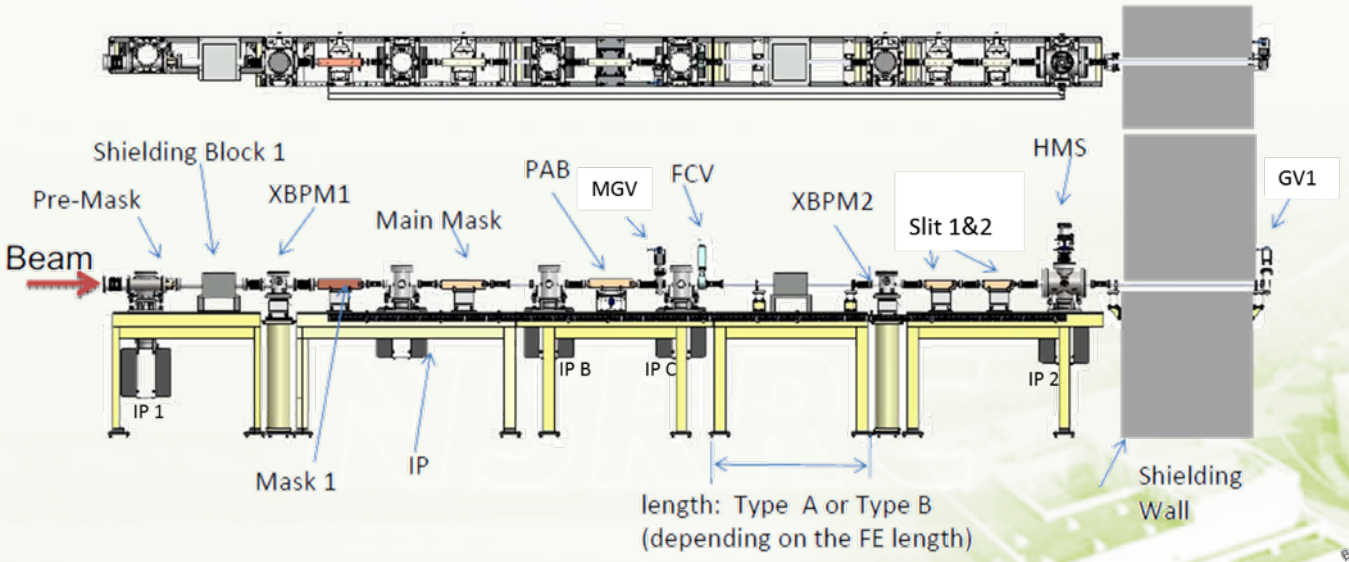
Outline

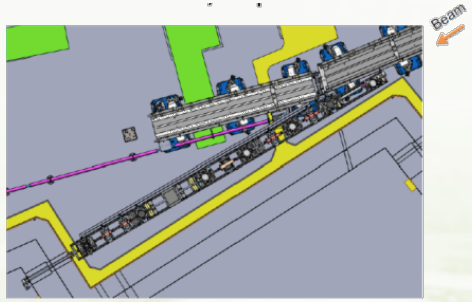
- Introductions to TLS and TPS
- TPS control system
- Front end interlock control system
- Conclusions

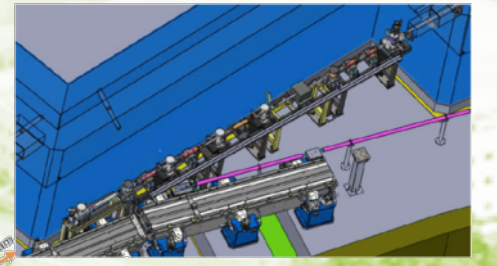
Introductions to Front end

The main functions of a front end are:

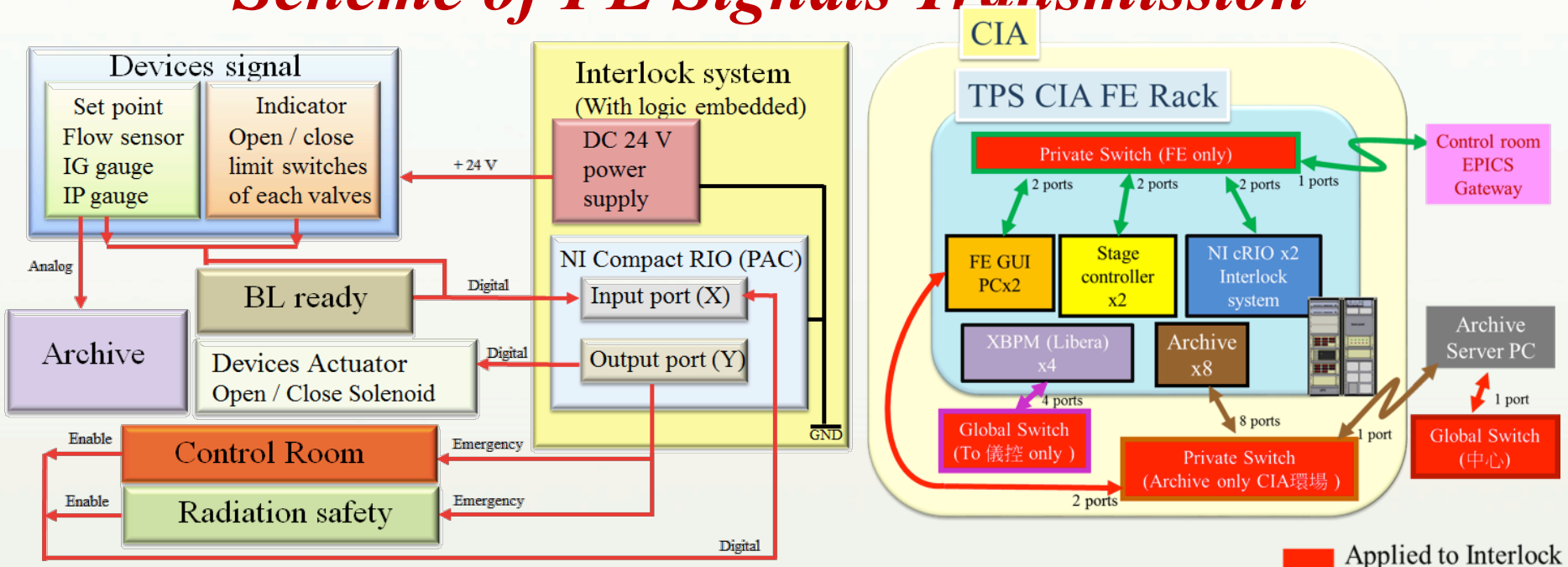
- To protect radiation safety for user.
- To allow synchrotron light generated in the storage ring to pass through to a beamline.
- To monitor the position of the synchrotron light.
- To protect the vacuum of storage ring if there is a leak in the beamline.
- To remove as much of the heat as possible from the synchrotron light.
- To allow safe access into the optics hutch when required.

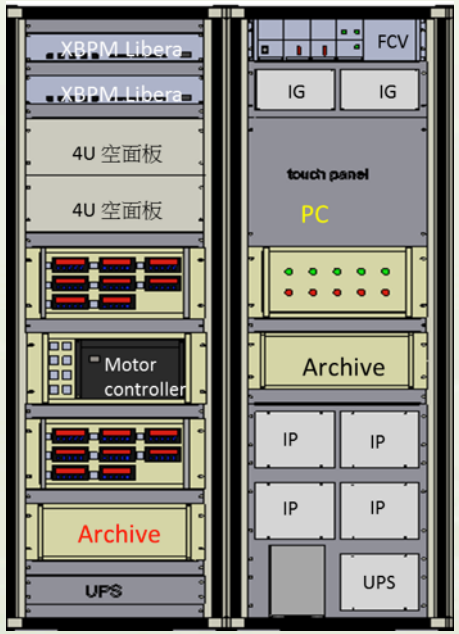


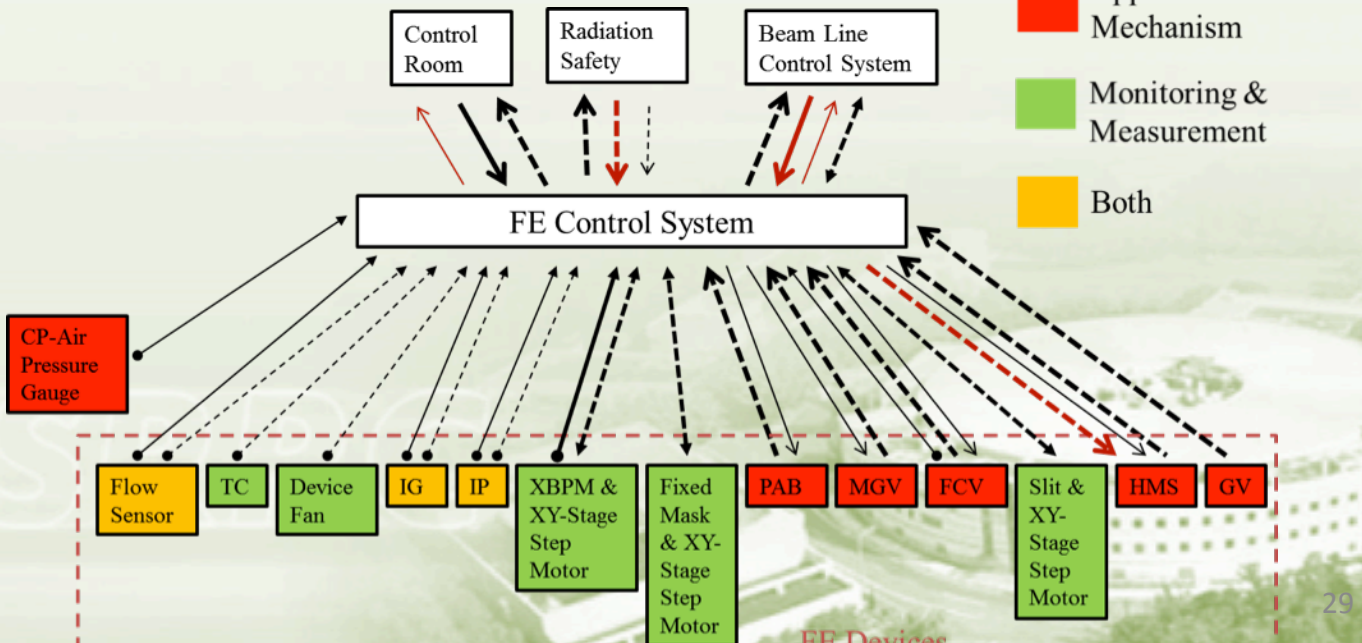




Scheme of FE Signals Transmission

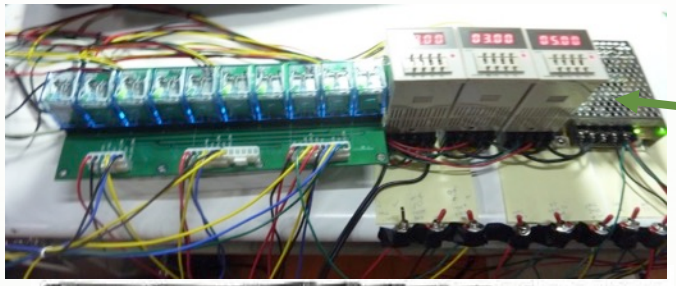






Hardware of TPS FE Interlock System

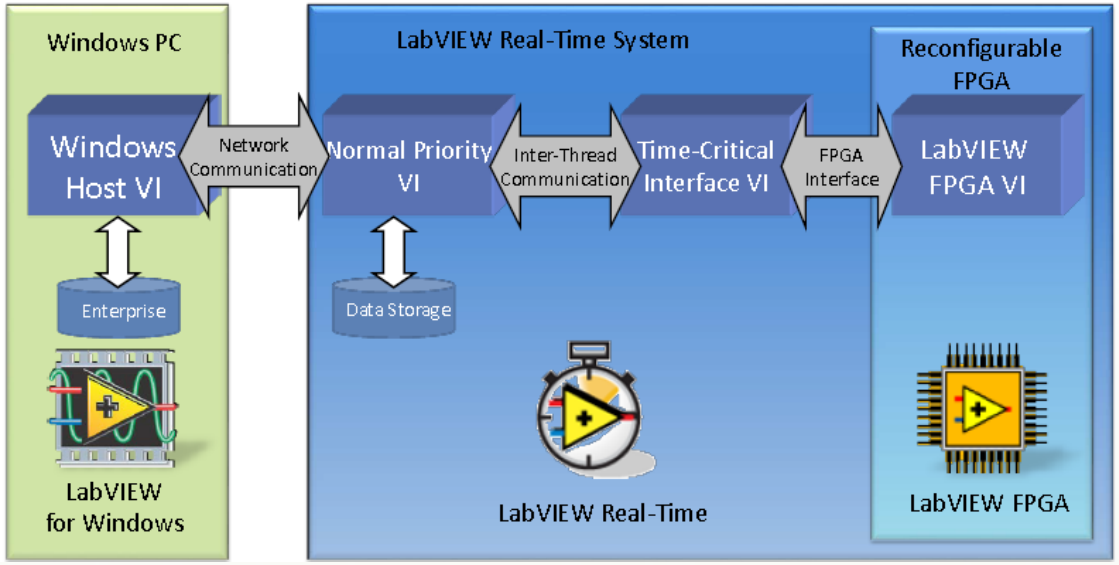
EMG loop

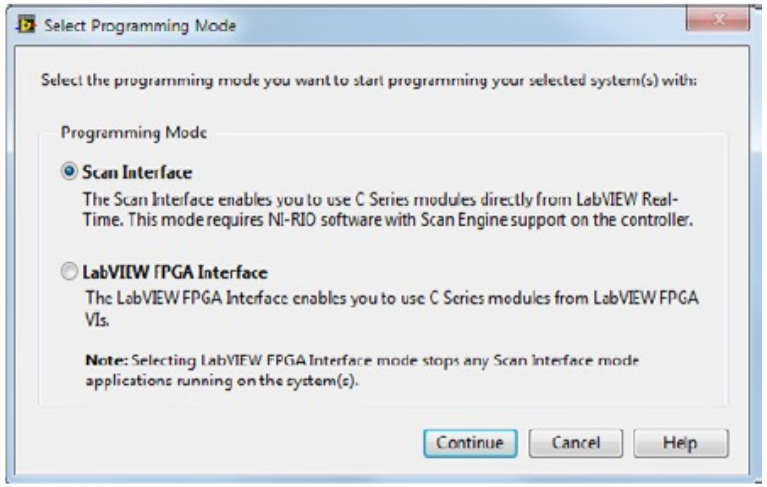


NI Compact RIO
9074→9030

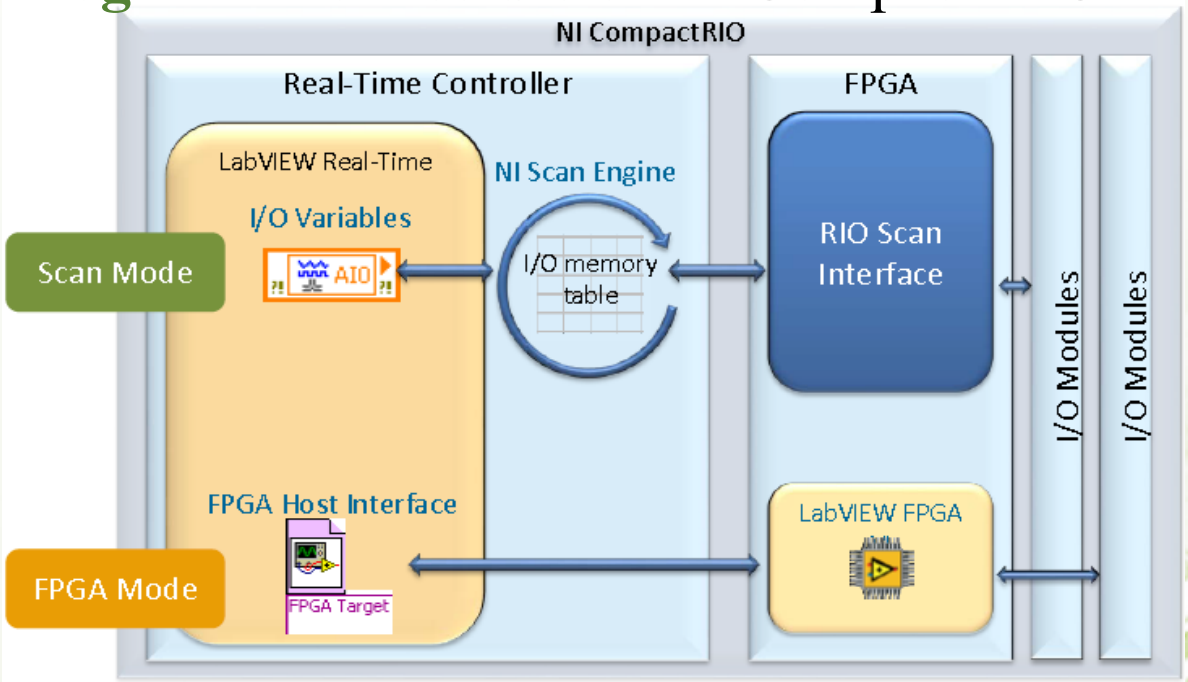
NI 9476	NI 9425
32-channel	32-channel
500 µs digital output	7 µs sinking digital inputs
6 to 36 V output range, sourcing	Compatible with 12 and 24 V levels
250 mA/ch maximum current drive on all channels	Industry-standard 37-pin D-Sub connector
Industry-standard 37-pin D-Sub connector	Hot-swappable operation
Hot-swappable operation	Extreme industrial
-40 to 70 °C operating range	-40 to 70 °C operating range

System Architecture of NI Compact RIO





Program Architecture of NI Compact RIO



RT Processor

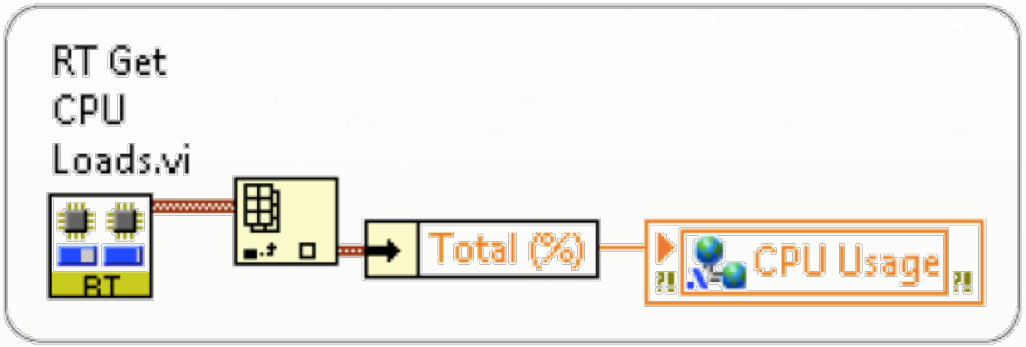
1. Real-time OS
2. Application software
3. Networking and peripheral I/O drivers
4. DMA, interrupt, and bus control drivers

FPGA

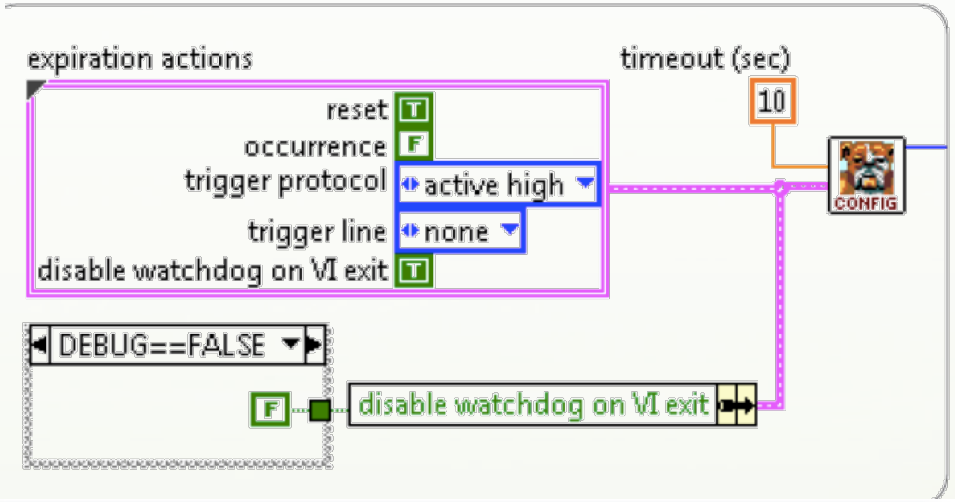
1. Application IP
2. Control IP
3. DSP IP
4. Specialized I/O drivers and interface
5. DMA controller

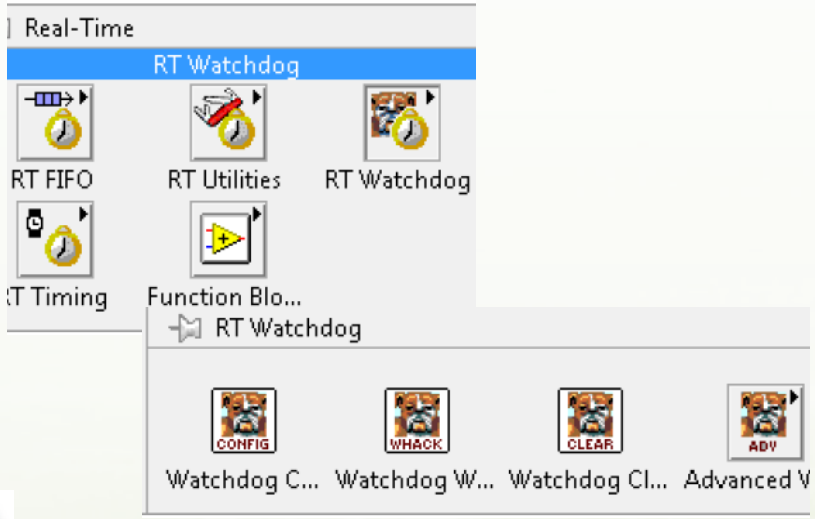
Reference from ni.com

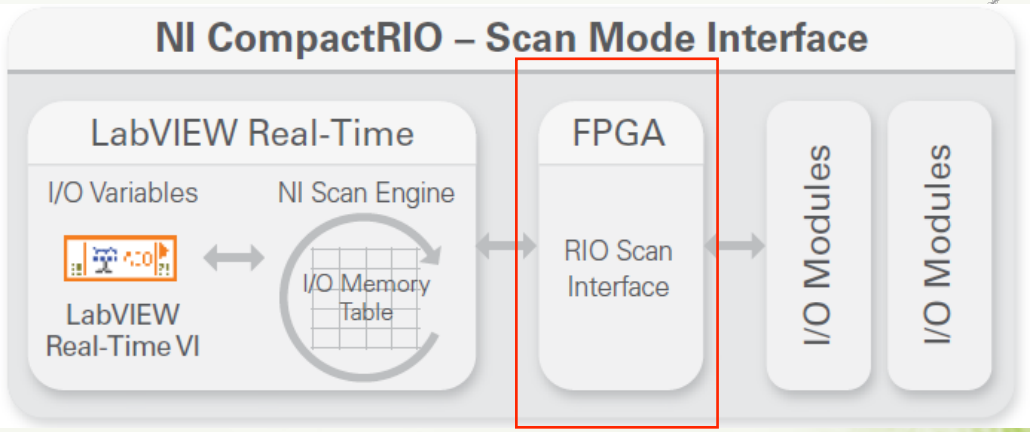
Reliability increase and fail safe



- Keep CPU usage below 70%.
- Utilized Watch dog

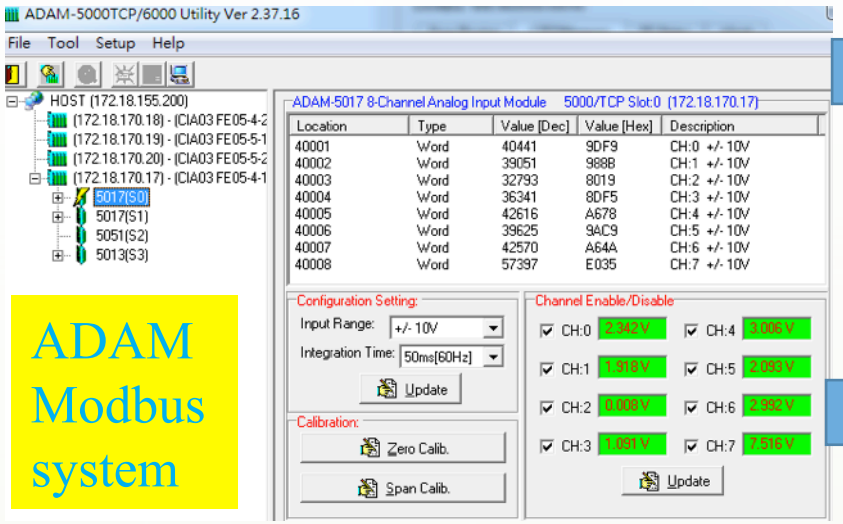




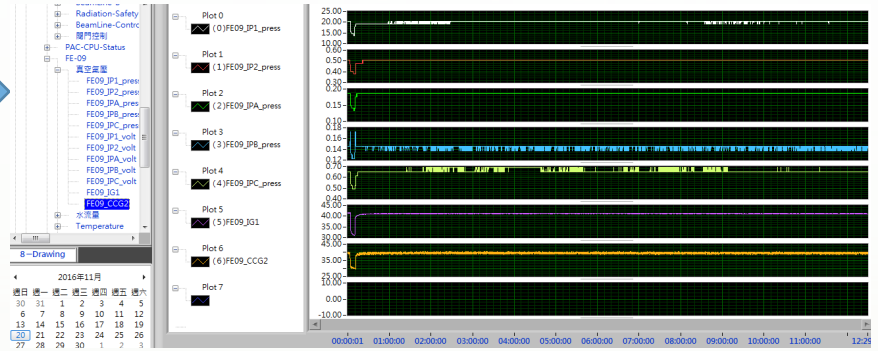


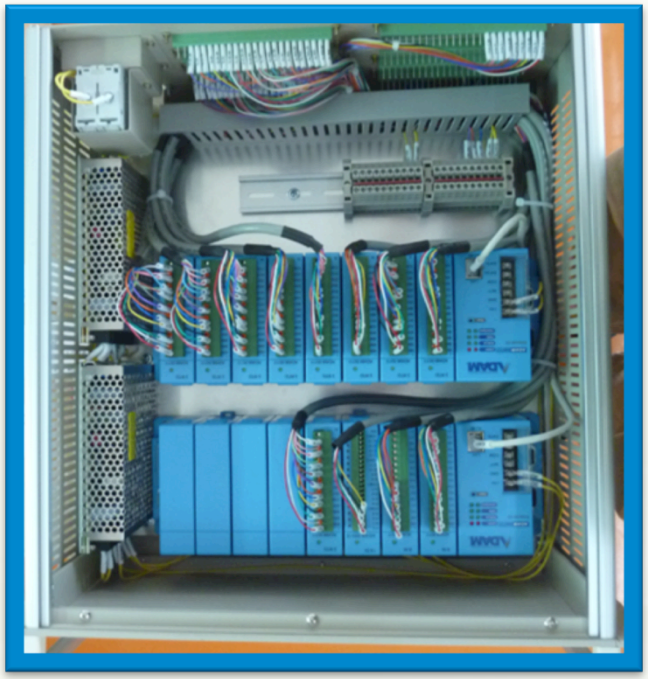
1. RT Safe
2. Emergency Safe
3. Watchdog safe
4. Control input valid

Network communication

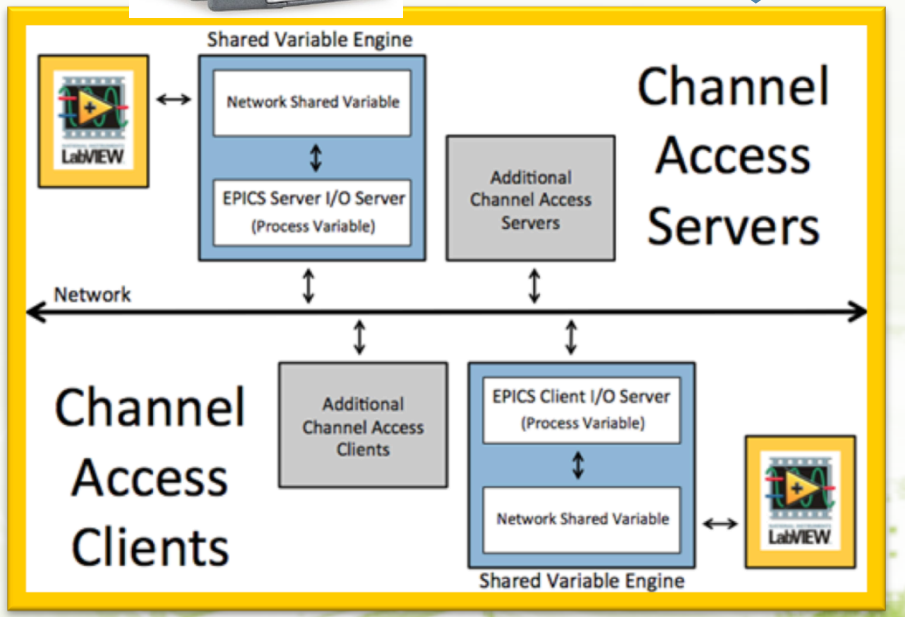


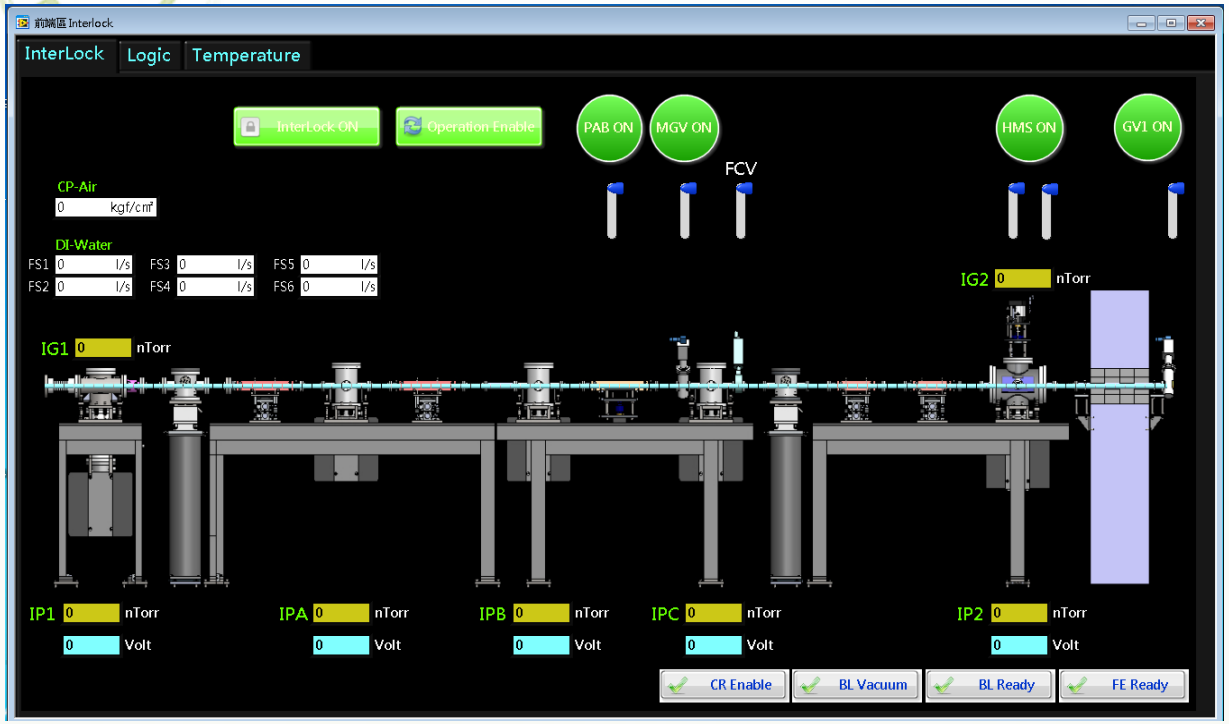
ADAM Modbus system

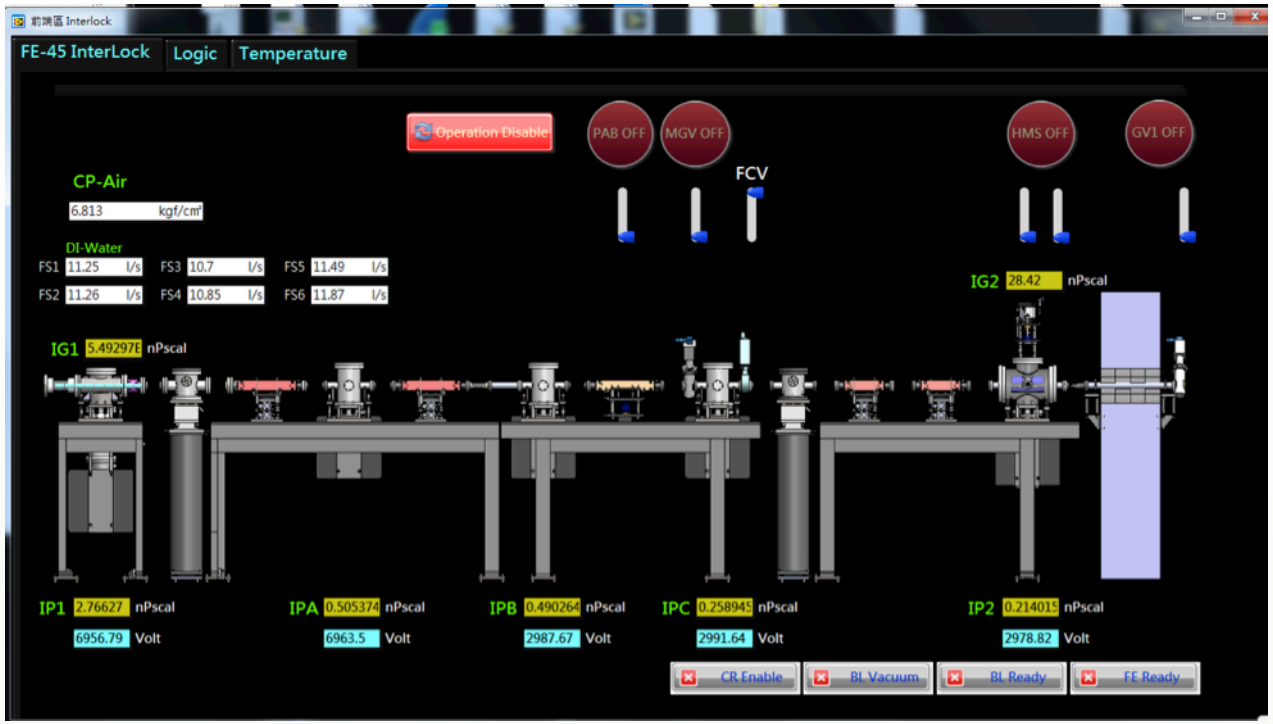




EPICS server







- MGV open/ close:

FE Vacuum & BL Vacuum normal

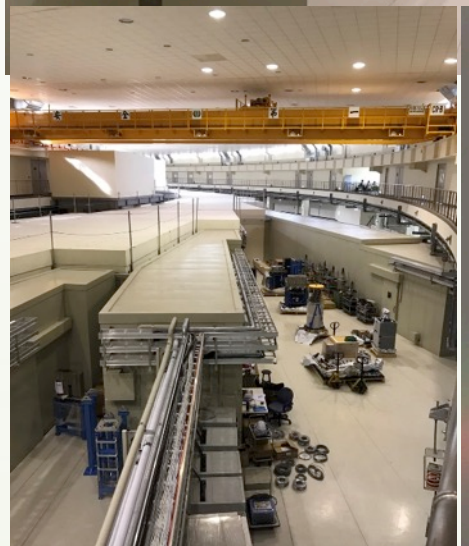
- HMS open/ close:

BL Ready ⇄ BL reset ⇄ CR enable ⇄ Radiation safety (⇄ BL push button)

- PAB open/ close:

BL Ready ⇄ BL reset ⇄ Radiation safety (⇄ BL push button)

1. BL Hutch EMG pushed & HMS opened
2. PAB & HMS over closing time
3. DI water set point alarm
4. FCV triggered
5. Interlock bypassed




O2 Alarm Panel-2
Optics Hutch 2 Interlock Control Panel


TPS 23A Front End Interlock Control Panel
BR02
23A

Outline

- Introductions to TLS and TPS
- TPS control system
- Front end interlock control system
- Conclusions

Conclusions

- TPS have operated for user by 3 GeV and 300 mA top-up mode.
- TPS BL construction is in progress, 5BLs are operated for user.
- Radiation safety is upgrading for human safety.
- YOKOSO TPS Taiwan.

Thank You For Your Attention