



國家同步輻射研究中心
National Synchrotron Radiation Research Center

CWRF2016

*Operation Status of the RF Systems
in Taiwan Light Source
and Taiwan Photon Source*

Ming-Chyuan Lin

NSRRC, Taiwan



Two Light Sources in NSRRC

Taiwan Light Source (TLS)

Taiwan Photon Source (TPS)



Machine Parameters

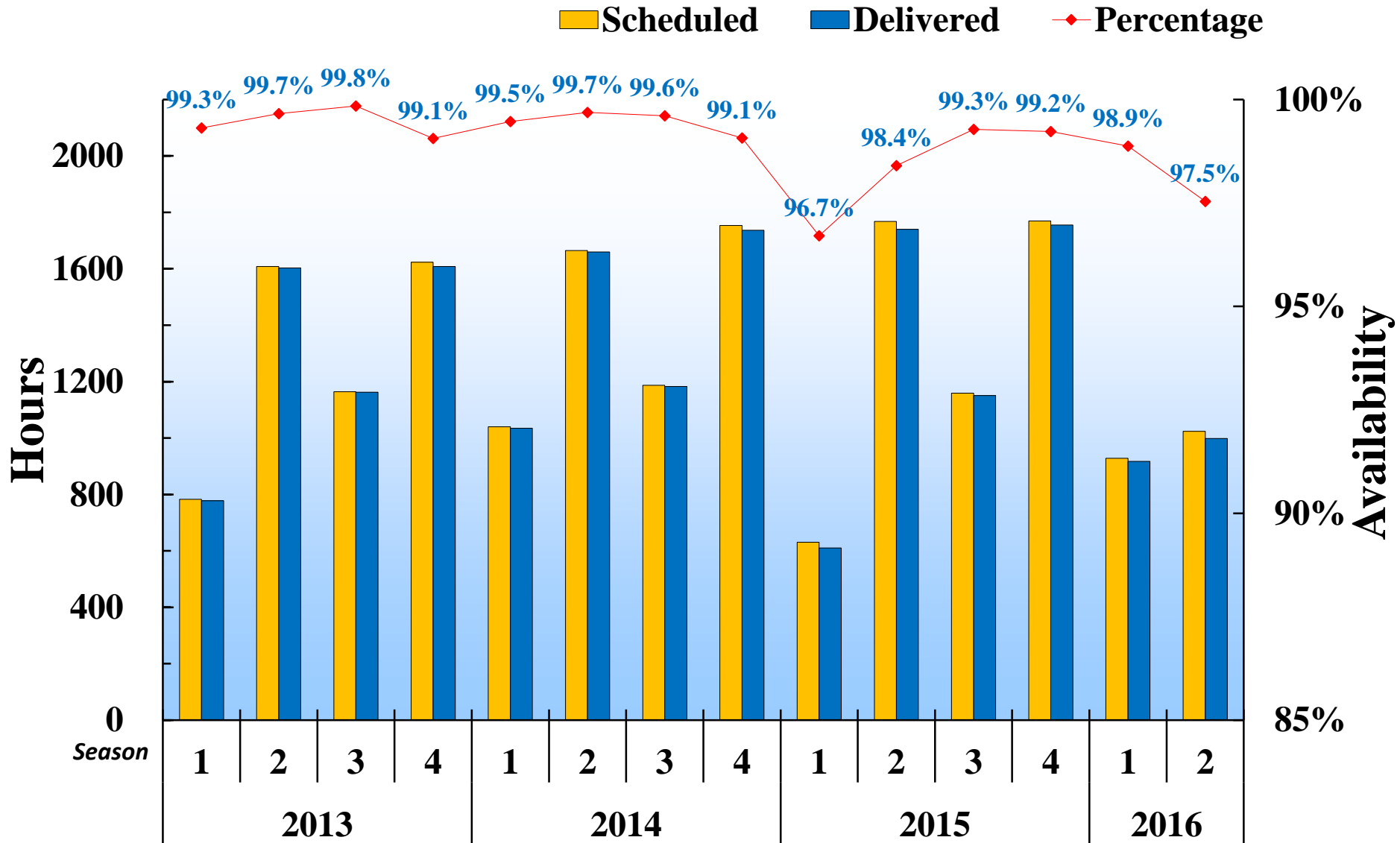
Main parameters	TLS	TPS
Energy [GeV]	1.5	3.0
LINAC [MeV]	50	150
Circumference of SR [m]	120	518.4
Number of buckets	200	864
Current [mA]	360	500
Bunch length [psec]	31	9.5
Horizontal emittance [nm-rad]	22	1.6
Vertical emittance [nm-rad]	0.088	0.016
Tunes (ν_x/ν_y)	7.302/4.17	26.18/13.28
Vertical (rms) orbit stability [μm]	1	0.2
Coupling [%]	0.4	< 1
RF voltage [MV]	1.6	2.8 ~ 3.5
Lifetime [hour]	6	10
Straight Sections	6m X6	12m X6 & 7m X18

Operation Status of Taiwan Light Source (TLS)

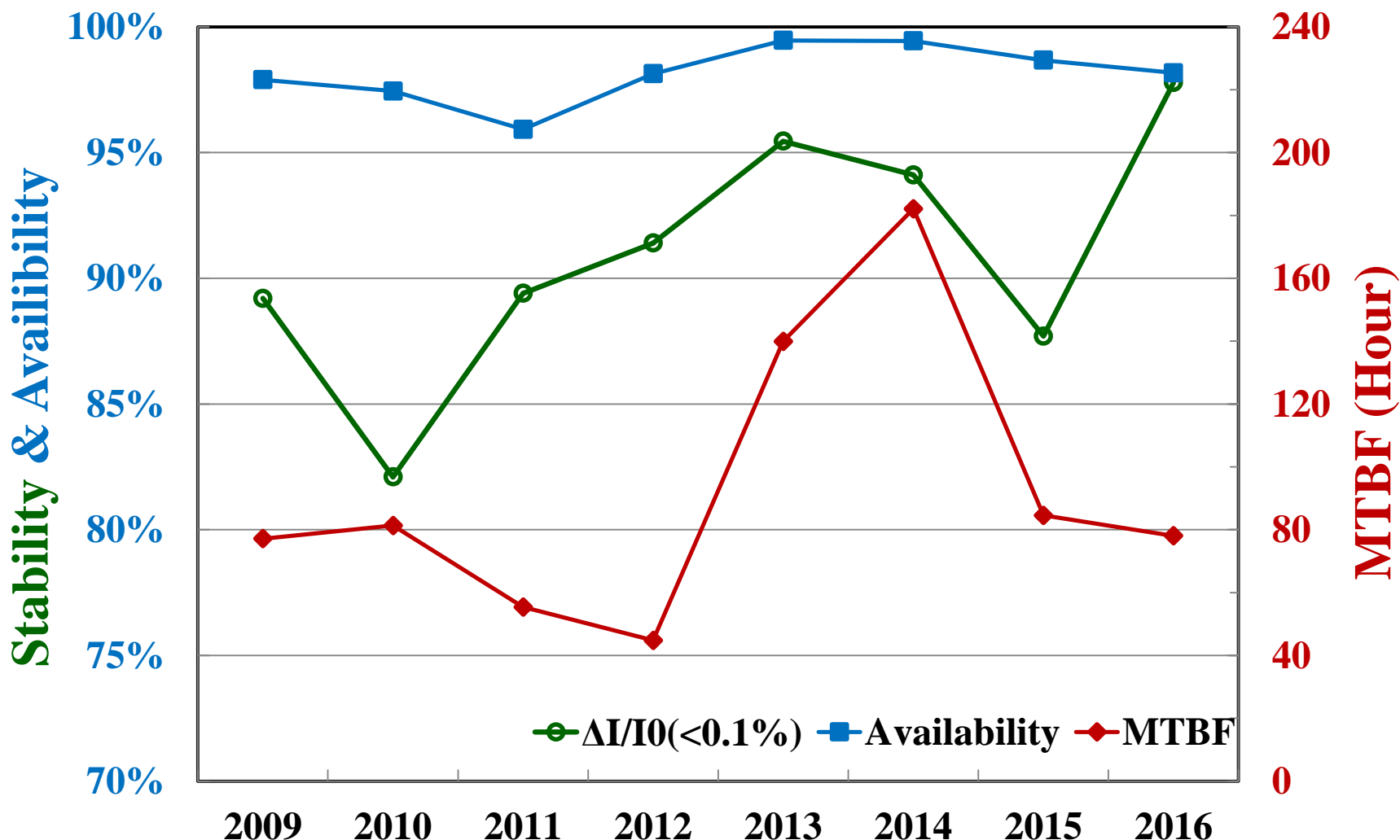
**A compact ring
with 9 IDs and 25 beamlines**

Status of TLS (1)

Annual user beam time > 5,000 hours, Availability > 96%



Status of TLS (2)



Beam stability:
ratio of user beam time with relative
intensity fluctuation $< 0.1\%$

MTBF: Mean Time Between Failure

Operation Status of the RF System in TLS

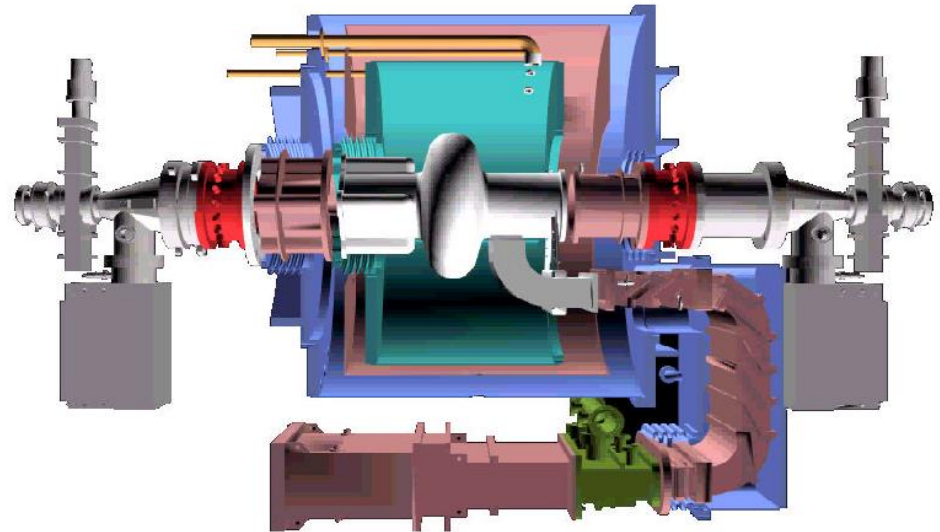
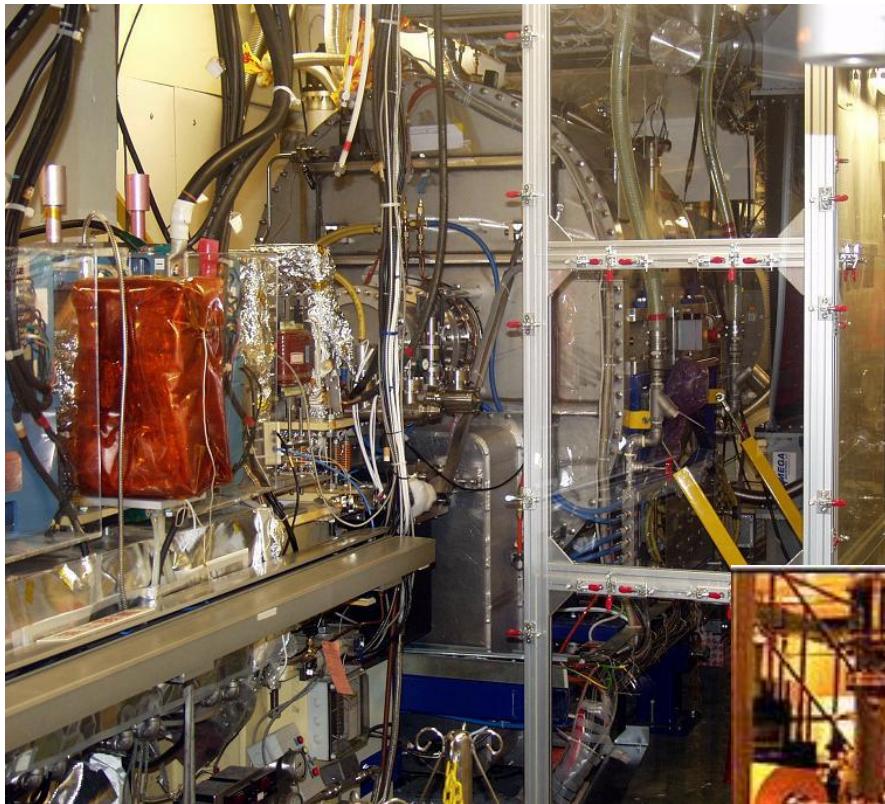
RF System of TLS (1)

**Transmitter and Klystron:
100 kW for storage ring, 60kW for booster ring**



RF System of TLS (2)

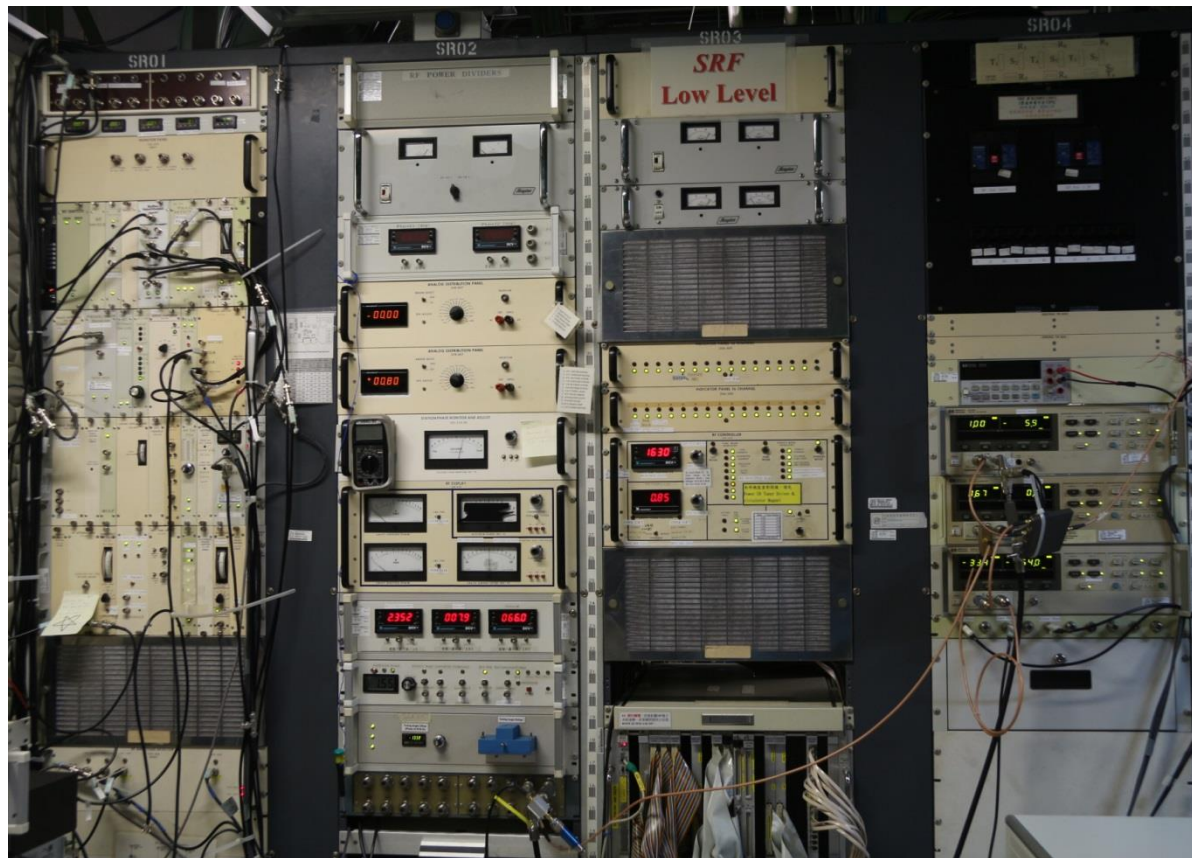
Cavity: CESR-type SRF module for storage ring
Doris Cavity for booster ring



RF System of TLS (3)

Low Level RF: Analog type

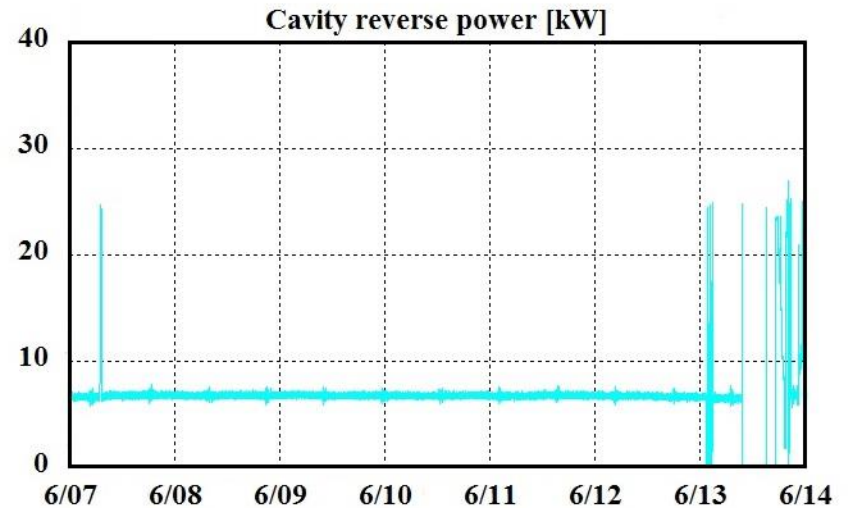
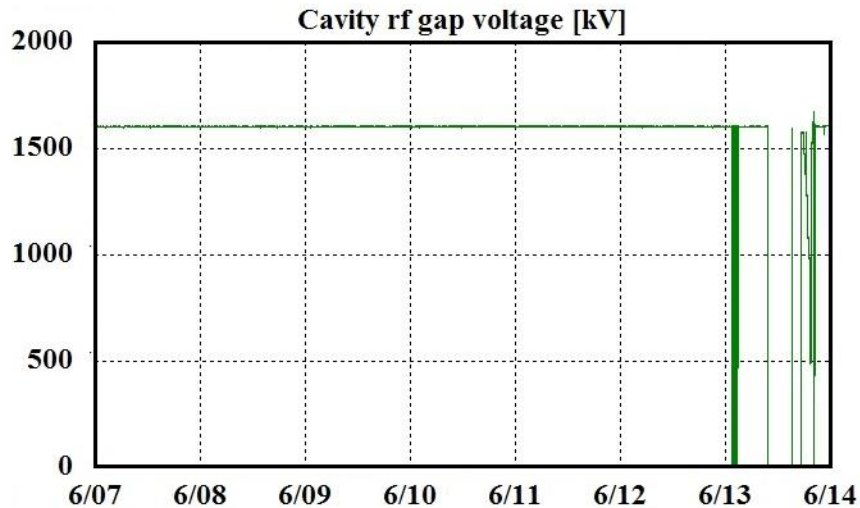
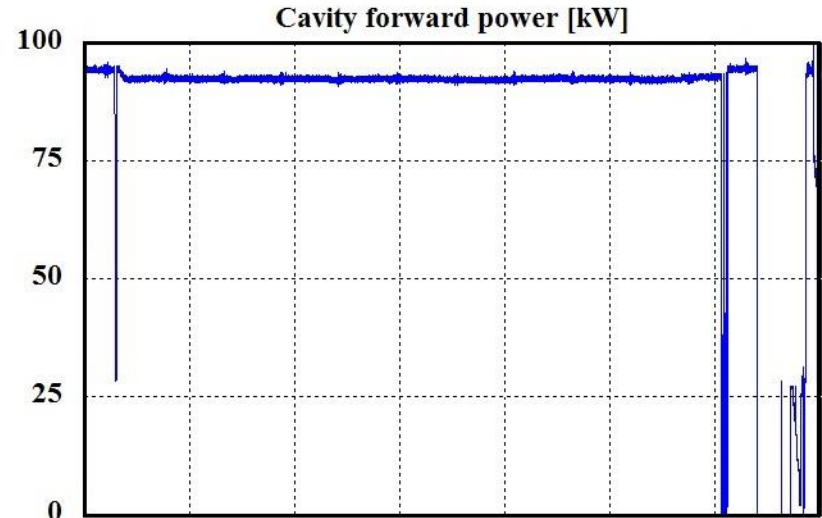
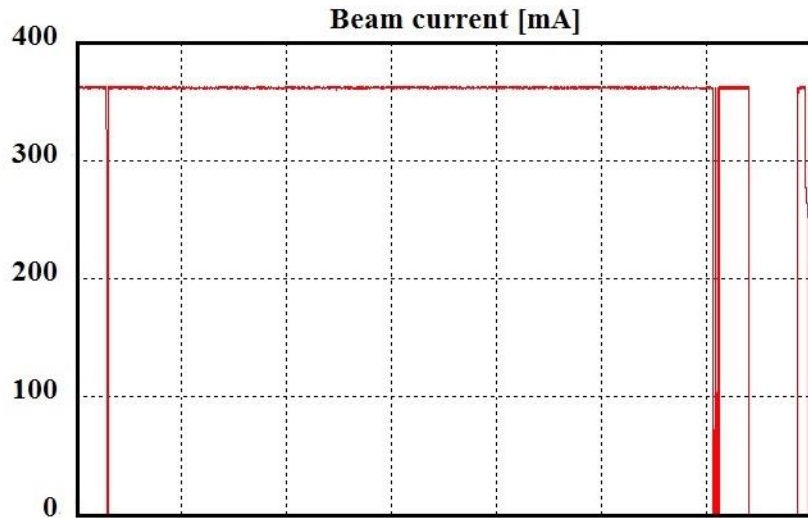
SRF Electronics: for SRF module and valve box



RF System of TLS (4)

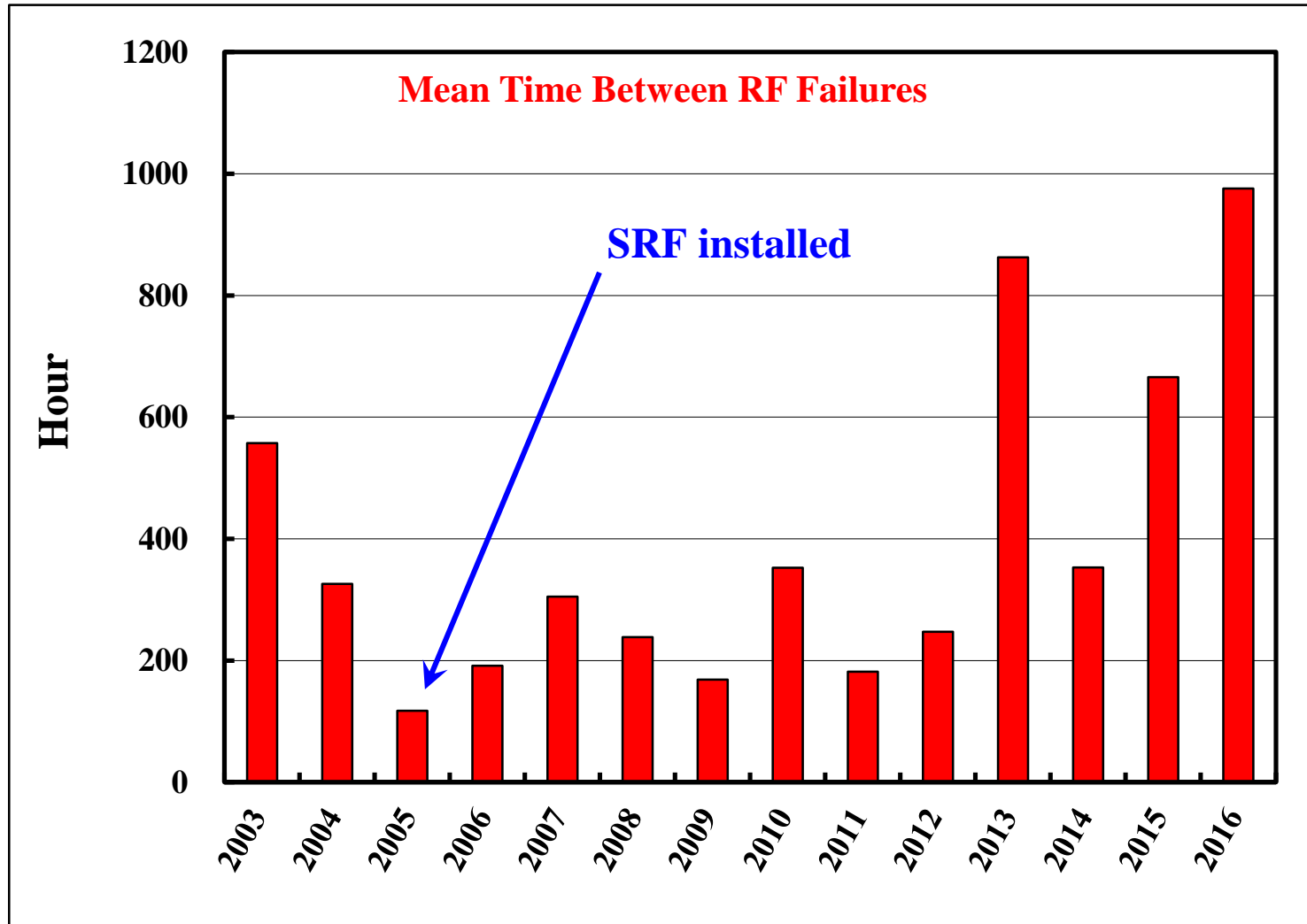
Normal operation at 90 kW

Gap voltage of SRF cavity at 1.6 MV



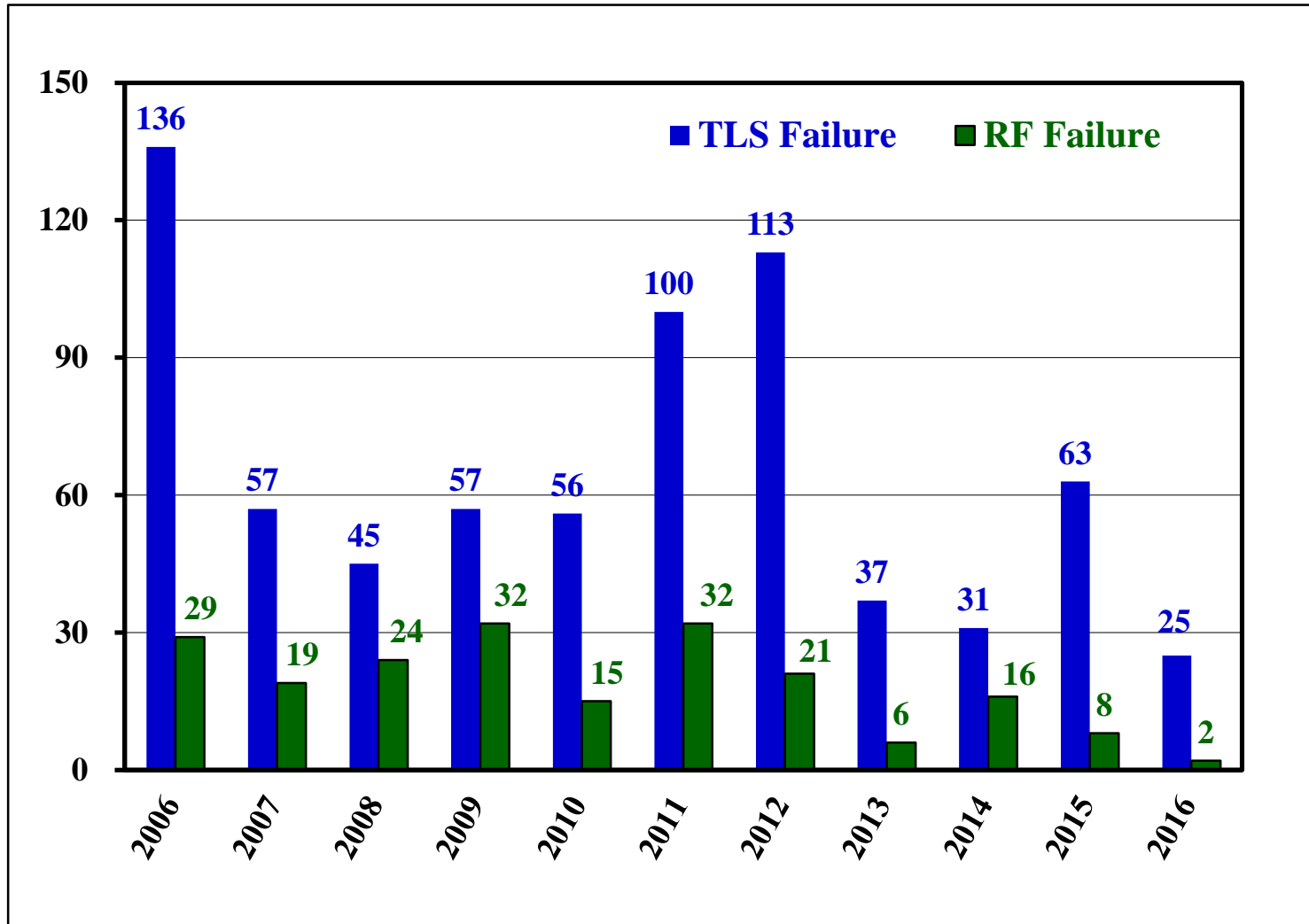
RF System of TLS (5)

Statistics of MTBF



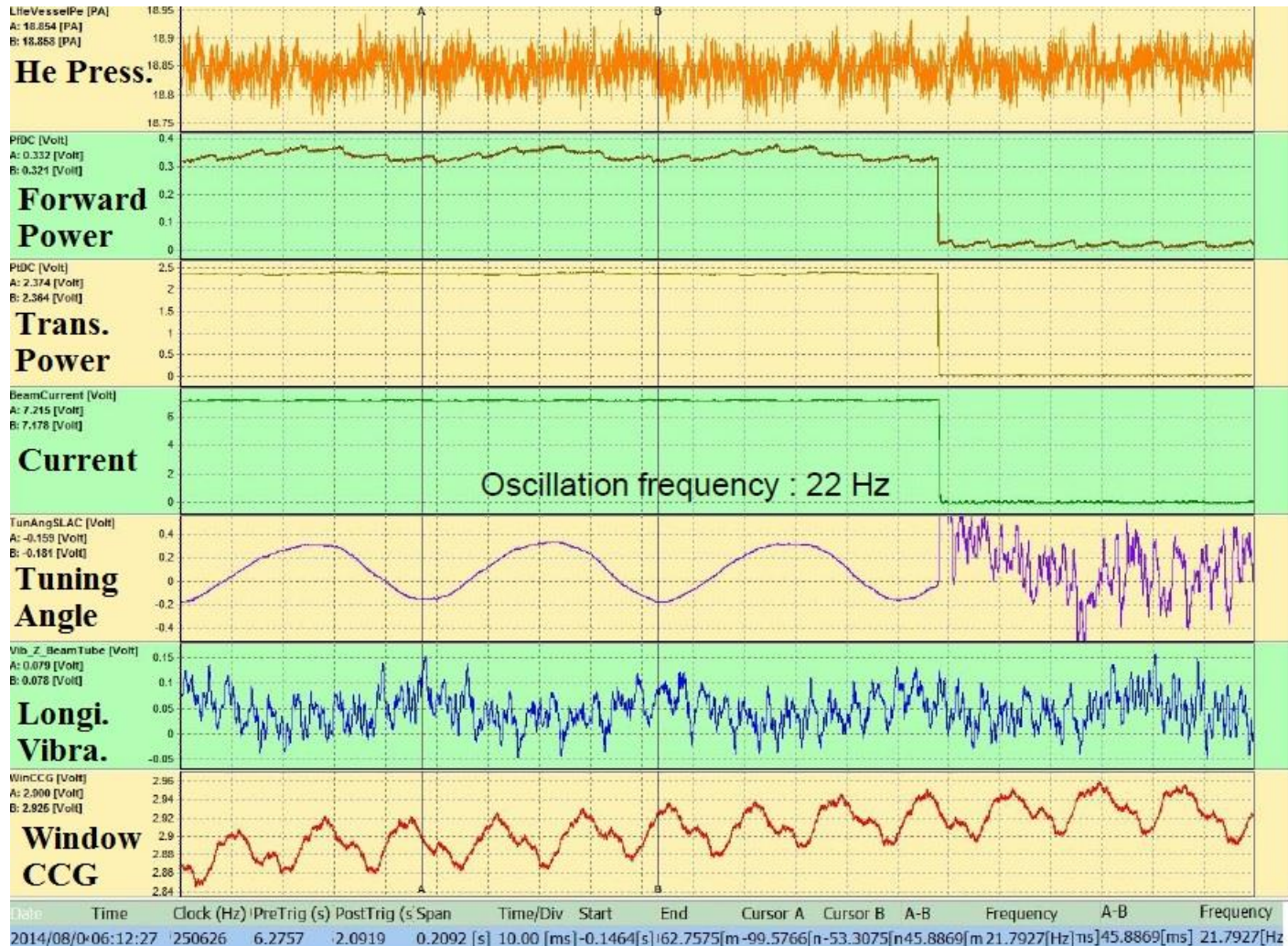
RF System of TLS (6)

Statistics of Failure



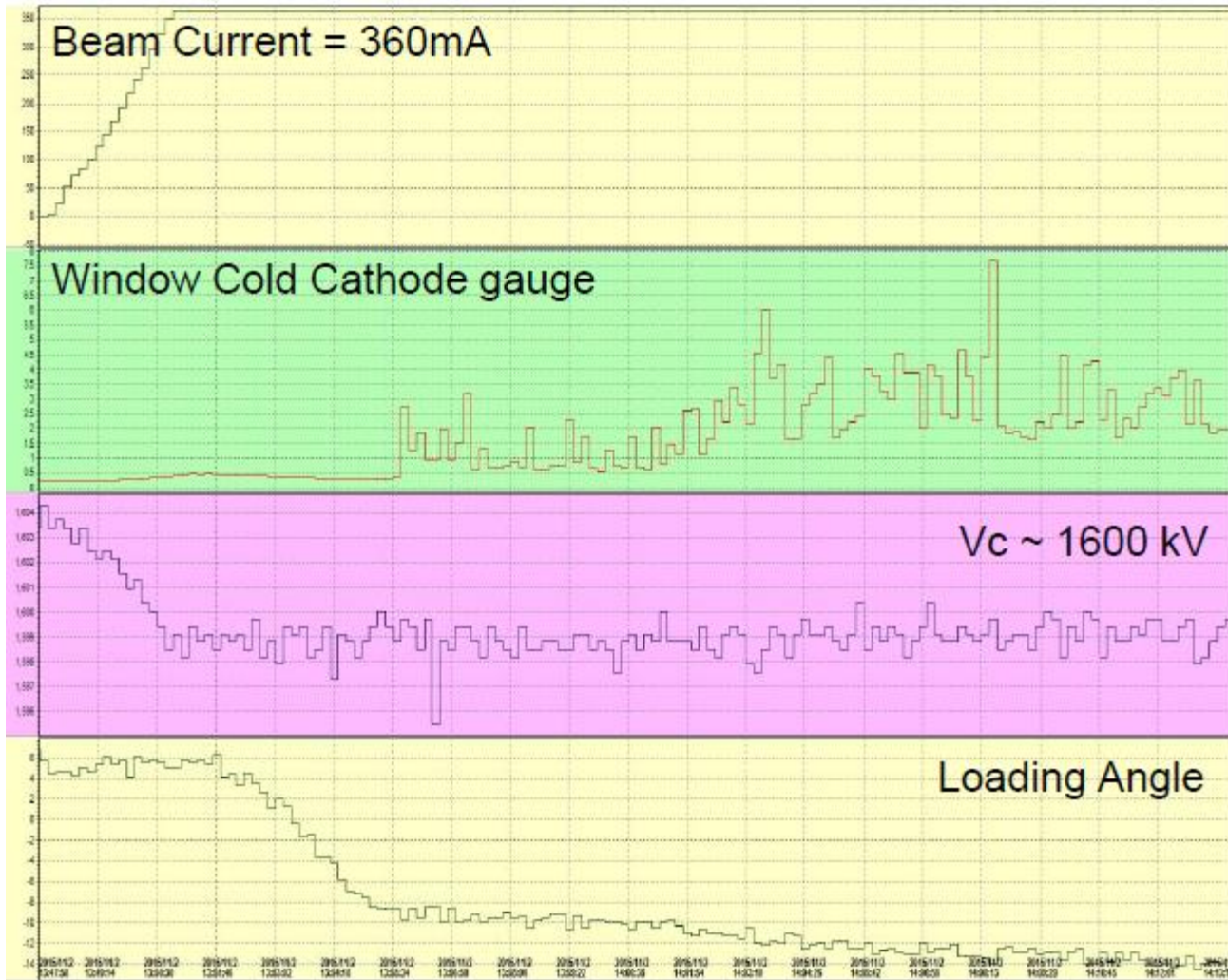
RF System of TLS (7)

Oscillation of SRF module caused by LHe filling of an superconducting wiggler nearby.



RF System of TLS (8)

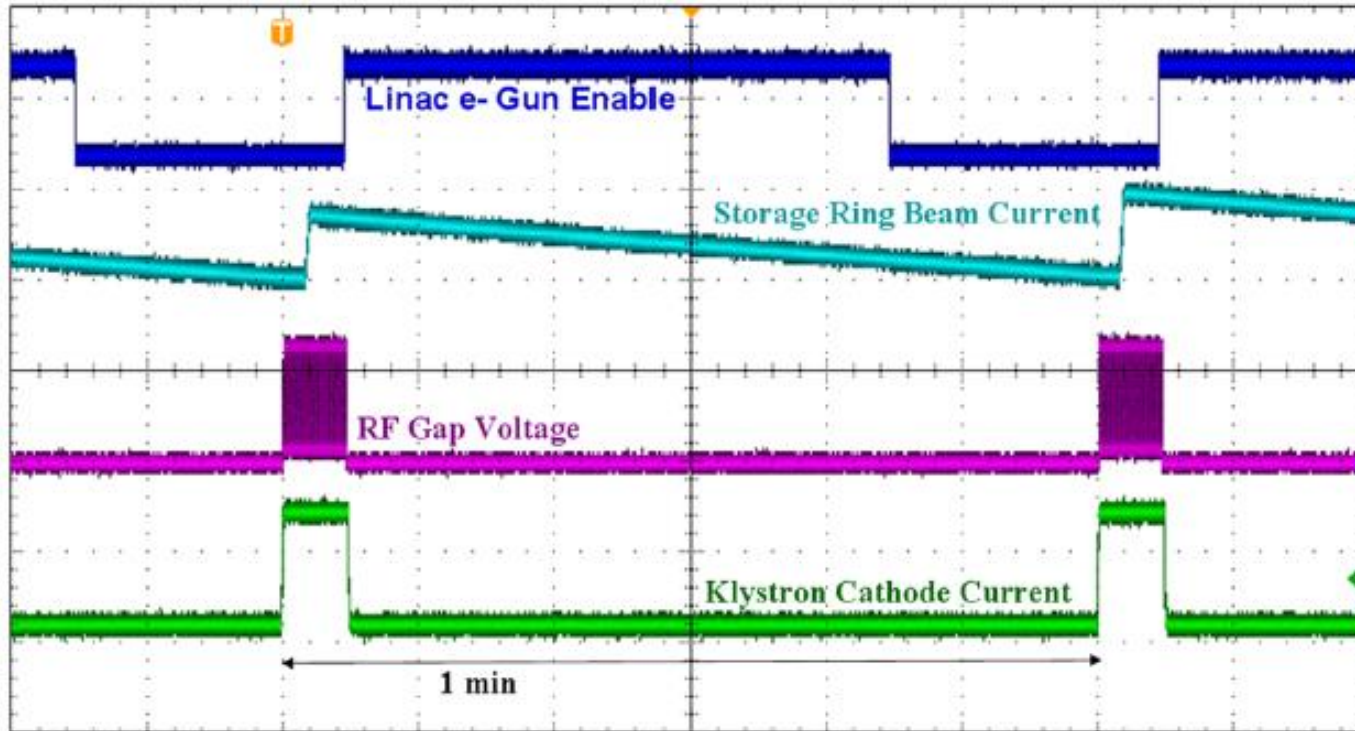
**Solution: Beam processing twice a year.
(scanning the loading angle at high beam current)**



Module for the loading angle tuning.

RF System of TLS (9)

Energy Saving on booster RF system



Booster RF Operation Condition	Total Power Consumption (kW)
Non-Energy Saving Mode	70
Energy Saving Mode	15

Operation Status of Taiwan Photon Source (TPS)

Recent Progress of TPS

2014

- July: 150 MeV LINAC commissioning.
- Dec. 16: Ramping electrons to 3 GeV in the booster ring.
- **Dec. 31: electron beam was firstly stored in the storage ring (5 mA).**

2015

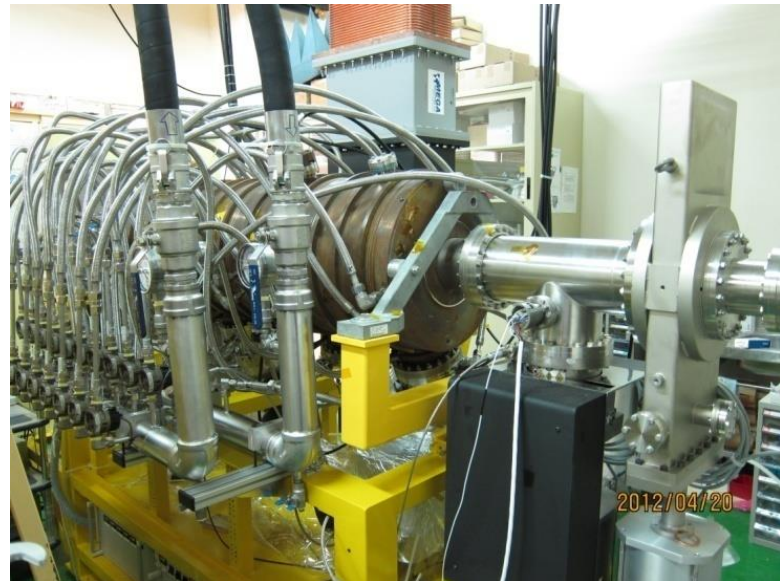
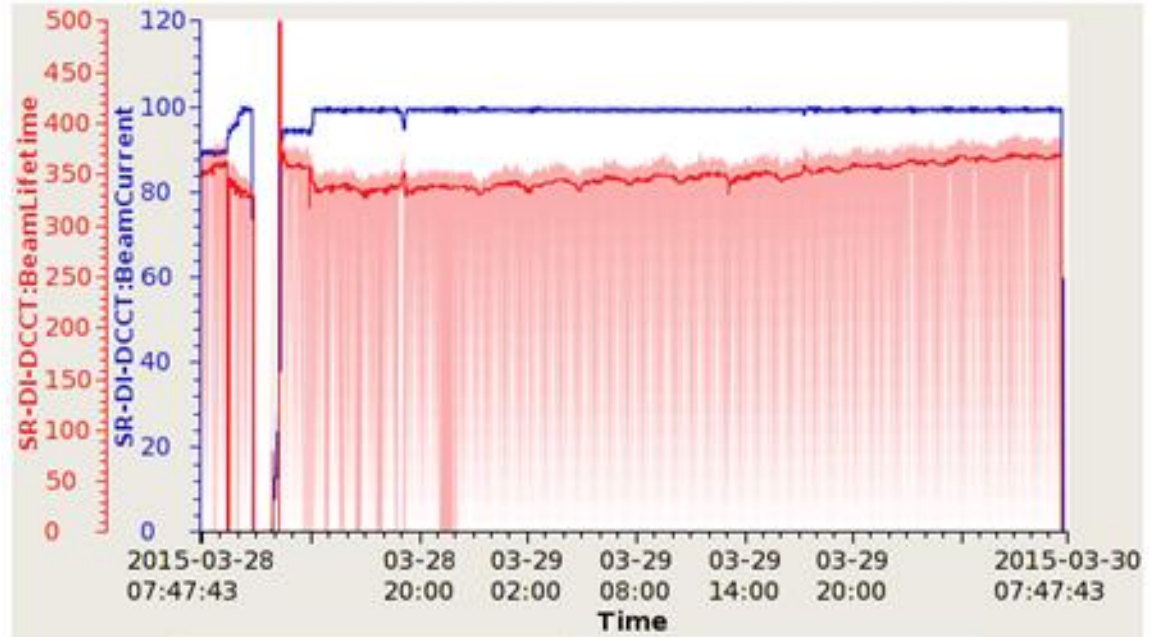
- **Feb. 9: Beam current up to 100mA** (phase-I accelerator commissioning).
- Mar. 31: Beam dose for Vacuum cleaning reached 35 A-hr.
- Apr. to Aug.: Installing **two SRF modules** and ten IDs .
Improving transport line from booster to storage ring.
- **Sep. 14: Starting phase-II accelerator commissioning with SRF modules, IDs, and beam lines.**
- **Dec. 12: Reaching 520 mA (Decay mode).**

2016

- Mar. 24 ~ June 28: User mode operation (for beamline commissioning).
- May 26: 300 mA top-up mode, for user operation.
- June 16: 400 mA top up mode, for testing.
- Sep. 22~ Dec. 27: User mode operation.

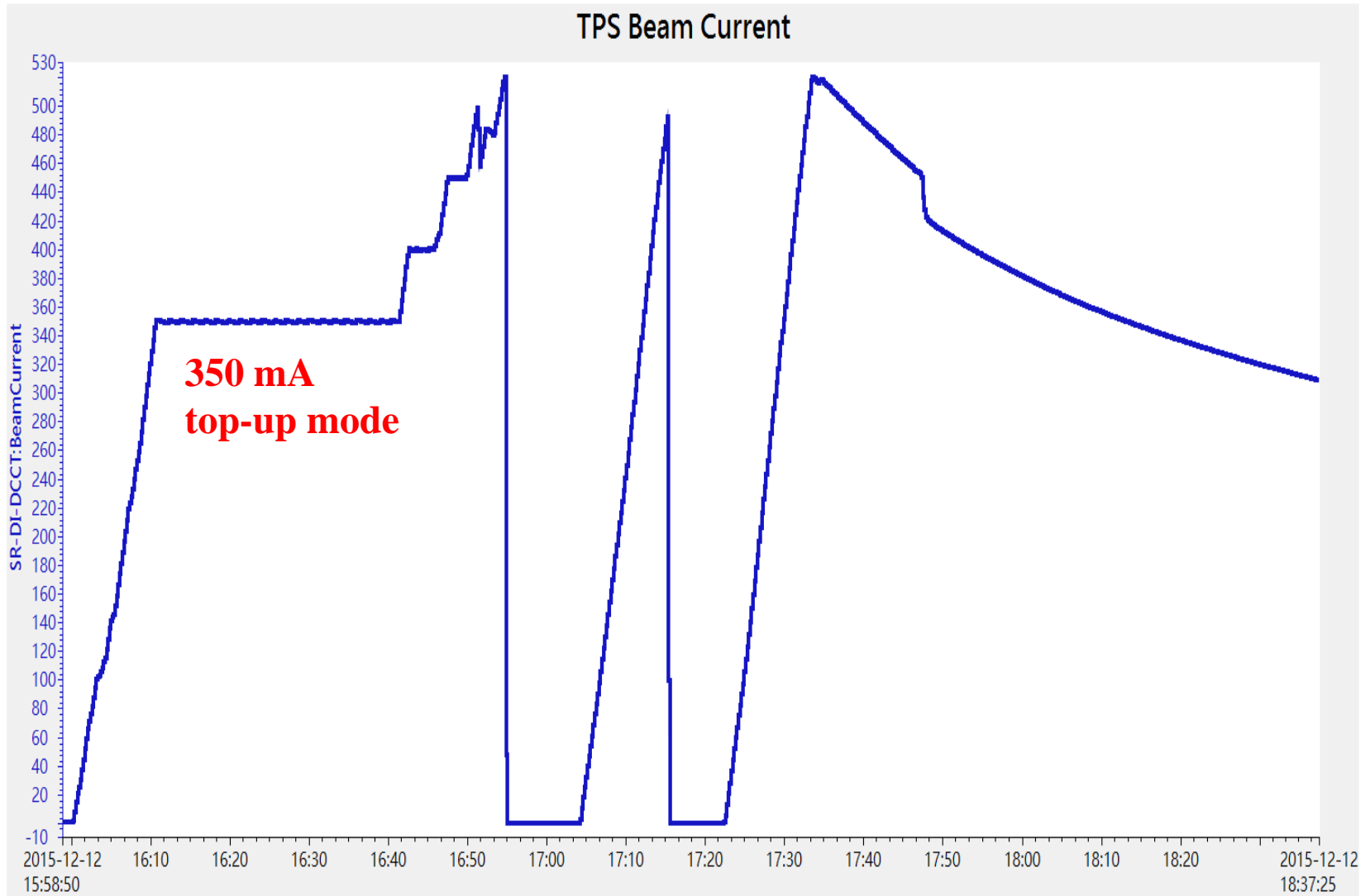
TPS: Phase-I Accelerator Commissioning

Up to 100 mA
(with two PETRA cavities)

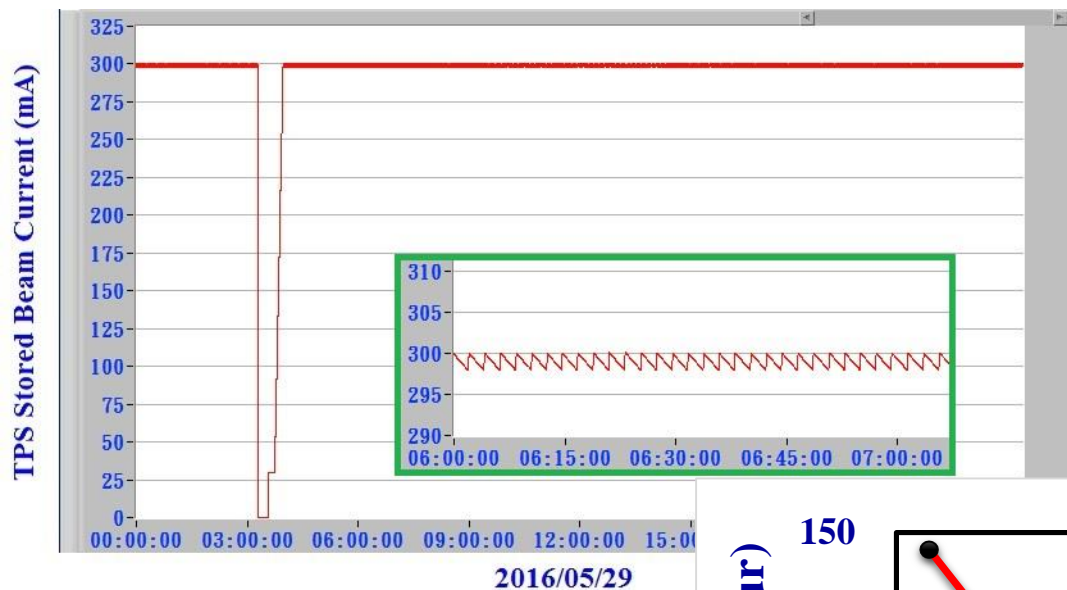


TPS: Phase-II Accelerator Commissioning

Up to 500 mA (with two SRF modules)

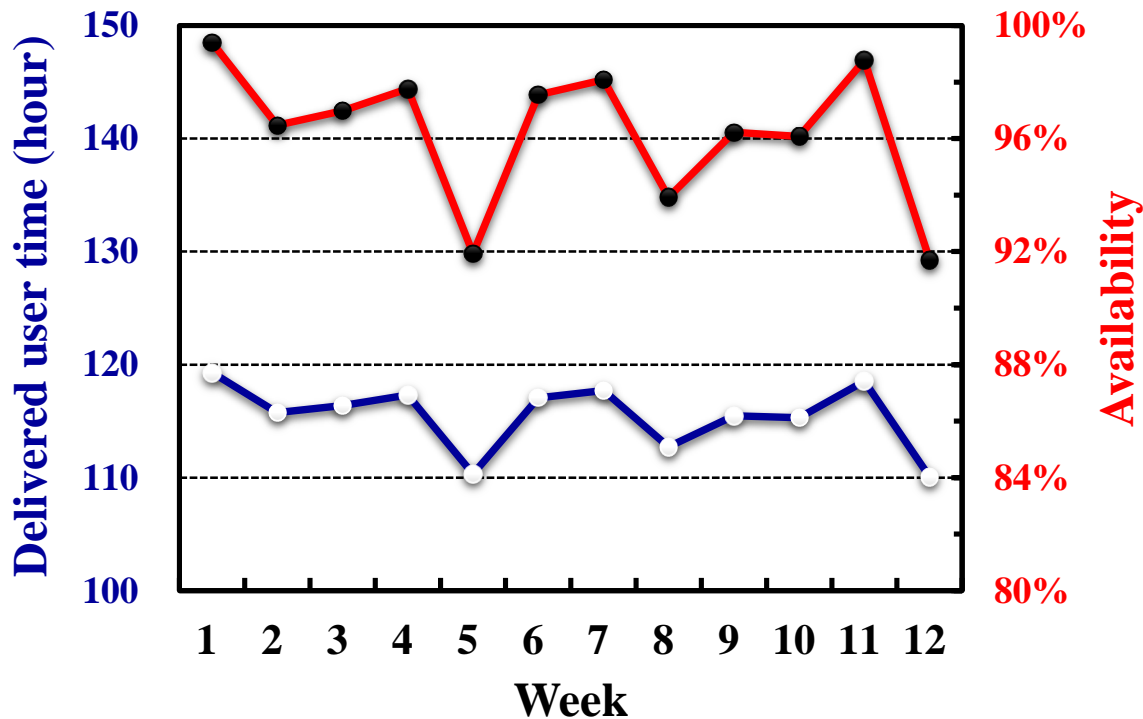


TPS: Beamline Commissioning



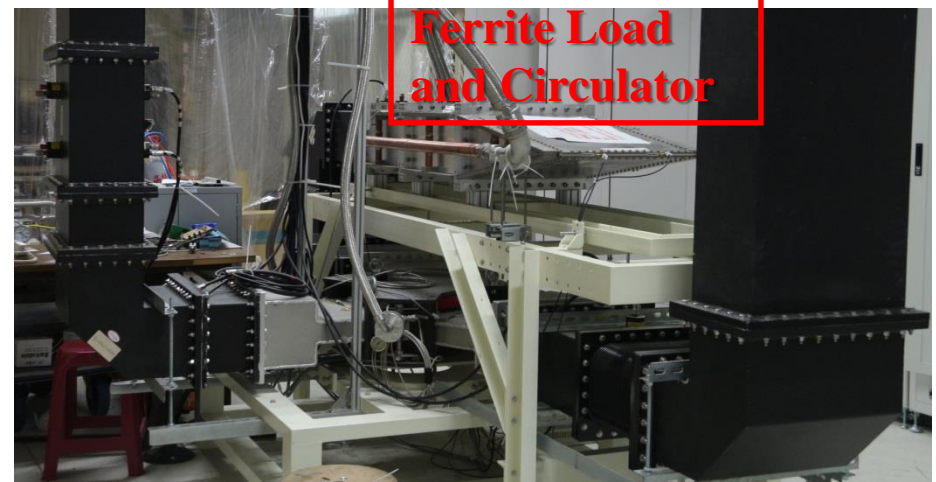
Up to 300 mA
(with two SRF modules)

Availability:
96.2% in average

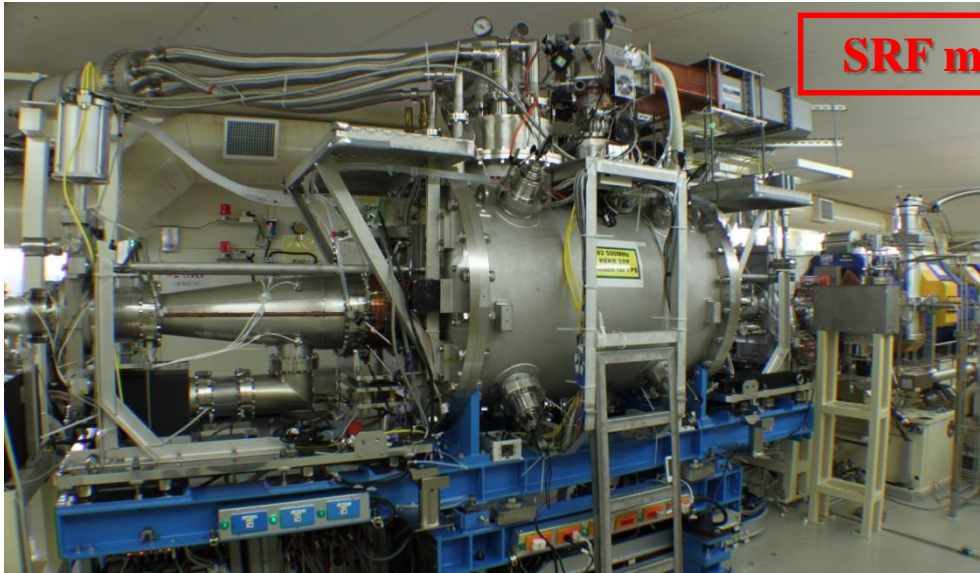


Operation Status of the RF System in TPS

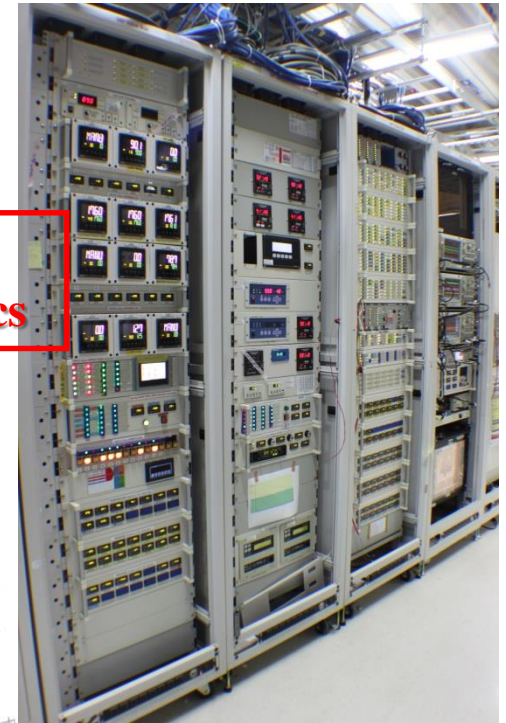
100-kW RF System for TPS Booster Ring



300-kW RF System for TPS Storage Ring



SRF module



SRF electronics



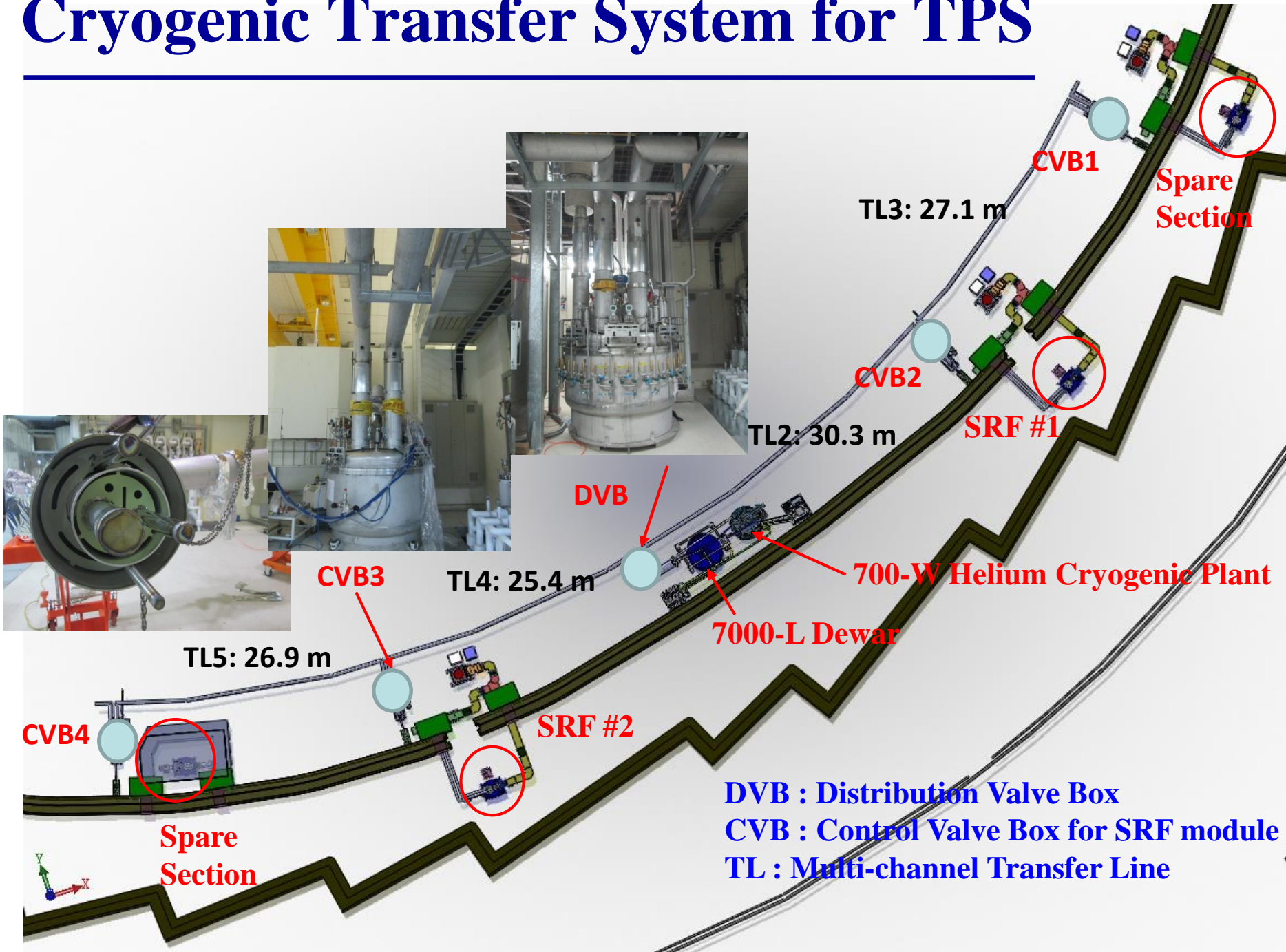
LLRF

300-kW transmitter

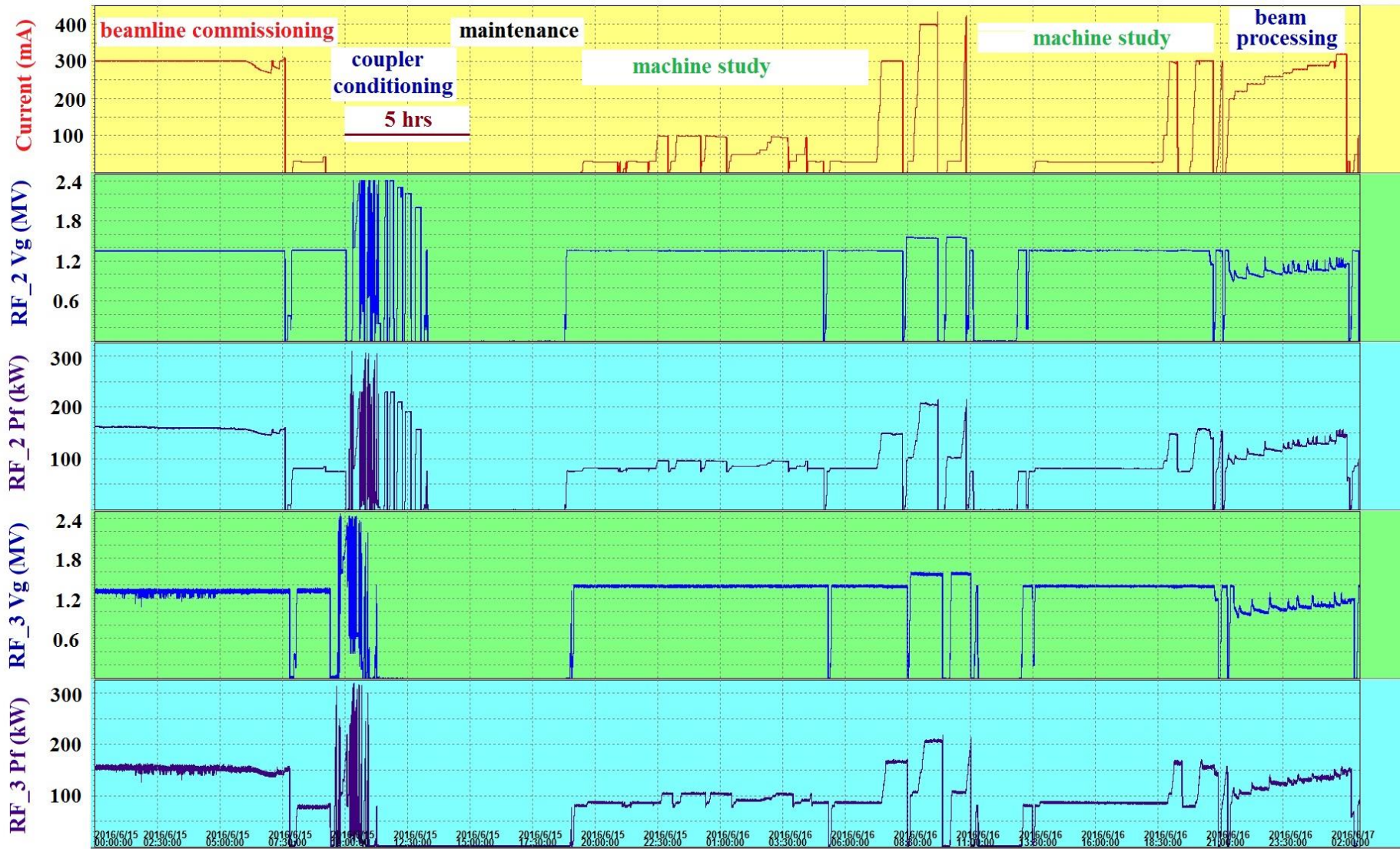


300-kW klystron

Cryogenic Transfer System for TPS

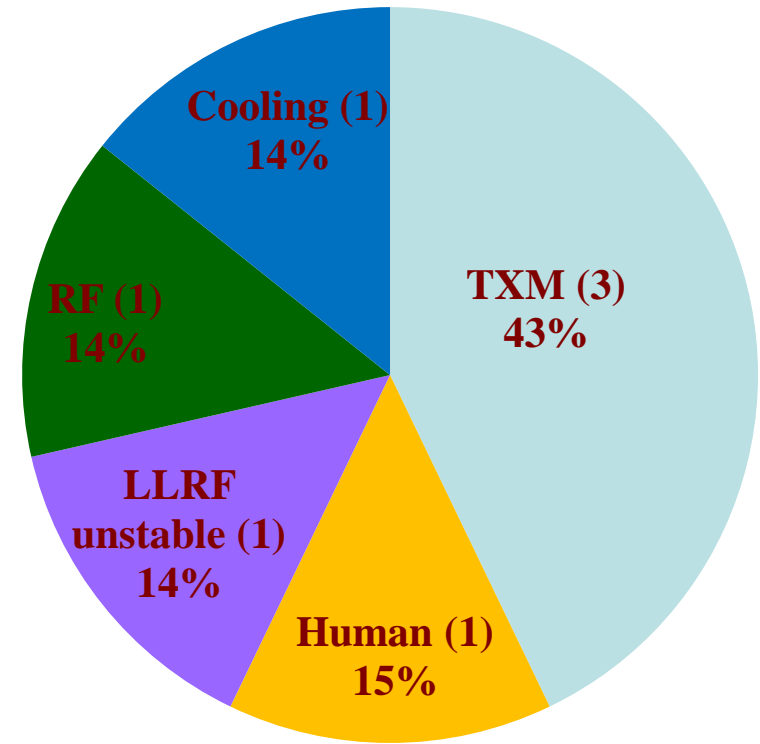
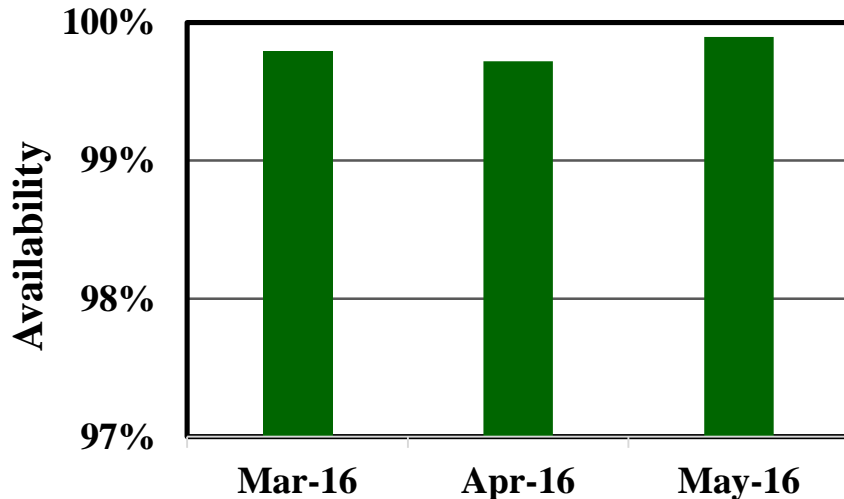
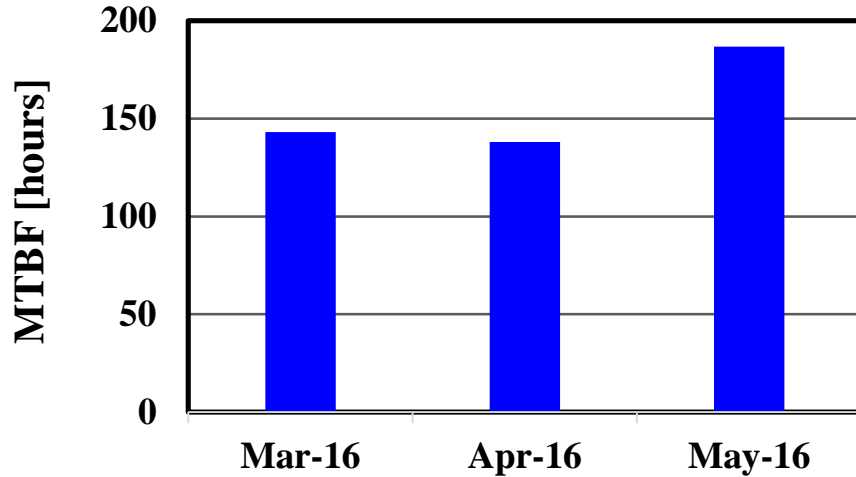


Operation of the 300-kW RF System



Operation of the 300-kW RF System

MTBF: 171.4 hours in average



Number of Trip: 7 (2016 Mar. ~ May)
Total failure time : 2.22 hours

Summary

- **RF System in Taiwan Light Source**

- **Nine IDs and one SRF module in this compact ring.**
- **Great reliability of the 100-kW RF system.**
- **Beam processing twice a year.**

- **RF System in Taiwan Photon Source**

- **Operation with greater power due to more insertion devices and higher stored current in the coming years.**
- ✓ **Design goal of 500-mA operation with bare lattice was examined.**
 - **Reliability to be improved.**
 - **Coupler conditioning and beam processing every week.**
 - **Digital LLRF in preparation.**



Thank you for your attention.