CWRF 2016

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

THE OPERATION EXPERIENCE OF TLS&TPS RF TRANSMITTER AND THE DEVELOPMENT SOLID-STATE AMPLIFIER IN NSRRC

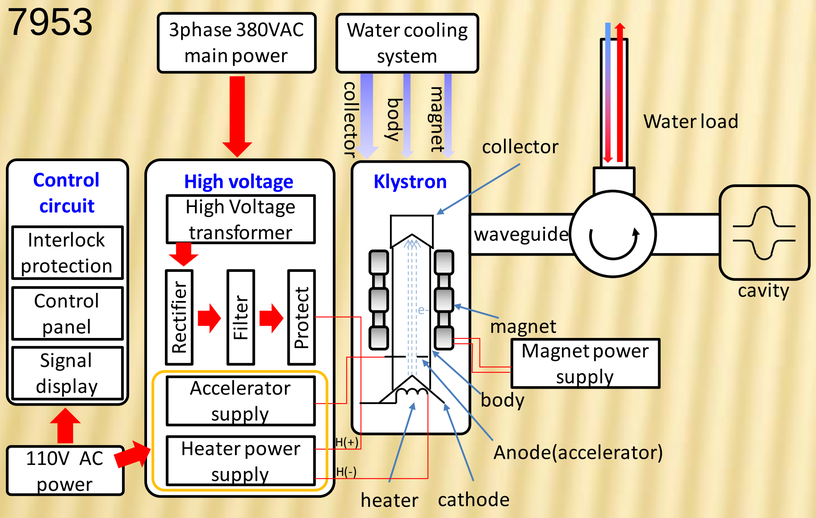
Tsung-Chi Yu, Chaoen Wang, Lung-Hai Chang, Meng-Shu Yeh, Ming-Chyuan Lin, Fu-Tsai Chung, Ming-Hsun Tsai, Mei-Hsia Chang, Chih-Hung Lo, Ling-Jhen Chen, Zong-Kai Liu, Chi-Lin Tsai, Fu-Yu Chang, NSRRC, Hsinchu, Taiwan

Abstract:
At present, two synchrotron radiation facilities -- Taiwan Light Source (TLS) & Taiwan Photon Source (TPS) are in operation simultaneously in NSRRC. Both RF system of these facilities use superconducting cavities as electron accelerating components in storage ring. The RF power for the cavity and electron beam is provided by klystrons with high voltage (HV) power supplies. For TLS, the klystron is supplied by a crowbar type HV power supply, while in TPS, the klystron is supplied by a PSM crowbar-less HV supply unit. The operation experience in daily operation and commission will be presented. Besides, to satisfy the coming RF requirement in Phase-II beam-line construction in TPS, solid-state amplifier is also developed in NSRRC. The progress and plan is also described here.

TPS and TLS in NSRRC

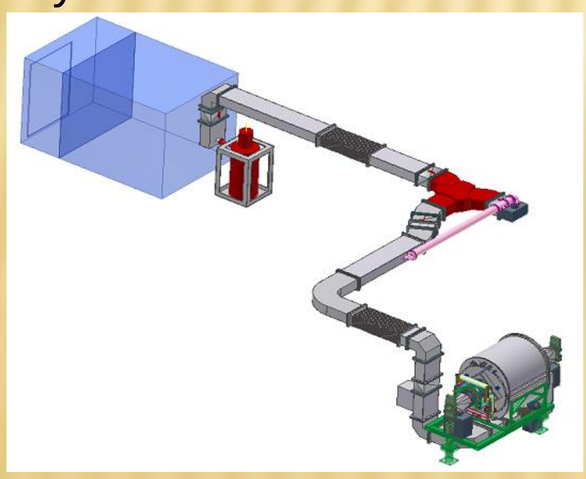
RF system in NSRRC – TLS&TPS

TLS booster ring
70kW crowbar transmitter for Doris cavity
DC power: 24.5kV, 5.7A , RF power Max.:70kW
TLS storage ring
100kW crowbar transmitter for Cornell SRF cavity
DC power 30kV, 8A, RF power Max.: 100kW, 360mA Top-up beam current in TLS daily operation
TPS booster ring
100kW crowbar transmitter for Petra cavity
DC power 30kV, 8A, RF power Max.: 100kW
The klystron is CPI 7953 (70kW) and 7953B (100kW) updated from 7953



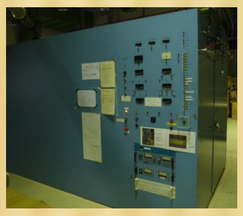
System blocks of crowbar transmitter

CPI klystron



TLS storage ring RF system layout

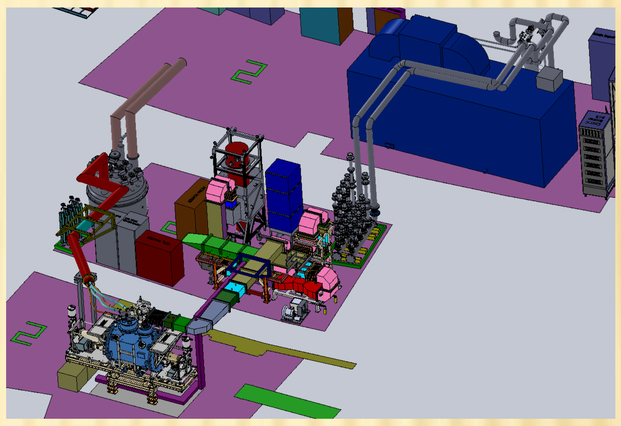
100kW transmitter



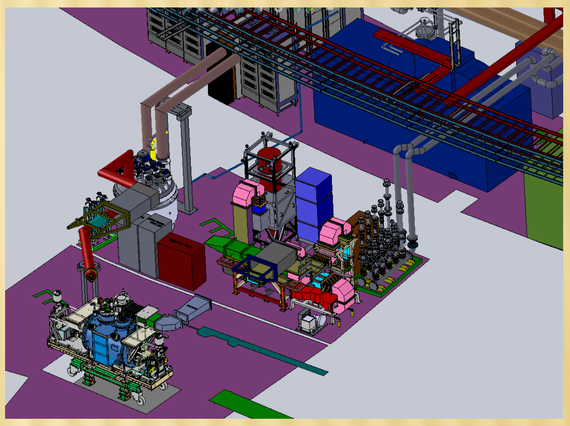
70kW transmitter

RF system in NSRRC – TPS

TPS storage ring: 4 area for RF system, #2&#3 are used now
2 sets 300kW PSM PLC based crowbar-less transmitters for 2 KEKB SRF cavities
Successful commission up to 520mA beam current



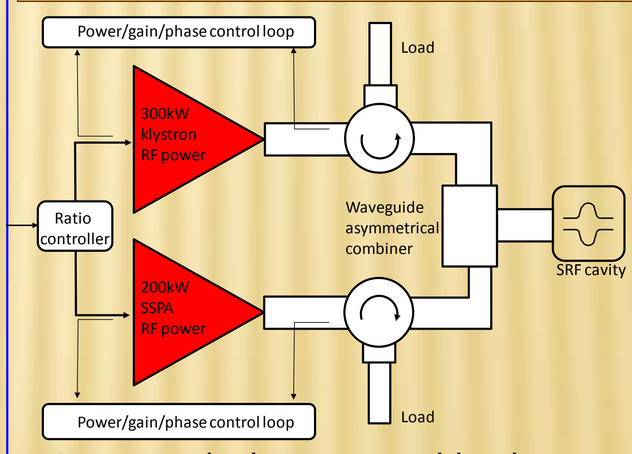
SRF#2 layout



SRF#3 layout

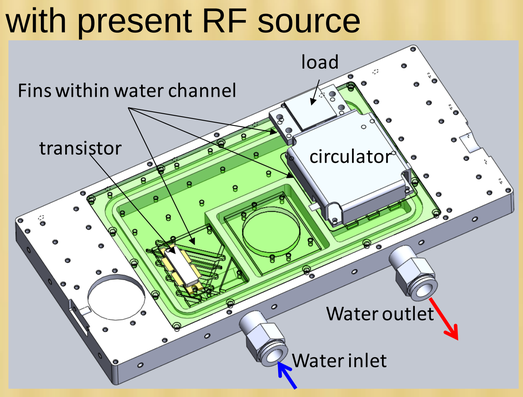
Efforts to improve reliability and reducing trip rate
1, High Voltage Test of HV components: 20% higher than its nominal operation voltage for leakage current measurement as early components failure detection
2, Heating curve: Cathode current vs. heater current at constant anode/cathode voltage to remain proper RF power output and life time of klystron
3, Clean: HV room needs regular clean up for reducing dust (prevent HV arc)
4, Motor replacement: The motor for fan needs temperature sensor for health detection and replace bad one regularly
5,Reduce thermal couple temperature sensors wire length: should not use long sensor cable. Long thermal couple wire would introduce many interference. The thermal signal shall be transferred to current signal on site for reducing EMI interference.
6, Continuous air cooling after high power off: The temperature of HV components would keep high after long term high power operation. Continuous air cooling can prevent power components become too hot.
7, Weekly coupler aging of SRF modules: Input coupler aging by beam processing and by varying loading angle RF aging can reduce the condensed particle

Solid-state amplifier for future demand

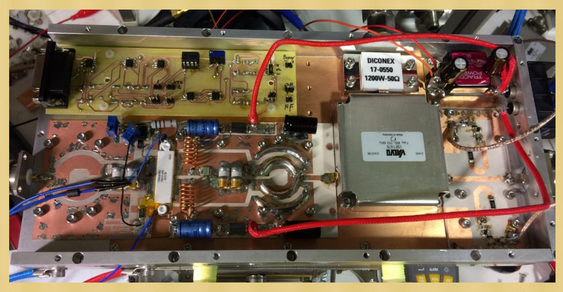


Asymmetrical power combination with present RF source

Features of the planned SSPA:
1, Higher power density lower module numbers: 1kW per module, 240 modules for 200 kW
2, Improved cooling and longer life time: 1mm water channel integrated
3, Integrated sensors for status monitor: temperature/V/I/RF
4, Planar balun for easier manufacture: No coaxial cable on circuit, easier production
5, Asymmetrical power combination for single SRF cavity: KEKB SRF cavity can support Max. 400kW CW operation



Integrated water cooling channel for better heat sinking



Integrated sensors for status monitor

CWRF 2016 poster ID:19