THAI SYNCHROTRON NATIONAL LAB

The New Design of the RF System for the SPS-II Light Source

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Siam Photon

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วิทยาศาสตร์ วิจัยและนวัตกรรม

The SPS-II Project

Table 1: SPS-II Storage Ring and Booster Ring Parameters

Parameters	Storage ring	Booster ring
Energy	3 GeV	3 GeV
Current	300 mA	30 mA
Lattice	DTBA	FODO
Circumference	327.502 m	304.829 m
RF frequency	119 MHz	119 MHz
Harmonic number	130	121
RF voltage	1.5 MV	1.2 MV
Emittance ϵ_{x0}	0.96 nm rad	5.87 nm rad
Nat. energy spread σ_E	0.077 %	0.091 %
Nat. chromaticity ξ_x/ξ_y	-65.6/ -76.7	-23.63/ -10.31
Tune Q_x/Q_y	34.24/ 12.31	14.71/ 5.61
Momentum compaction α_c	3.33×10^{-4}	1.674×10^{-3}
Nat. bunch length	7.48 mm	23.04 mm
Energy loss per turn U_0	577 keV	750 keV
Full IDs energy loss per turn	693 keV	-

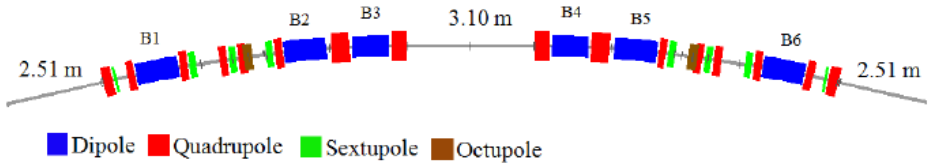


Figure 1: The DTBA cell of SPS-II.

6 Cavities Capacity

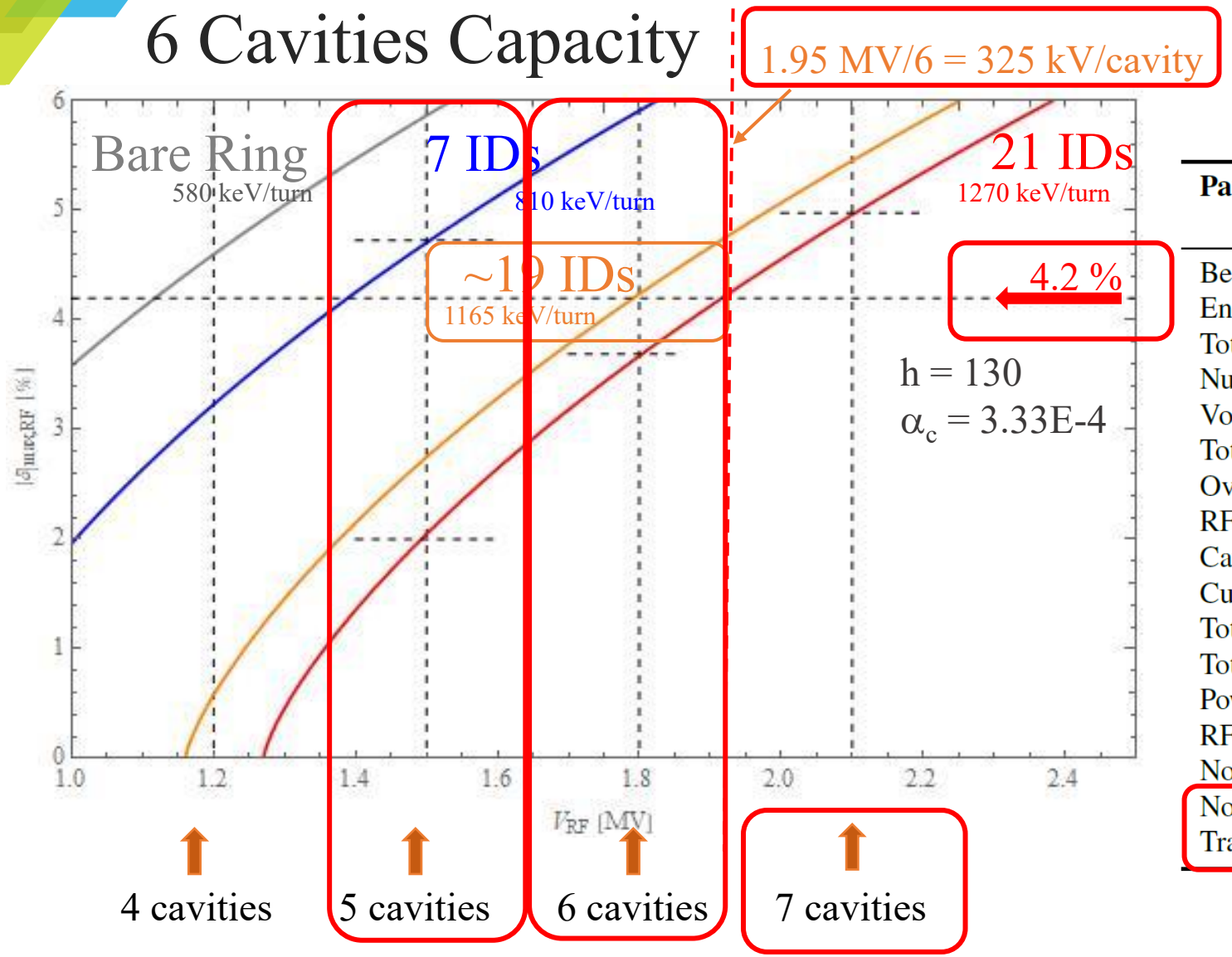


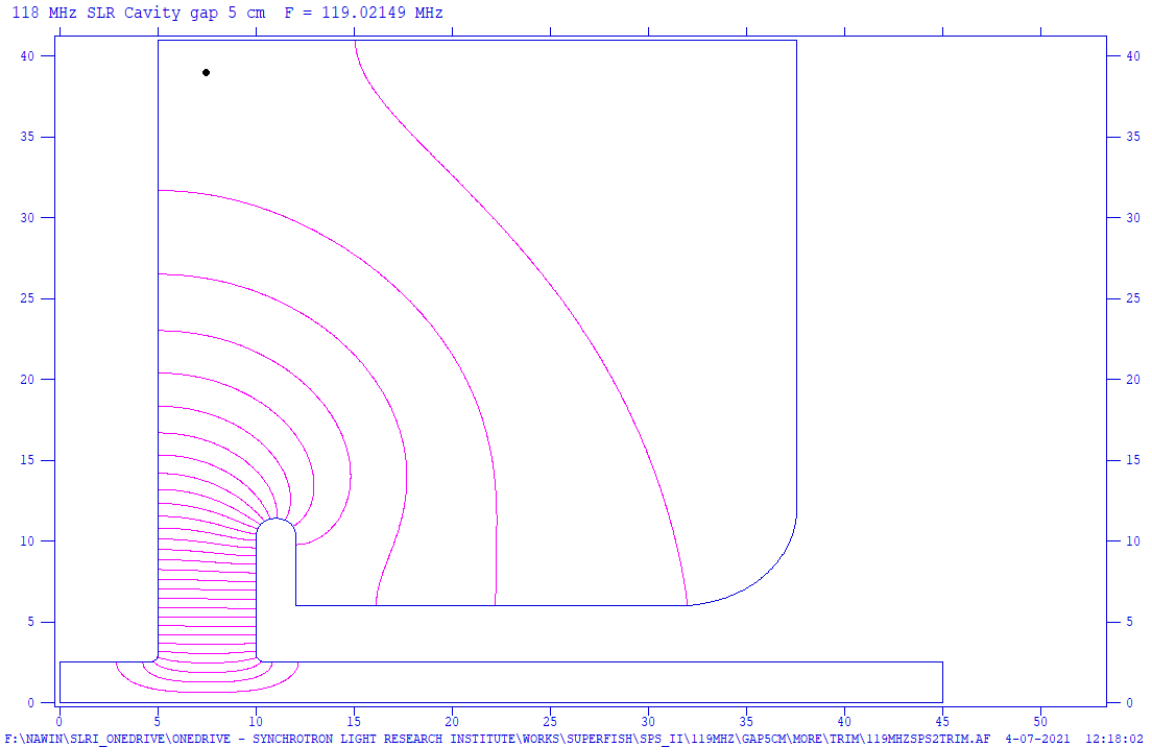
Table 2: SPS-II RF Requirements

Parameters	Storagr ring			Booster ring
	0-IDs	7-IDs	21-IDs	
Beam current (mA)		300		30
Energy loss (keV/turn)	580	810	1270	750
Total beam power (kW)	174.0	243.0	381.0	22.5
Number of RF cavity	5	5	6	4
Voltage/cavity (kV)			300	
Total RF voltage (MV)	1.5	1.5	1.8	1.2
Over voltage ratio	2.59	1.85	1.42	1.7
RF acceptance (%)	5.8	4.7	3.7	1.60
Cavity R_{sh} (MΩ)			3.4	
Cu losses/cavity (kW)			26.5	
Total Cu losses (kW)	132.4	132.4	158.8	105.9
Total RF power (kW)	306.4	375.4	539.8	128.4
Power per cavity (kW)	61.3	75.1	90.0	32.1
RF coupling (β)	2.3	2.8	3.4	1.2
No. of RF station	5	5	6	4
No. of RF transmitter	5	5	6	4
Transmitter power (kW)		120		50

1st construction 5 cavities → Added the 6th cavity when needed → Full IDs the 7th cavity may be added, need to be decided at the time

Comparison of MAX-Lab Type RF Cavity (5 cm accelerating gap)

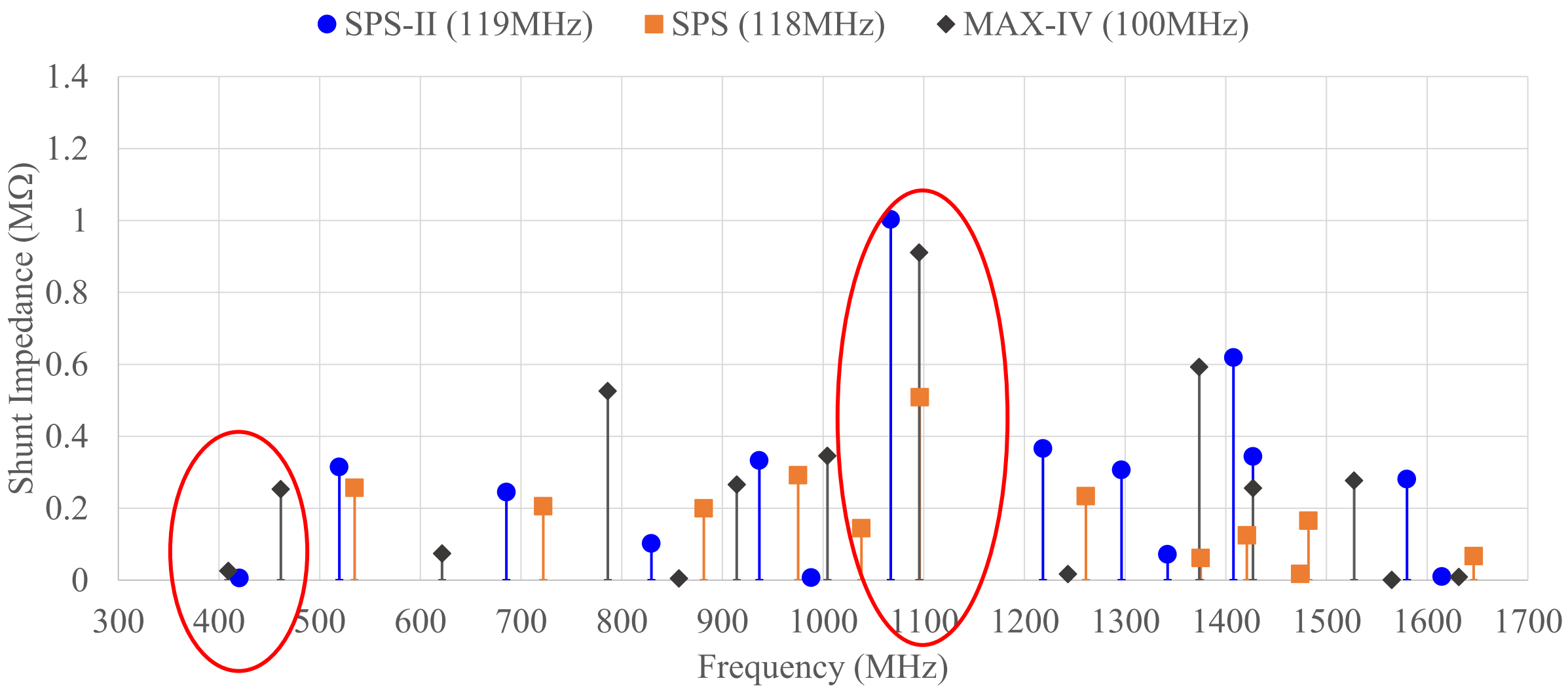
	MAX-IV	SPS	SPS-II
f (MHz)	100	118	119
Q	20000 (19000)	22000 (19000)	22000 (20000)
R/Q (Ω)	168	136	173
R_{sh} (MΩ)	3.4 (3.2)	3.1 (2.94)	3.8 (3.4)
Cavity diameter (cm)	82.0	82.0	82.0
Beam port diameter (cm)	5.0	11.0	5.0
Insertion length (cm)	50.0	49.0	50.0
Cavity voltage (kV)	300	300	300
RF power @300kV (kW)	28.2	30.6	26.5



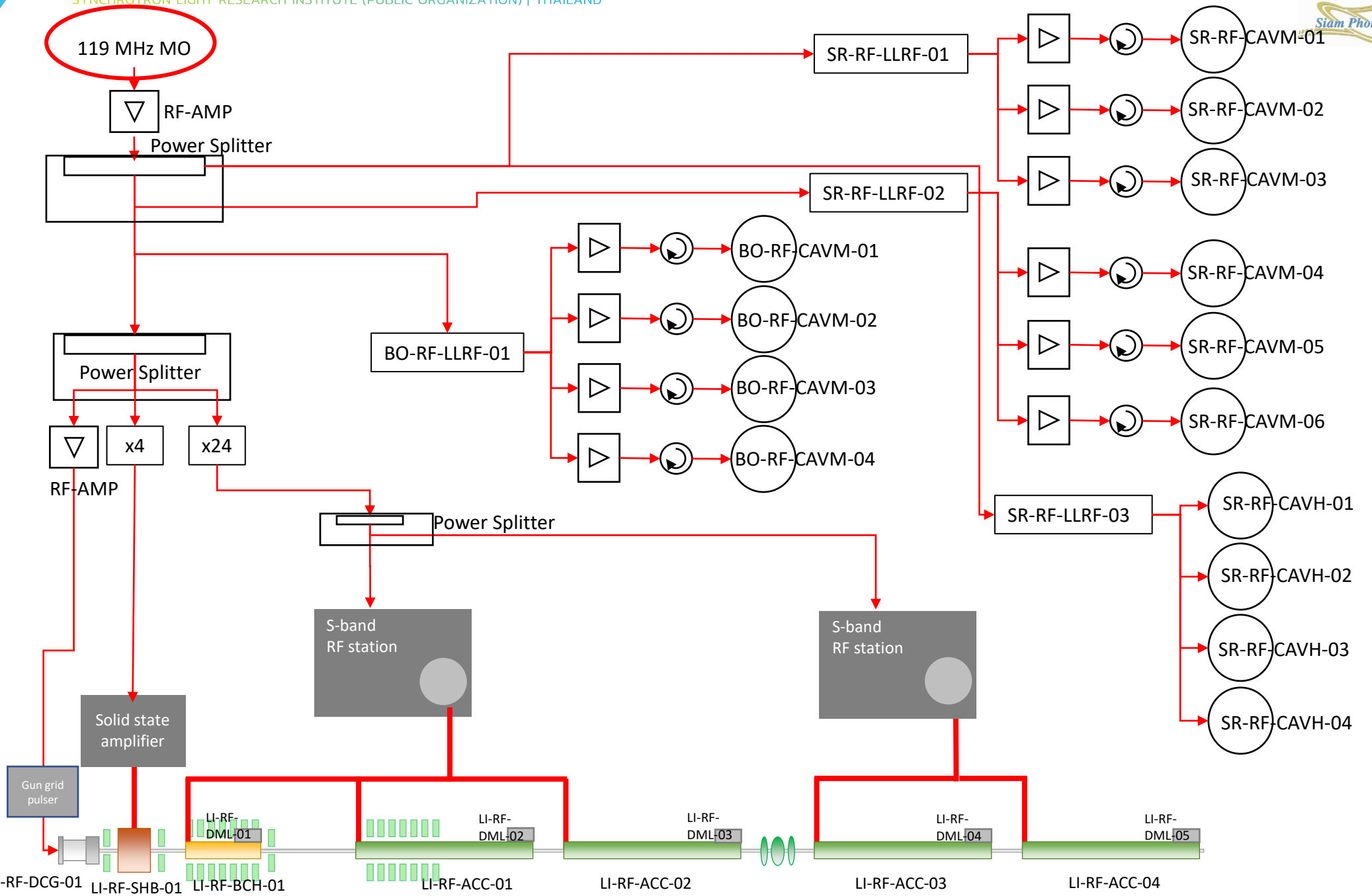
R/Q = 173 Ω
Q = 22,000 – design → 20,000 – scaled
R_{sh} = 3.8 MΩ - design → 3.4 MΩ - scaled

From, MAX-IV Lab experience, surface roughness and ports on the cavity body will lower these values by roughly 7 %.

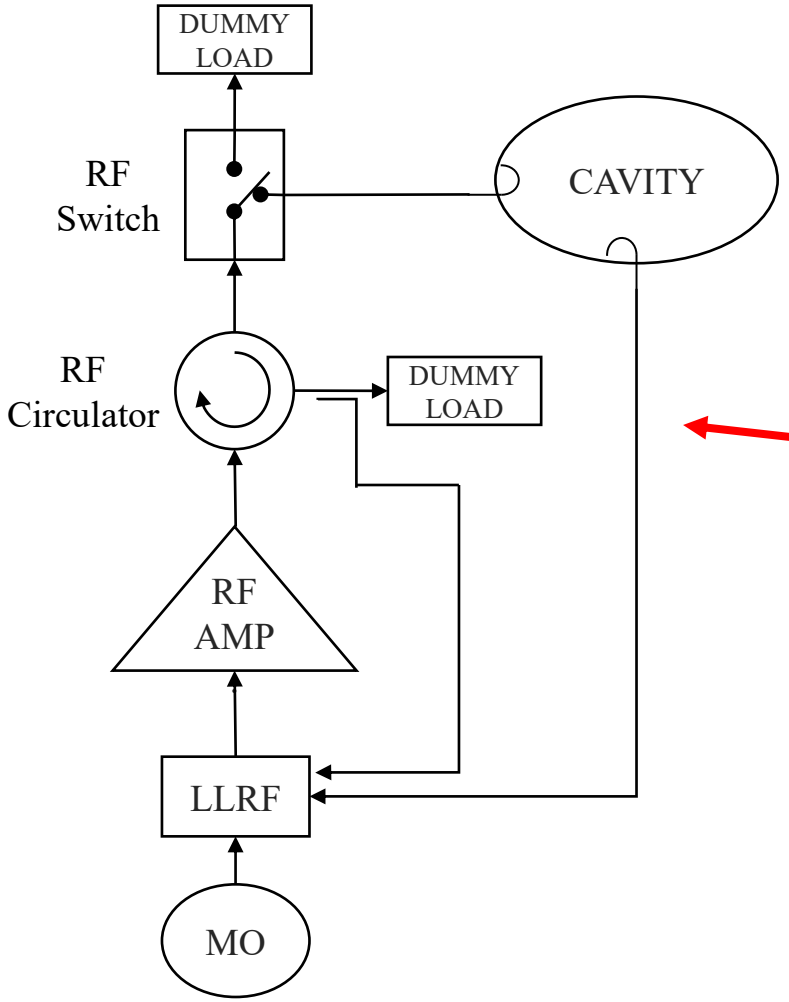
Longitudinal Mode Properties

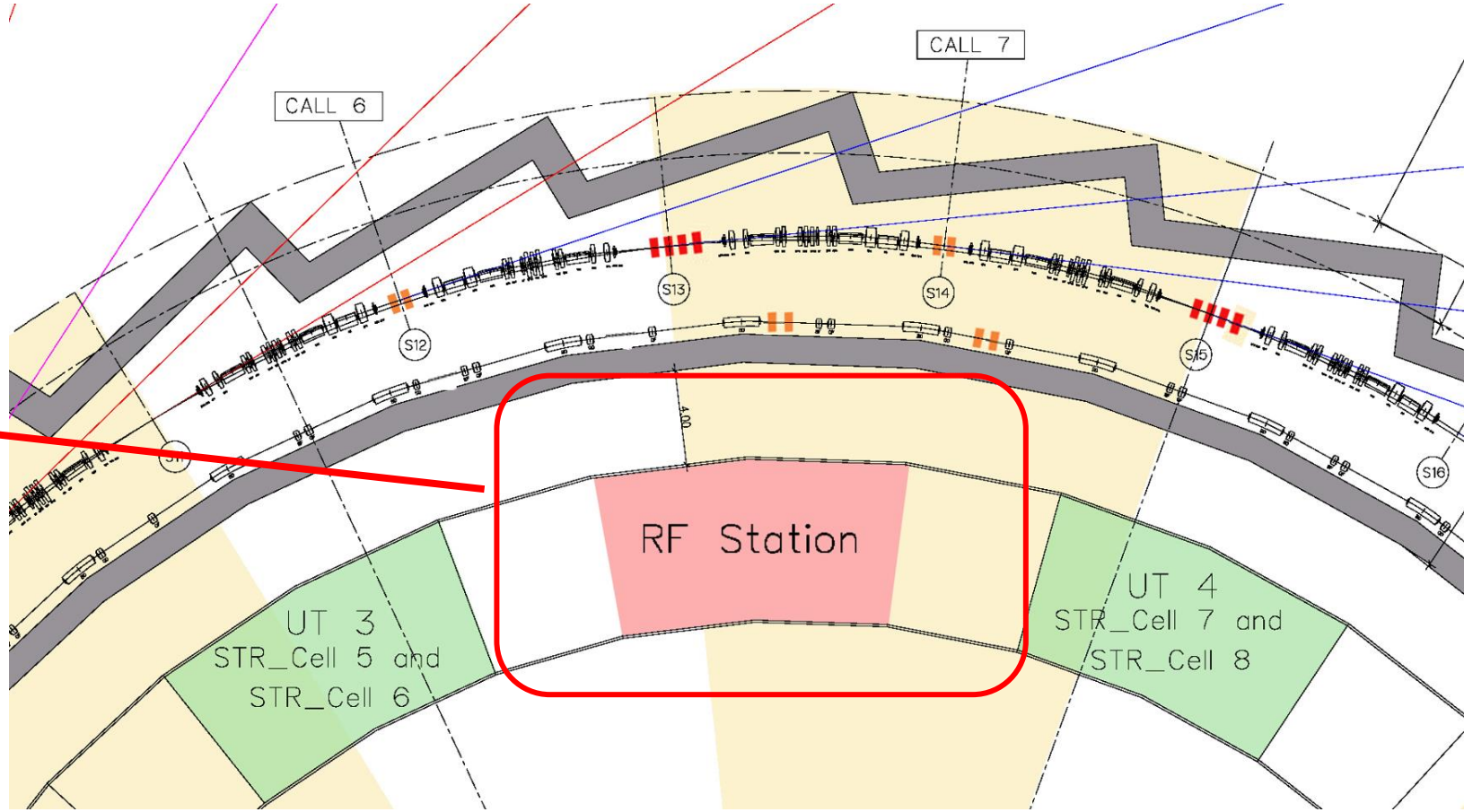


RF Distribution Diagram



RF Station


DUMMY LOAD
RF Switch
CAVITY
RF Circulator
DUMMY LOAD
RF AMP
LLRF
MO


CALL 6
CALL 7
S12
S13
S14
S15
S16
RF Station
UT 3
STR_Cell 5 and
STR_Cell 6
UT 4
STR_Cell 7 and
STR_Cell 8

THANK YOU

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