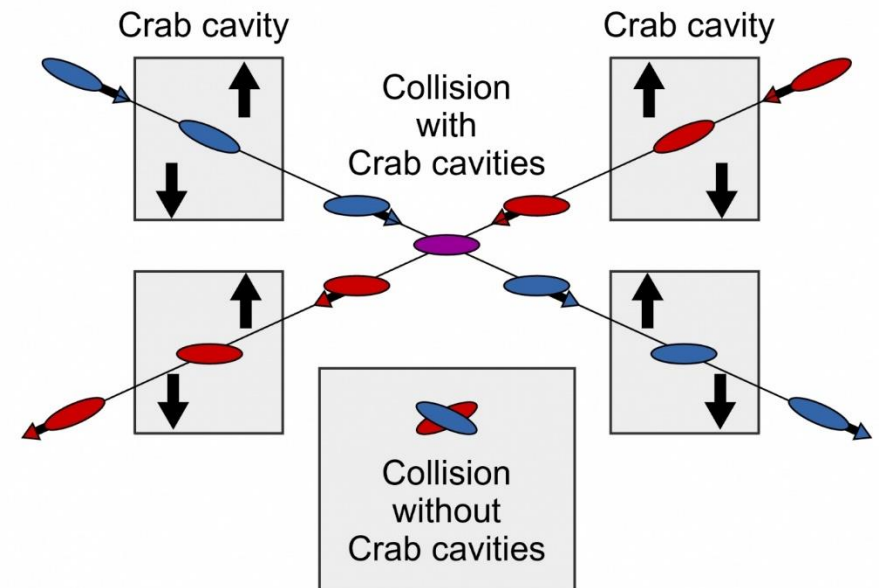


WG2 SRF: WP3 Crab Cavities

Design Review Workshop #2

Peter McIntosh
UKRI-STFC Daresbury Laboratory

22nd June 2022



Agenda for Today (GMT)

13:30	Introduction and Remit for the Workshop	Peter McIntosh (STFC)	5 min
13:35	Specification Review	Peter McIntosh (STFC)	5 min
Cavity Design Updates			
13:40	Elliptical/Racetrack	Graeme Burt (Lancaster University)	15 + 5 min
14:00	RF Dipole (RFD)	Suba De Silva/Jean Delayen (ODU/JLab)	15 + 5 min
14:20	Double Quarter Wave (DQW)	Silvia Verdu Andres (CERN)	15 + 5 min
14:40	Wide Open Waveguide (WOW)	Binping Xiao (BNL)	15 + 5 min
15:00	Quasi-waveguide Multicell Resonator (QMIR)	Andrei Lunin (FNAL)	15 + 5 min
15:20	Preparations for Down-selection review (Sept 27 th 2022)	Peter McIntosh (STFC)	10 min
15:30	Meeting close		

Preparations for 2nd Design Workshop (22nd June 2022)

- Assess and compare CC EM designs, not likely finally optimised:
 - Cavity,
 - HOMs,
 - Couplers,
 - Multipacting,
 - Tuning.
- Clarifying then next steps to perform first CC down-selection on 27th Sept 2022:
 - All EM design aspects complete, including pressure stability and fabrication assessment.
 - Down-select 2 optimum CC designs for future prototype development (external review).
- Final CC down-selection, post-prototype validation at ~18-months later (Mar 2024).

Workshop Remit

- For WP3 teams to identify progress made with CC designs.
- Identify outstanding issues which may exist regarding specifications as defined (v13).
- Agree the cavity parameters to define for down-selection review – finalise process today.

CC Design Updates

- Elliptical/Racetrack
 - RF Dipole (RFD)
 - Double Quarter Wave (DQW)
 - Wide Open Waveguide (WOW)
 - Quasi-waveguide Multicell Resonator (QMIR)
- G Burt (Lancaster U)
- S De Silva/J Delayen (ODU/Jlab)
- S Verdu Andres (CERN)
- B Xiao (BNL)
- A Lunin (FNAL)

Specifications Update (v13)



Parameter	Recent Spec (After TDR)		10Hz Upgrade ^{1,2}		1 TeV CoM Spec ²	
Beam Energy (GeV) e-	125				500	
Crossing Angle (mrad)			14			
Installation site (m from IP)			14			
RF Repetition Rate (Hz)	5		10		4	
number of bunches	1312		2625		2450	
Bunch Train Length (ms)	727		961		897	
Bunch Spacing (ns)	554		366			
Beam current (mA)	5.8		8.75		7.6	
Operating Temp (K)			2			
Cryomodule installation length (m)			3.25			
Horizontal beam-pipe separation (m)	0.1967 (centre) ±0.0266 (each end of installation length)					
Cavity Frequency (GHz)	3.9	2.6	1.3	3.9	2.6	1.3
Total Kick Voltage (MV)	0.615	0.923	1.845	2.5	3.7	7.4
Max Ep (MV/m)	45				45	
Max Bp (mT)	80				80	
Amplitude regulation/cavity (% rms)	3.5 (for 2% luminosity drop)					
Relative RF Phase Jitter (deg rms)	0.069					
Timing Jitter (fs rms)	49 (for 2% luminosity drop)					
Max Detuning (Hz)		200 TBC				
Longitudinal impedance threshold (Ohm)						
Trasverse impedance threshold (MOhm/m) (X,Y)	48.8, 61.7					
Cavity field rotation tolerance/cavity (mrad rms)	5.2 (for 2% luminosity drop)					
Beam tilt tolerance (H and V) (mrad rms and urad rms)	0.35, 7.4 (for 2% luminosity drop)					
Minimum CC beam-pipe aperture size (mm)	>25 (same as FD magnets)					
Minimum Extraction beam-pipe aperture size (mm)	20					
Beam size at CC location (X, Y,Z) (mm,um,um)	0.97, 66, 300					
Beta function at CC location (X, Y) (m,m)	23200, 15400					
CC System operation	assume CW-mode operation					

Break Here



Preparations for Down-Selection Review

Sept 27th 2022

- Terms of Reference for the review to be developed (Myself, Akira and Kirk).
- Review panel membership to be determined and invitations solicited (Myself, Akira and Kirk):
 - Suggestions welcome from WP3 collaborators.
- Discussion of remaining requirements for all WP3 collaborators.

CC Design Parameters

- Propose standardised set of CC parameters for each design.
- This will become the basis for comparison at the Sept Down-selection review.
- No further feedback since Design Review meeting #1.

Parameter	Value	Units
Operating frequency		GHz
SOM		GHz
1 st Longitudinal HOM		GHz
1 st Transverse HOM		GHz
E_p/E_t^*		
B_p/E_t^*		mT/(MV/m)
B_p/E_p		mT/(MV/m)
G		Ω
R/Q		Ω
$R_t R_s$		Ω^2
V_t per cavity		MV
E_p		MV/m
B_p		mT
Total V_t		MV
Total No. of cavities		
Active Cavity Length		mm
Flange-flange Cavity Length		
Number of cells		
Cavity Diameter		mm
Minimum Aperture		mm
FPC Q_L		
Bandwidth		kHz
Cavity Input Power		kW
Horizontal Kick Factor k_x		V/pC
Vertical Kick Factor k_y		V/pC/m
Stored Energy W		J
HOM impedance (Longitudinal)		M Ω
HOM impedance (Transverse)		M Ω /m
First 3 multipole parameters		

MANY THANKS

Questions?