

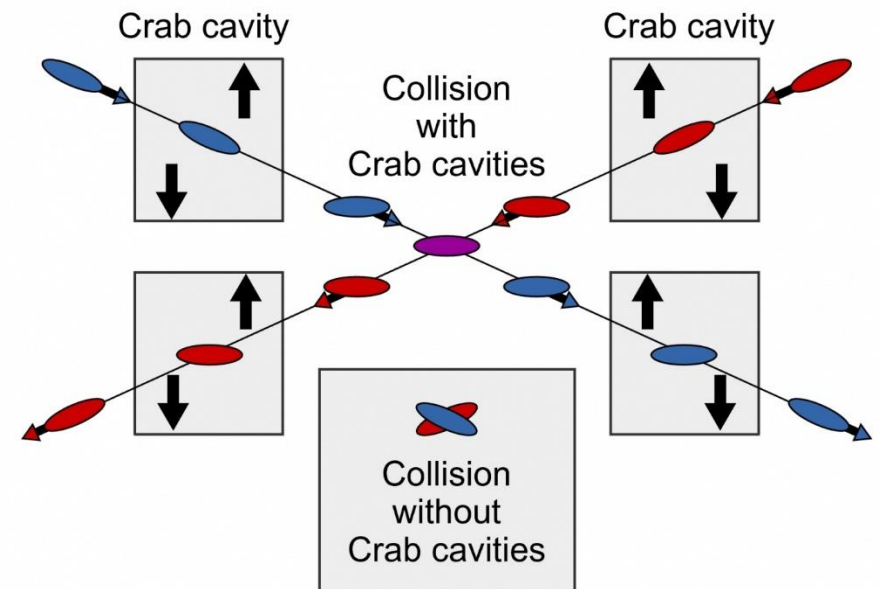
# WG2 SRF: WP3 Crab Cavities

## Design Review Workshop #1

Peter McIntosh

UKRI-STFC Daresbury Laboratory

8<sup>th</sup> December 2021



# Agenda for Today (GMT)

15:00	Introduction and Remit for the Workshop	Peter McIntosh (STFC)	5 min
15:05	Beam Aperture Specification Discussion	Peter McIntosh (STFC) Toshiyuki Okugi (KEK)	10 min
Cavity Design Updates			
15:15	Elliptical/Racetrack	Graeme Burt (Lancaster University)	15 + 5 min
15:35	RF Dipole (RFD)	Suba De Silva/Jean Delayen (ODU/JLab)	15 + 5 min
15:55	Double Quarter Wave (DQW)	Silvia Verdu Andres (CERN)	15 + 5 min
16:15	Wide Open Waveguide (WOW)	Binping Xiao (BNL)	15 + 5 min
16:35	Quasi-waveguide Multicell Resonator (QMIR)	Andrei Lunin (FNAL)	15 + 5 min
16:55	Specifications Review	Peter McIntosh (STFC)	5 min
17:00	Preparations for 2 <sup>nd</sup> Workshop (22 <sup>nd</sup> Jun 2022)	Peter McIntosh (STFC)	5 min

# Workshop Remit

- For WP3 teams to identify progress made with CC designs.
- Identify issues which exist regarding specifications as defined (v10).
- Resolve outstanding issues from ILCX21 in Nov:
  - Beam Aperture
  - Operational robustness - Epk, Bpk or Vt?
  - CW vs Pulsed operation
  - Tweak specifications as necessary?
- Agree the cavity parameters to define for future reviews – trigger process today.

# Beam Aperture Specification (ILCX21 Discussion)

- ILC BDS team identified 20 mm minimum beam aperture requirements for CC's at 14 m from the IP.
- Query relating to synchrotron photon flux and potential impact needing aperture to be increased – G Burt experience from ILC TDR.
- Is the 20mm restriction really valid if only a small proportion of the cavity geometry (<30%) is limited – A Lunin for the QMiR CC design.
- Okugi-san identified that 20mm aperture is minimum expectation, ideally it should be larger, up to the interfacing magnet aperture dimension (52mm and 84mm).
- The larger the CC aperture (especially horizontally), the more beneficial it will be for the collimation systems – generates more secondary particles.
- BDS team would therefore prefer >20mm aperture for the CC's.
- Analysis underway to determine SR impact, but do not expect it to be significant for >20 mm.

**Can we please discuss and agree a solution!**

# 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 Review

- Operational Robustness:
  - Ep, Bp or Vt – consistent for all CC geometries?
- CW or pulsed:
  - Preference is for CW, no LFD issues, simpler optimisation process and tuning.
- Anything else?

# CC Design Parameters

- Need to standardise the CC parameters for each design.
- Proposed start for list to agree as baseline for future comparative assessment.
- Please provide feedback, which I will collate and refine the list accordingly.

Cavity Properties	
Operating frequency [GHz]	No. of cavities
SOM [GHz]	Cavity Length [mm]
1 <sup>st</sup> Longitudinal HOM [GHz]	Cavity Diameter [mm]
1 <sup>st</sup> Transverse HOM (GHz)	Minimum Aperture [mm]
$E_p/E_t^*$	$R_t/Q$ [ $\Omega$ ]
$B_p/E_t^*$ [mT/(MV/m)]	FPC $Q_L$
$B_p/E_p$ [mT/(MV/m)]	Bandwidth [kHz]
$G$ [ $\Omega$ ]	Cavity Input Power [kW]
$R/Q$ [ $\Omega$ ]	Horizontal Kick Factor $k_x$ [V/pC/m]
$R_t R_s$ [ $\Omega^2$ ]	Vertical Kick Factor $k_y$ [V/pC/m]
$V_t$ per cavity [MV]	Stored Energy $W$ [J]
$E_p$ [MV/m]	HOM impedances
$B_p$ [mT]	Anything else?
Total $V_t$ [MV]	

# Preparations for 2<sup>nd</sup> Design Workshop (22<sup>nd</sup> 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 27<sup>th</sup> 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).



**MANY THANKS**

**Questions?**