
CERN

Update on e-cloud heat load in the triplets

Galina Skripka, Giovanni Iadarola

Acknowledgements: Vanessa Gahier, Cedric Garion, Serge Claudet, Peter Zijm

January 26, 2021

Outline

- Previous e-cloud studies for triplets
- New assumptions for coatings
  - e-cloud heat loads

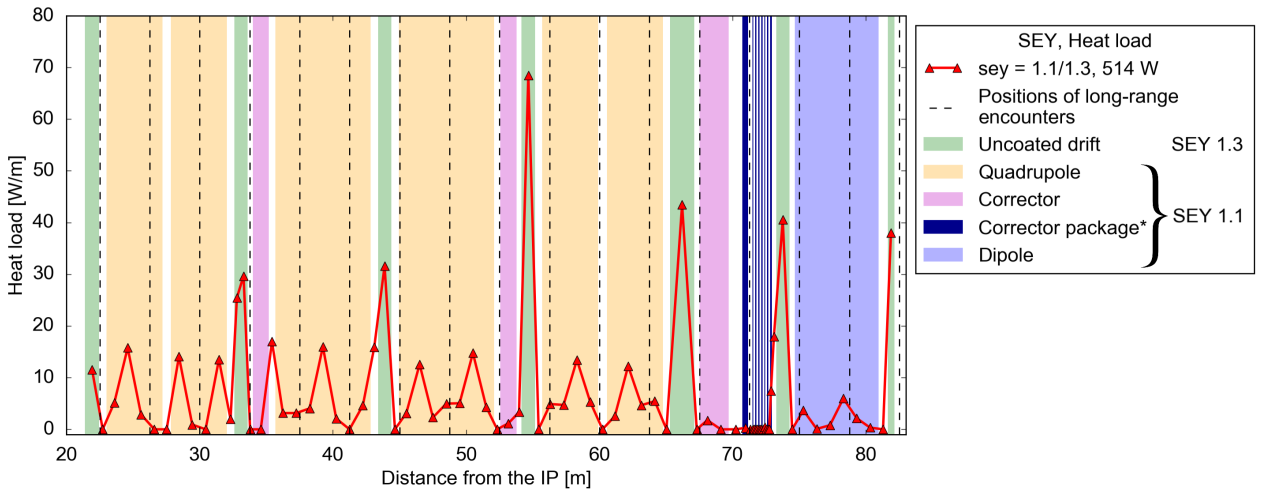
Outline

- Previous e-cloud studies for triplets
- New assumptions for coatings
  - e-cloud heat loads

Previous studies

e-cloud studies for HL-LHC triplets were reported in CERN-ACC-NOTE-2018-0009

- for slices along triplet elements:
  - dipoles
  - quadrupoles
  - drifts
  - correctors



* dodecapole, skew dodecapole, decapole, skew decapole, octupole, skew octupole, sextupole, skew sextupole

- for 2.2×10^{11} p/bunch intensity
- for different coating scenarios:
  - nonuniform SEY: 1.3 for warm drifts and 1.1 for the rest
    - N.B: SEY 1.1 - aC coating, SEY 1.3 - copper after conditioning

Previous studies: heat loads in IR5 drifts

Name	Length	Field config.	Chamber	Impedance (T_BS=70 K)	e-cloud (SEY=1.1/1.3(UncDrifts))	Total
ITQ1R5	11.6 m		BSHL_Q1	4.1 W	78.5 W	82.6 W
MQXFA.A1R5	4.2 m	quad	BSHL_Q1	1.5 W	25.0 W	
MQXFA.B1R5	4.2 m	quad	BSHL_Q1	1.5 W	29.9 W	
Drifts	1.7 m	drift	BSHL_Q1	0.6 W	1.1 W	
UncoatedDrifts	1.5 m	drift	BSHL_Q1	0.5 W	**22.5 W** ←	
ITQ2Q3R5	49.1 m		BSHL_Q23	15.3 W	434.4 W	449.7 W
MQXFB.A2R5	7.2 m	quad	BSHL_Q23	2.3 W	33.8 W	
MQXFB.B2R5	7.2 m	quad	BSHL_Q23	2.3 W	48.1 W	
MQXFA.A3R5	4.2 m	quad	BSHL_Q23	1.3 W	29.7 W	
MQXFA.B3R5	4.2 m	quad	BSHL_Q23	1.3 W	26.2 W	
MBXF.4R5	6.3 m	dip	BSHL_Q23	2.0 W	13.6 W	
MCBXFBV.A2R5	1.2 m	dip	BSHL_Q23	0.4 W	0.0 W	
MCBXFBH.A2R5						
MCBXFBV.B2R5	1.2 m	dip	BSHL_Q23	0.4 W	1.4 W	
MCBXFBH.B2R5						
MCBXFAV.3R5	2.2 m	dip	BSHL_Q23	0.7 W	1.9 W	
MCBXFAH.3R5						
MCTXF.3R5	0.4 m	dodecap	BSHL_Q23	0.1 W	0.1 W	
MCTSXF.3R5	0.1 m	skew dodecap	BSHL_Q23	0.0 W	0.0 W	
MCDXF.3R5	0.1 m	decap	BSHL_Q23	0.0 W	0.0 W	
MCDSXF.3R5	0.1 m	skew decap	BSHL_Q23	0.0 W	0.0 W	
MCOXF.3R5	0.1 m	oct	BSHL_Q23	0.0 W	0.0 W	
MCOSXF.3R5	0.1 m	skew oct	BSHL_Q23	0.0 W	0.0 W	
MCSXF.3R5	0.1 m	sext	BSHL_Q23	0.0 W	0.0 W	
MCSSXF.3R5	0.1 m	skew sext	BSHL_Q23	0.0 W	0.8 W	
Drifts	8.6 m	drift	BSHL_Q23	2.6 W	24.3 W	
UncoatedDrifts	5.9 m	drift	BSHL_Q23	1.8 W	**255.4 W** ←	
Total IT R5						**532.4 W**

Drifts outside cold masses assumed uncoated (SEY 1.3)

The total heat load is dominated by the contribution of the e-cloud in the uncoated drifts

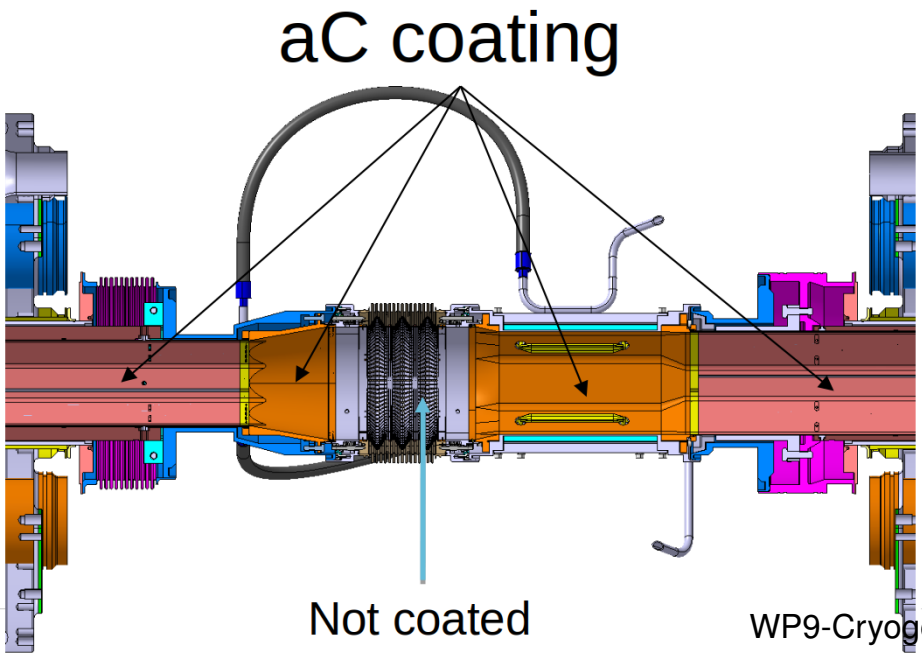
Outline

- Previous e-cloud studies for triplets
- New assumptions for coatings
  - e-cloud heat loads

New coating scenario

New scenario: the total uncoated length is ∼5 m shorter

- For all drifts inside the triplet **only DRF bellows ∼20 cm are uncoated (SEY 1.3)**
- Drifts at the extremities still considered not coated. No need to refine as their contribution is small (∼30 W)



WP9-Cryogenics, P. Zijm

New estimated heat loads

Name	Length	Field config.	Chamber	Impedance (T_BS=70 K)	e-cloud (SEY=1.1/1.3(UncDrifts))	Total
ITQ1R5	11.6 m		BSHL_Q1	4.1 W	70.6 W	74.7 W
MQXFA.A1R5	4.2 m	quad	BSHL_Q1	1.5 W	25.0 W	
MQXFA.B1R5	4.2 m	quad	BSHL_Q1	1.5 W	29.9 W	
Drifts	2.1 m	drift	BSHL_Q1	0.7 W	1.1 W	
UncoatedDrifts	1.1 m	drift	BSHL_Q1	0.4 W	**14.6 W**	
ITQ2Q3R5	49.1 m		BSHL_Q23	15.3 W	262.8 W	278.1 W
MQXFB.A2R5	7.2 m	quad	BSHL_Q23	2.3 W	33.8 W	
MQXFB.B2R5	7.2 m	quad	BSHL_Q23	2.3 W	48.1 W	
MQXFA.A3R5	4.2 m	quad	BSHL_Q23	1.3 W	29.7 W	
MQXFA.B3R5	4.2 m	quad	BSHL_Q23	1.3 W	26.2 W	
MBXF.4R5	6.3 m	dip	BSHL_Q23	2.0 W	13.6 W	
MCBXFBV.A2R5	1.2 m	dip	BSHL_Q23	0.4 W	0.0 W	
MCBXFBH.A2R5						
MCBXFBV.B2R5	1.2 m	dip	BSHL_Q23	0.4 W	1.4 W	
MCBXFBH.B2R5						
MCBXFAV.3R5	2.2 m	dip	BSHL_Q23	0.7 W	1.9 W	
MCBXFAH.3R5						
MCTXF.3R5	0.4 m	dodecap	BSHL_Q23	0.1 W	0.1 W	
MCTSXF.3R5	0.1 m	skew dodecap	BSHL_Q23	0.0 W	0.0 W	
MCDXF.3R5	0.1 m	decap	BSHL_Q23	0.0 W	0.0 W	
MCDSXF.3R5	0.1 m	skew decap	BSHL_Q23	0.0 W	0.0 W	
MCOXF.3R5	0.1 m	oct	BSHL_Q23	0.0 W	0.0 W	
MCOSXF.3R5	0.1 m	skew oct	BSHL_Q23	0.0 W	0.0 W	
MCSXF.3R5	0.1 m	sext	BSHL_Q23	0.0 W	0.0 W	
MCSSXF.3R5	0.1 m	skew sext	BSHL_Q23	0.0 W	0.8 W	
Drifts	13.1 m	drift	BSHL_Q23	4.3 W	52.2 W	
UncoatedDrifts	1.4 m	drift	BSHL_Q23	0.1 W	**55.9 W**	
Total IT R5						**352.8W**

The total heat load is reduced by ∼180 W

Summary

Electron cloud build-up in the HL-LHC Triplets was simulated and reported earlier

New coating scenario for the warm drifts was considered:

- drifts before Q1 and after D1 are uncoated (SEY 1.3)
- in other warm drifts only DRF bellows are uncoated (SEY 1.3)

For this scenario the total heat loads are reduced by $\sim$180 W

Backup

Estimates for heat heat loads

Assuming the new lengths of uncoated drifts heat loads were recalculated

Old heat loads

Name	Length	Field config.	Chamber	Impedance (T_BS=70 K)	e-cloud (SEY=1.1/1.3(UncDrifts))	Total
ITQ1R5	3.2 m		BSHL_Q1	1.1 W	23.6 W	24.7 W
Drifts	1.7 m	drift	BSHL_Q1	0.6 W	1.1 W	
UncoatedDrifts	1.5 m	drift	BSHL_Q1	0.5 W	**22.5 W**	
ITQ2Q3R5	14.5 m		BSHL_Q23	4.4 W	279.7 W	295.0 W
Drifts	8.6 m	drift	BSHL_Q23	2.6 W	24.3 W	
UncoatedDrifts	5.9 m	drift	BSHL_Q23	1.8 W	**255.4 W**	
Total IT R5						**319.7 W**

New heat loads

Name	Length	Field config.	Chamber	Impedance (T_BS=70 K)	e-cloud (SEY=1.1/1.3(UncDrifts))	Total
ITQ1R5	3.2 m		BSHL_Q1	1.1 W	15.7 W	16.8 W
Drifts	2.1 m	drift	BSHL_Q1	0.7 W	1.1 W	
UncoatedDrifts	1.1 m	drift	BSHL_Q1	0.4 W	**14.6 W**	
• Drift0 (unc)	1.0 m	drift	BSHL_Q1	0.4 W	12.2 W	
• Drift2Q1 (unc)	0.1 m	drift	BSHL_Q1	0.0 W	2.4 W	
ITQ2Q3R5	14.5 m		BSHL_Q23	4.4 W	108.1 W	112.5 W
Drifts	13.1 m	drift	BSHL_Q23	4.3 W	52.2 W	
UncoatedDrifts	1.4 m	drift	BSHL_Q23	0.1 W	**55.9 W**	
• Drift2Q2 (unc)	0.1 m	drift	BSHL_Q23	0.0 W	2.8 W	
• Drift4 (unc)	0.2 m	drift	BSHL_Q23	0.0 W	6.0 W	
• Drift6 (unc)	0.2 m	drift	BSHL_Q23	0.0 W	12.9 W	
• Drift8 (unc)	0.2 m	drift	BSHL_Q23	0.0 W	7.8 W	
• Drift9 (unc)	0.2 m	drift	BSHL_Q23	0.0 W	7.3 W	
• Drift10 (unc)	0.5 m	drift	BSHL_Q23	0.1 W	19.1 W	
Total IT R5						**129.3W**

The total heat loads on the drifts are reduced by more than factor two: 320 W $\rightarrow$ 130 W