A 3.8 to 4.1 TeV RCS in the LHC
First calculations

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Parameter and LHC restraints

Basic assumptions:

- ± 1.8 T normal conduction magnets (unchanged)
- 16 T SC magnets to see limits
- 45 MV/m gradient in cavity
- 90% survival rate

LHC lattice: C = 26659 m

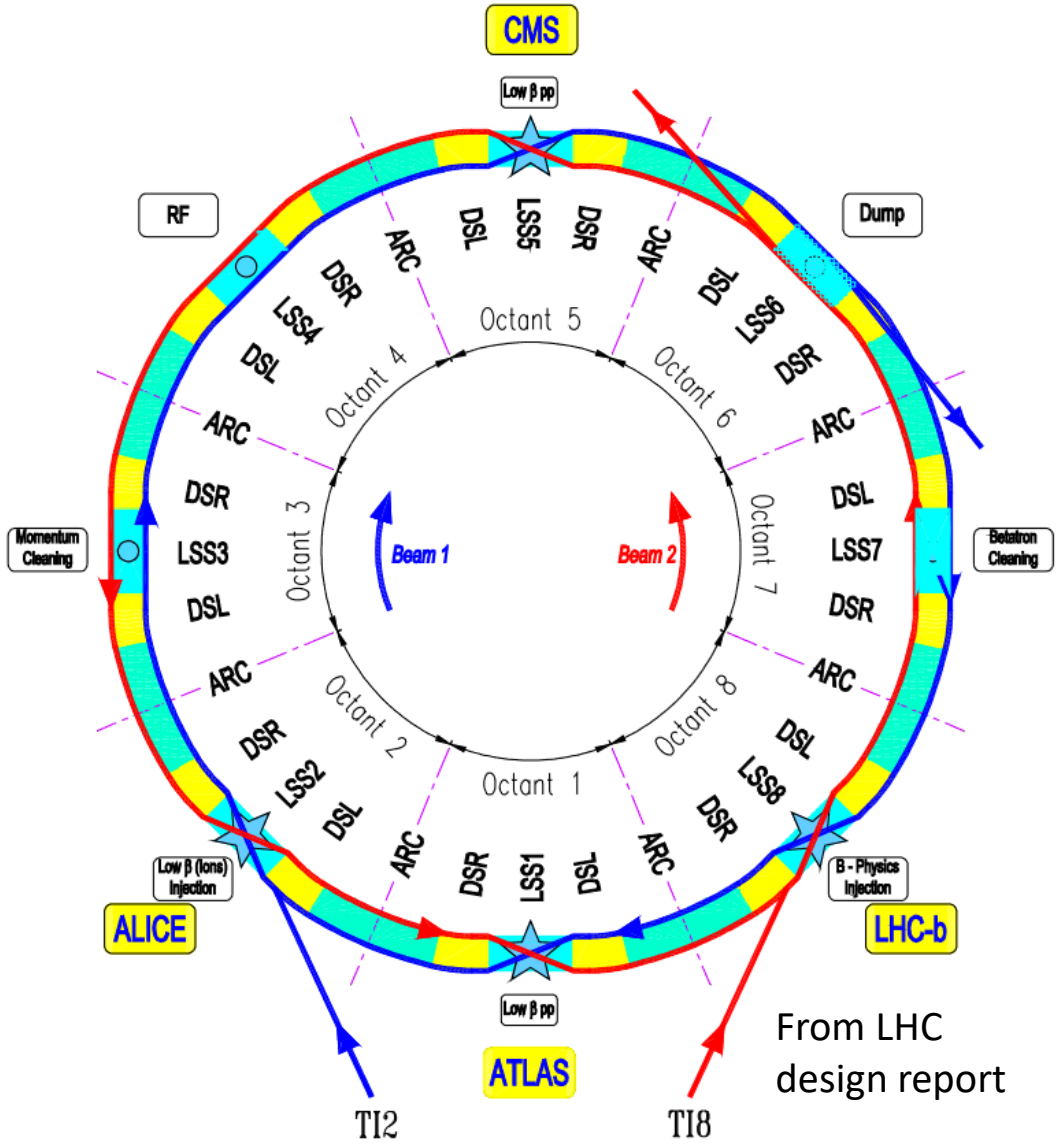
- 8 arcs, 2450 m long

→ 19600 m for SC and NC magnets

- 2808 m bend radius
- 8 long straights, 528 m long

→ 4224 m for insertions and RF

→ 5 TeV requires dipoles >>30 T, not feasible



From LHC design report

Parameter and LHC restraints

4.1 TeV RCS	Aggressive parameter 16 T, 45 MV/m
Survival rate	90%
Turns	64
Acceleration time [ms]	5.67
SC / NC magnetic strength [T]	16 / ±1.8
Filling factor	0.705
Length NC section [m]	15137
Length SC section [m]	3668
Number of 45 MV/m cavities	1277
Max straight length needed [m]	1277*1.5m/0.45 = 4256 m

= 18805 m, fits 19600 m arc length

fits 4224 m of long straights, sufficient to place 1277 cavities

Length of straight 7854 m, but ca 3630 m missing for SC links etc

→ Too optimistic assumptions? → next slide

Parameter and LHC restraints

4.1 TeV RCS	Aggressive parameter 16 T, 45 MV/m	3.8 TeV RCS	Conservative parameter 10 T, 30 MV/m
Survival rate	90%	Survival rate	90%
Turns	64	Turns	61
Acceleration time [ms]	5.67	Acceleration time [ms]	5.42
SC / NC magnetic strength [T]	16 / ±1.8	SC / NC magnetic strength [T]	10 / ±1.8
Filling factor	0.705	Filling factor	0.711
Length NC section [m]	15137	Length NC section [m]	13390
Length SC section [m]	3668	Length SC section [m]	5554
Number of 45 MV/m cavities	1277	Number of 30(45) MV/m cavities	1777 (1185)
Max straight length needed [m]	1277*1.5m/0.45 = 4256 m	Max straight length needed [m]	1465*1.5m/0.45 = 5923 m

= 18944 m, ok

<u>Note:</u> A lower ejection energy also leads to eased RF requirements (same survival rate at lower energy)

→ Are 8 RF stations ok?

International Muon Collider Collaboration

Summary

A 5 TeV RCS does not fit in the LHC tunnel, but a 3.8 to 4.1 TeV RCS seems feasible

The final energy depends on the assumptions for the dipole strengths and the RF gradient in the cavity

The space requirements for the RF should be checked to see if we could fit more cavities for an improved survival rate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