

# Decision on Crab Cavity location in SPS

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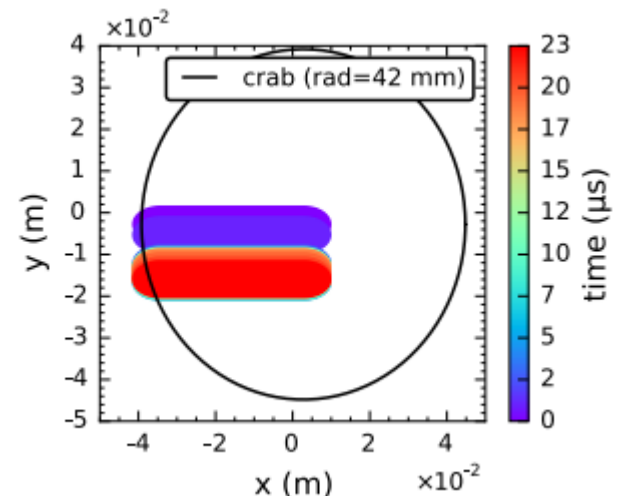
"outcome of global optimisation"

# Investigated locations

1. LSS4: after QDA417 (COLDEX alcove, baseline)
2. LSS5: after QF518 (on ECX5 platform)
3. LSS5: after QD517 (in alcove)
4. LSS6: after QDA617 (in enlarged tunnel)

# Comparison of features: general

- Schedule: assume that facility will be needed after LS2
  - Cannot assume temporal decoupling in same machine zone: too much risk of major incompatibility in case of any delay in CC test program
- No option is compatible with FT beam separatrices
  - Aperture for large H beam insufficient (cannot fix phase advance as this can change with extraction scheme)
  - CC needs by-pass, like COLDEX, with Y bellows etc.
  - 10.0 m assumed in layout (may be 10.5 m)



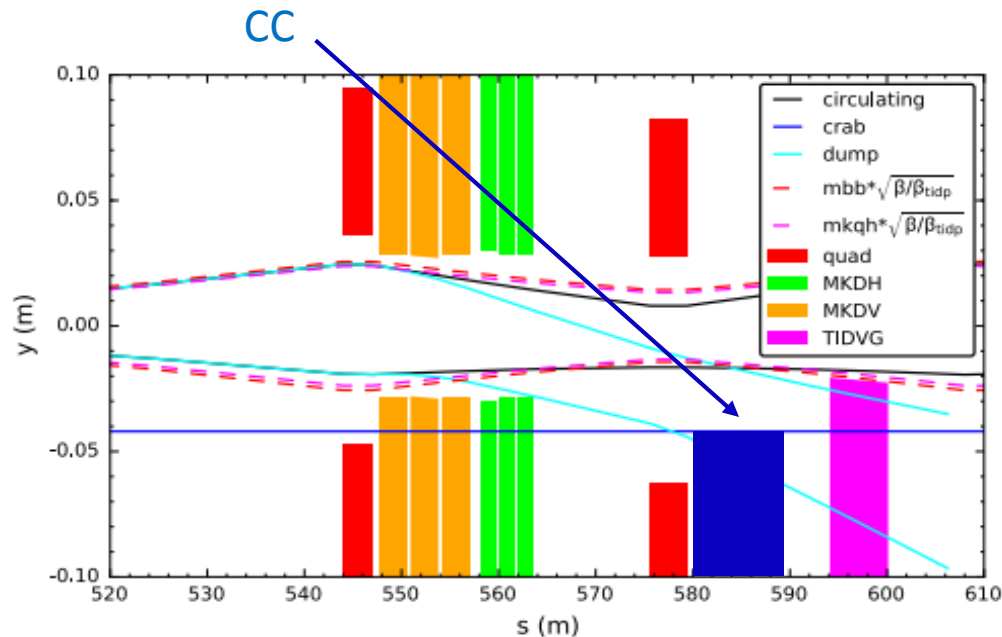
FT separatrices at CC in QD517

# Comparison of features: specific

- Option 1 (LSS4 alcove)
  - OK for machine, but major impact on/from COLDEX
- Option 2 (ECX5 platform)
  - Incompatible with planned LSS5 dump
- Option 3 (LSS5 alcove)
  - Significant impact on/from LSS5 dump (apertures, margins, losses, space remaining, EMC, ...)
- Option 4 (LSS6 enlarged tunnel)
  - OK for machine, and most flexible and decoupled solution

# Option 2: Incompatible with LSS5 dump

- Does not work for location downstream of QFA518 (on ECX5 platform)
  - Need to always dump beam (for CC tests)
  - CC aperture of  $\varnothing 84$  mm completely insufficient (need  $\sim \varnothing 120$  mm)



- **Not feasible** (from machine side)

# Option 3: Details of layout/performance

	Unit	Baseline layout (3 MKDVs)	With Crab Cavity layout
N. MKDV		3	3
N. MKDH		3	3
MKDV max V	kV	34.8	33.0
MKDH max V	kV	9.80	9.80
MKDV min V	kV	1.06	1.06
MKDH min V	kV	0.107	0.107
N of GTOs *		12	12
MKDV Max kick**	mrاد	0.30	0.34
MKDH Max kick**	mrاد	0.566	0.566
Pos on TIDVG (min)***	mm	39.2	37.8
Pos on TIDVG (max)***	mm	54.7	52.9
Pos on TIDVG - MKDV fail (min)***	mm	25.5	25.9
Pos on TIDVG - MKDV fail (max)***	mm	35.6	36.1
H/V min aperture MKDV (circ)****	$\sigma$	8.3 // 3.8	7.5 // 3.75
H/V min aperture MKDV (dumped)****	$\sigma$	8.3 // 3.6	7.5 // 3.55
H/V min aperture MKDH (circ)****	$\sigma$	8.5 // 4.3	7.1 // 4.5
H/V min aperture MKDH (dumped)****	$\sigma$	8.5 // 3.55	7.5 // 3.55
min aperture QFA (dumped)****	$\sigma$	5.8//3.55	5.6//3.5

- Kicker voltages, tracking functions are almost identical
- Lose 0.8 sigma in H aperture at MKDV, 1.5 sigma at MKDH (for circulating beam)
- Slight loss in vertical aperture (at worse is 0.2 sigma for MKDH)
- Dumped beam position worse (nearer surface) by about 1.5 mm (approx. 8%)

# Conclusion

- Feasible locations are
  - LSS4: after QDA417 (alcove)
    - But need to replace COLDEX.
  - LSS6: after QDA617 (enlarged tunnel)
    - No constraints from machine side
    - 200 m<sup>2</sup> ideally in BA6 needed: checking with TE/ABT
    - Extra MD time to be planned for SPS when not filling LHC or running FT
    - No common control room with AWAKE
    - Some redesign of support structure needed
- With increasing incentive to keep COLDEX operational in LSS4 over the coming runs **it was agreed together (HL-LHC/LIU) to change the baseline Crab Cavity test installation from LSS4 to LSS6.**