

MD Outlook, Constraints & Discussion

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Crab Cavity $\frac{1}{2}$ day May 8, 2018

- **Operational limitations**

- Aperture
- (In-)compatibility of crab cavity in parallel to regular SPS operation
- Proposed mode of operation

- **Considerations on MD planning**

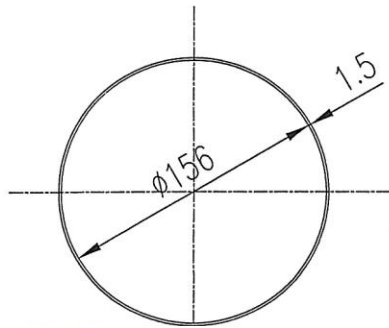
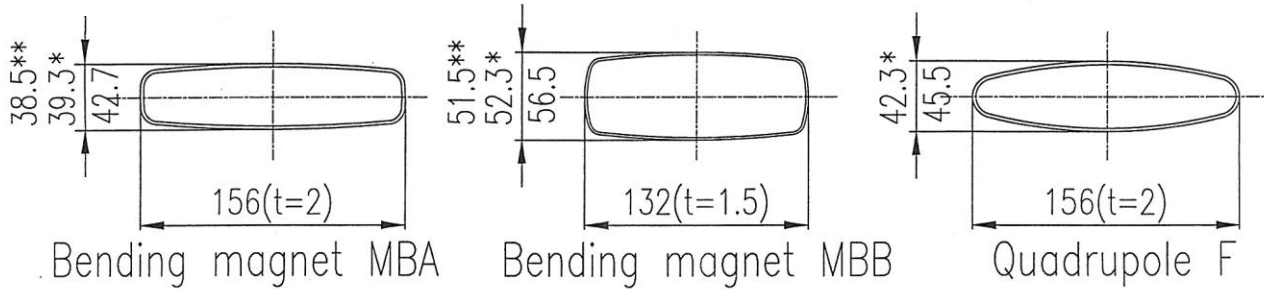
- Present allocation of MD slots

SPS main vacuum chambers

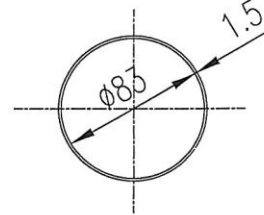
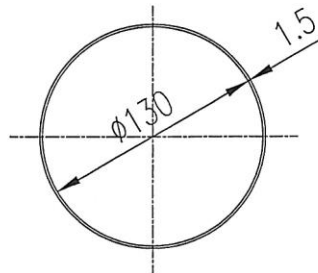


SPS MAIN VACUUM CHAMBERS

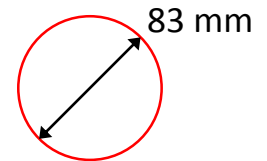
* Under vacuum
** When compressed in magnet



Straight sections



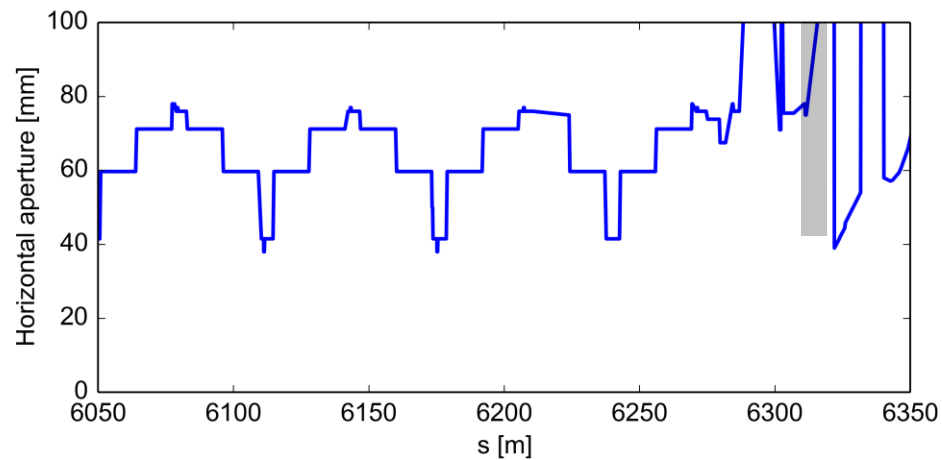
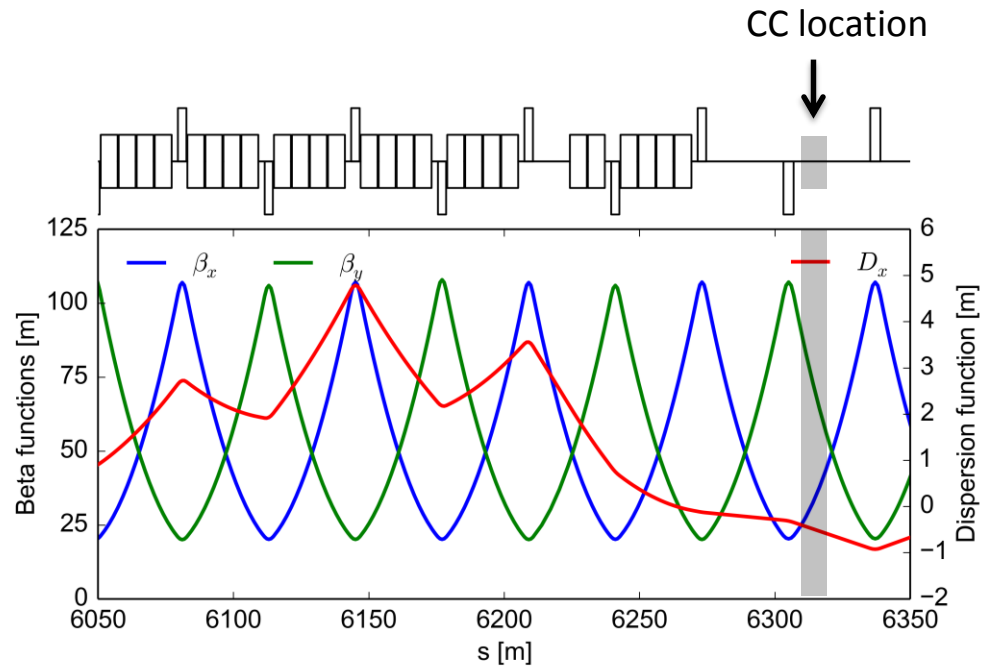
Quadrupole D



Crab cavity aperture (equivalent to "QD")

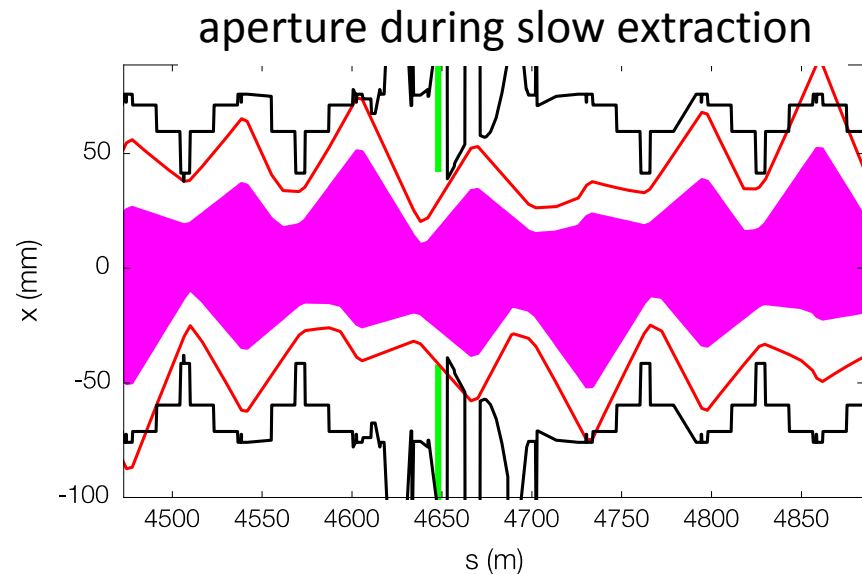
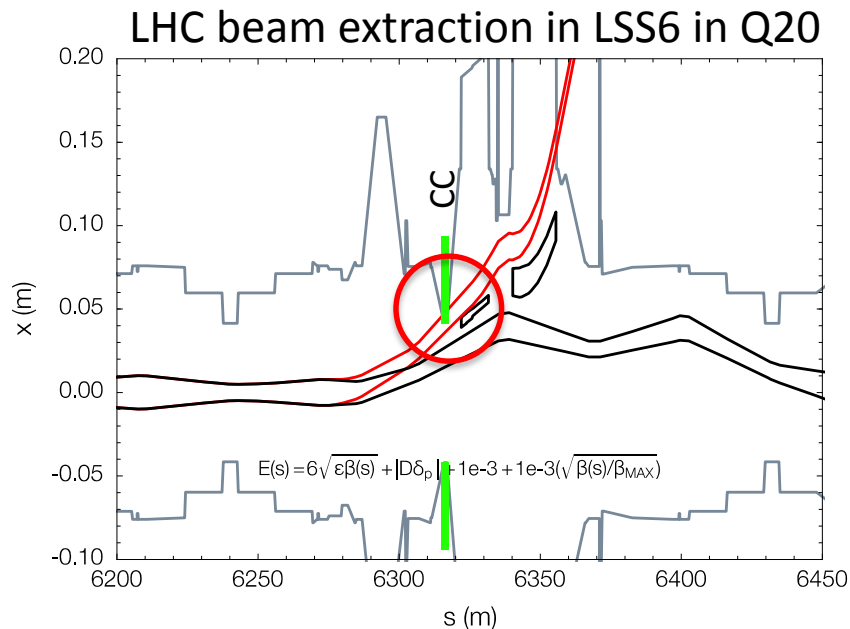
- Natural location for crab cavity is next to a QD → nominal location preferred
- **Crab cavities not expected to impose vertical aperture restriction!**

Optics (Q26) and aperture at crab cavity location



Crab cavities in shadow of close by elements

(In-)compatibility with extraction



- **Not enough aperture for LHC beam extraction (crab cavities need to be moved out)**
- NA slow extraction: calculation of beam envelope at 400 GeV including extraction bump
 - purple area: raw beam envelope during slow extraction
 - red line: beam envelope including tolerances (closed orbit, beta-beat, halo, ...)
 - **Slow extraction to North Area would be compatible (in principle), but not recommended**

Operational aspects for crab cavity MDs



- **Remote handling of table movement**

- Presently done from BA6 – is OK for SPS OP but from CCC would be preferred

- **Interlocks**

- Table interlocks tested successfully last Wednesday (including access, beam interlock, ...)
 - Software interlock
 - 2 hardware interlocks (circulating and extracting beam)
- **Interlock conditions for having beam with crab cavity IN not yet verified**
- **Crab cavity BLM interlocks in LSS6 to be tested (display of BLM readings?) ... to be followed up**

- **Intensity limitations**

- **In coast: only low total intensity (few nominal Indivs) because BLMs are blind during few hundred ms at supercycle increase**

Proposed mode of operation

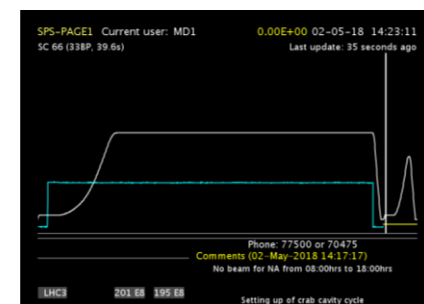
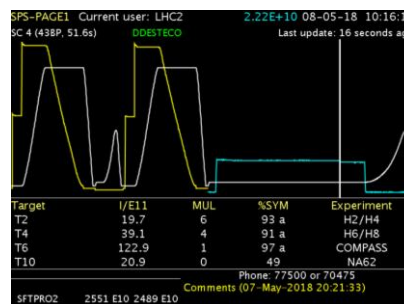


- **Use mostly cycles instead of coast**

- More efficient use of machine time for initial commissioning of CCs
- Allows functions or crab cavities along storage (voltage ramping, phase scans, ...)

- **2 MD cycles have been setup:**

- 26 GeV cycle with 19 s FB
- 270 GeV cycle with 26 s FT



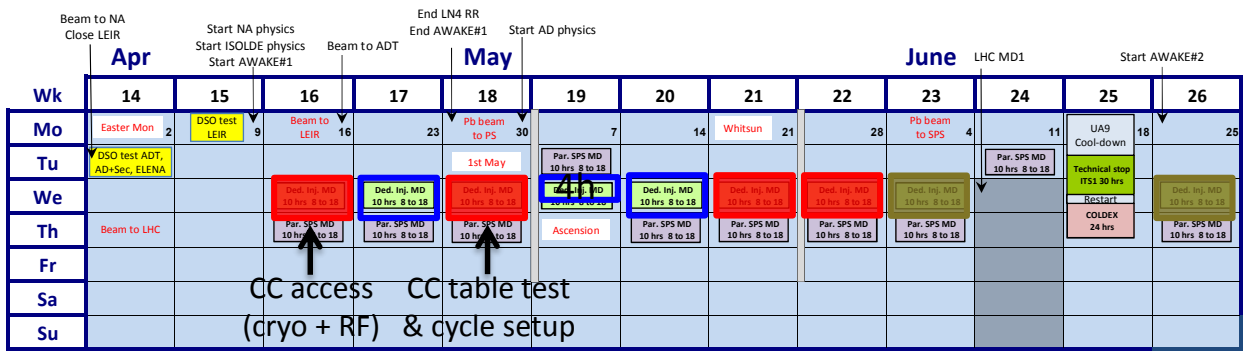
- **First MDs with beam**

- Use 26 GeV flat bottom cycle (preparation of re-phasing ongoing)
- Test CC protection with low intensity single bunches (BLM interlocks)

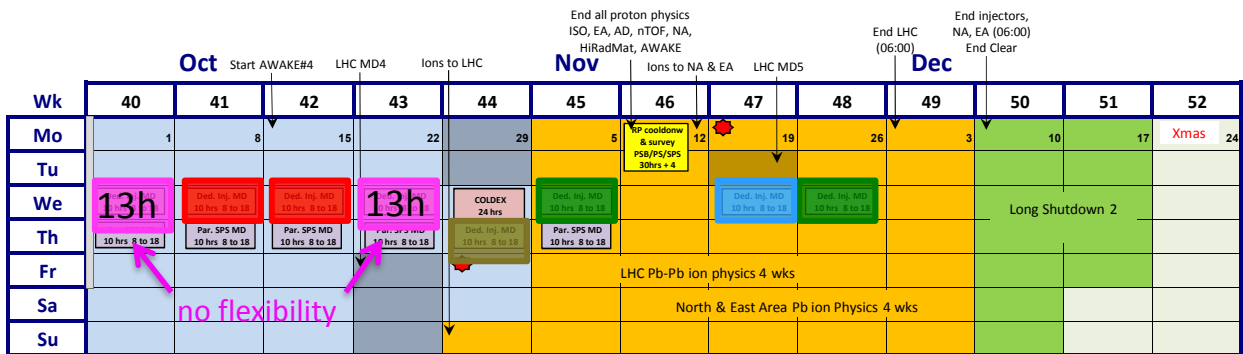
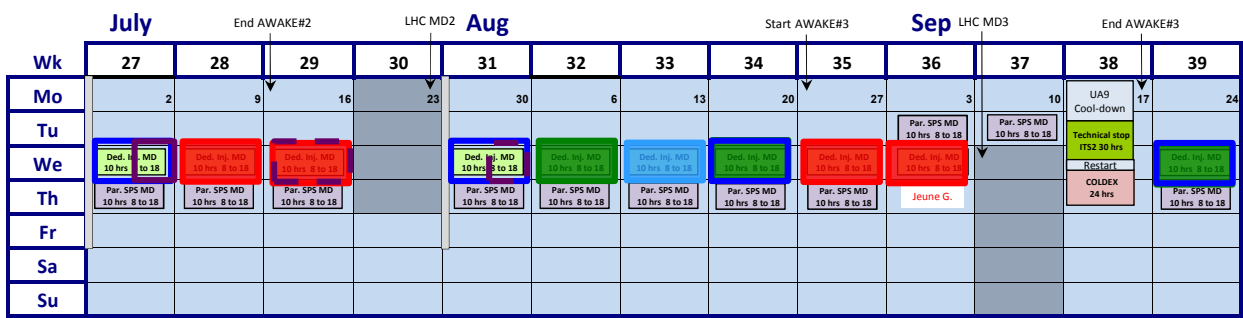
- **No CC operation in parallel to physics**

- not evident how to make sure crab cavity is “transparent” for physics users + risk for CCs themselves
- **Restrict CC operation to dedicated MDs on Wednesdays (allocated 10 slots of 10h) – CCs can be retracted within 20 minutes (later without access) in case of LHC filling**

MD slot allocation for 2018



- Crab Cavities
- Slow extraction
- Target test for BDF
- SPS BPMs
- Ion MDs
- Partially stripped Pb
- UA9 (collimation + shadowing)
- LIU SPS Thursdays (RF / transv. alternating)



... there is a certain flexibility in the slot allocation, but changes should not be made last minute ...