Towards freezing the design for the Demonstration of Ionization Cooling

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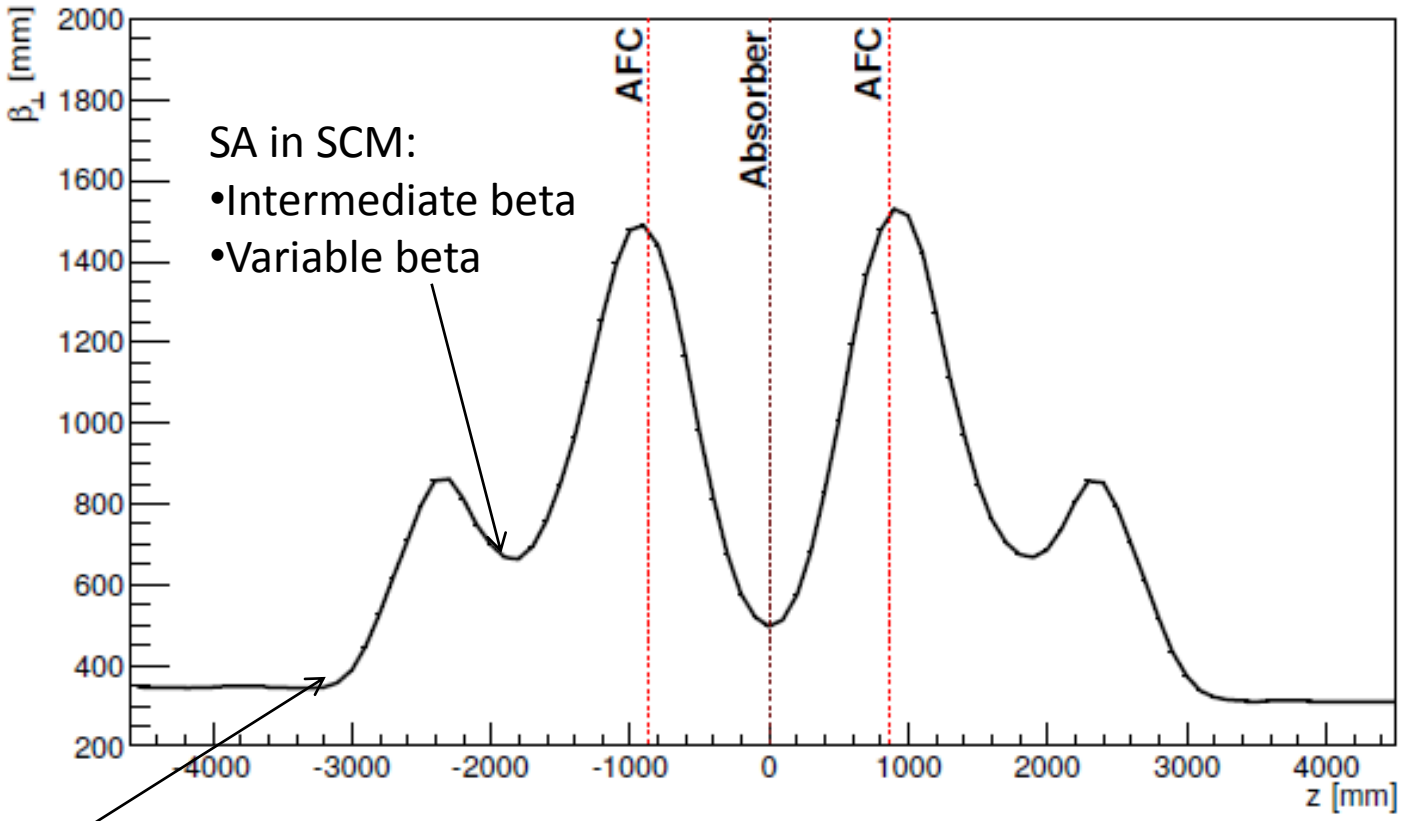
Outline

- Do we need movable secondary absorbers?
- Optics of the channel as a function of the distance between FCs.

Do we need movable secondary absorbers (SA)?

- It is assumed that the main absorbers will be movable (we can remove them).
- Two solutions for the secondary absorbers position have been identified
  - Near RF cavity window (inside SCM –single cavity module)-> this position allows for both movable or fixed SA.
  - Near the He window inside SS -> This is only compatible with the fixed SA option.

Optics at two SA's positions in reference lattice (cell of 1724mm)

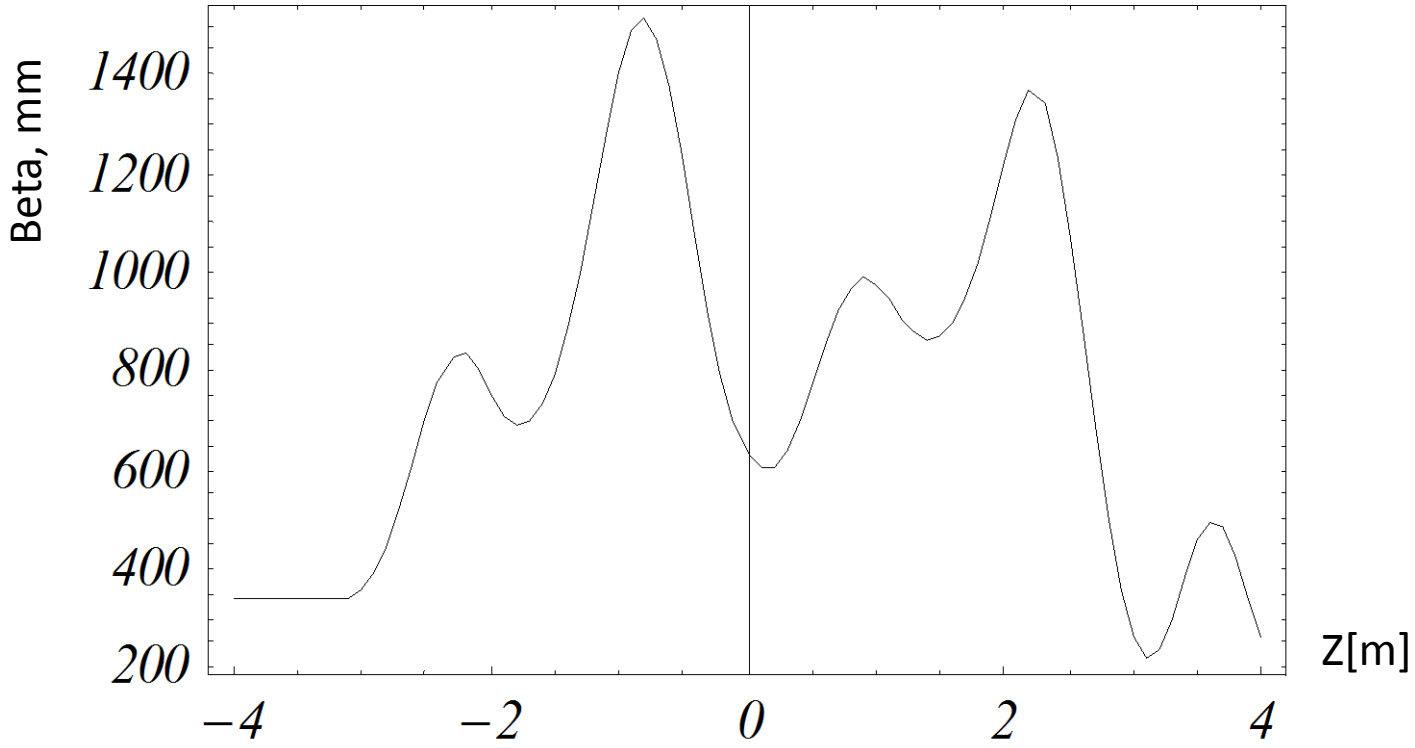


SA in SS:
•Small beta
•~Constant beta

Advantages and disadvantages of movable/fixed SAs

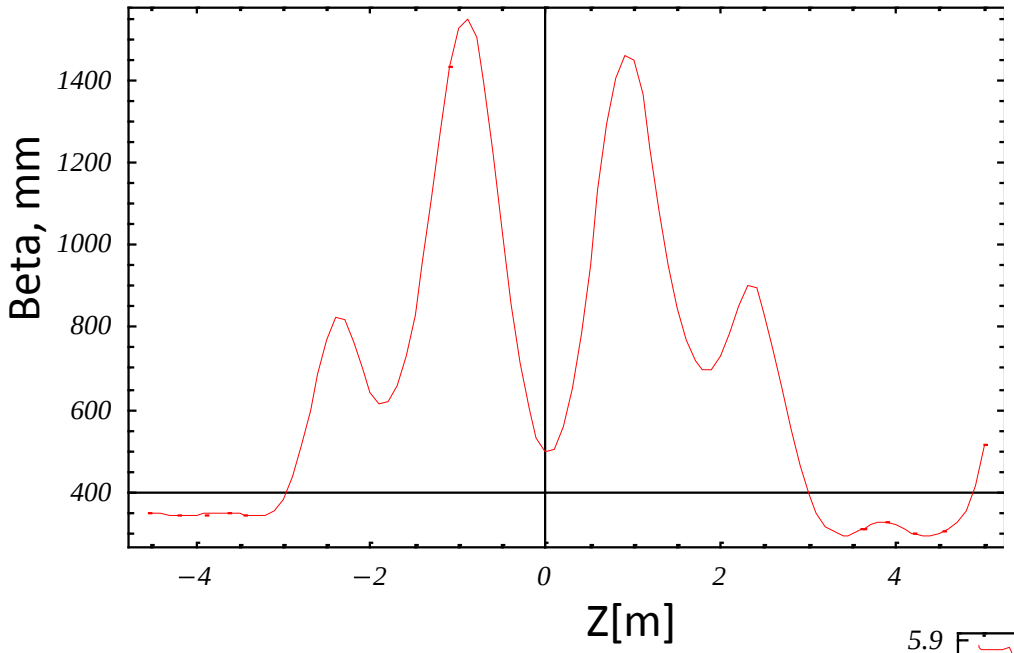
	Advantages	Disadvantages
Movable SAs	•Allow to study "bare" optics •Allow for variable value of beta at SAs	•Complex mechanical system, however we can use the shutter mechanism •Allow for only intermediate value of beta in SAs
Fixed SAs at SCM	•Simple engineering •Allow for variable value of beta at SAs •Small chance for being able to remove them	• Do not allow to study "bare" optics •Allow for only intermediate value of beta in SAs
Fixed SAs at SSs	•Simple engineering •No chance for being able to remove them •Fixed value of beta (good or bad?) • Very small value of beta -> more cooling	• Do not allow to study "bare" optics • Do not allow for variable value of beta at SAs •Fixed value of beta (good or bad?)

Optics in the reference lattice without SAs

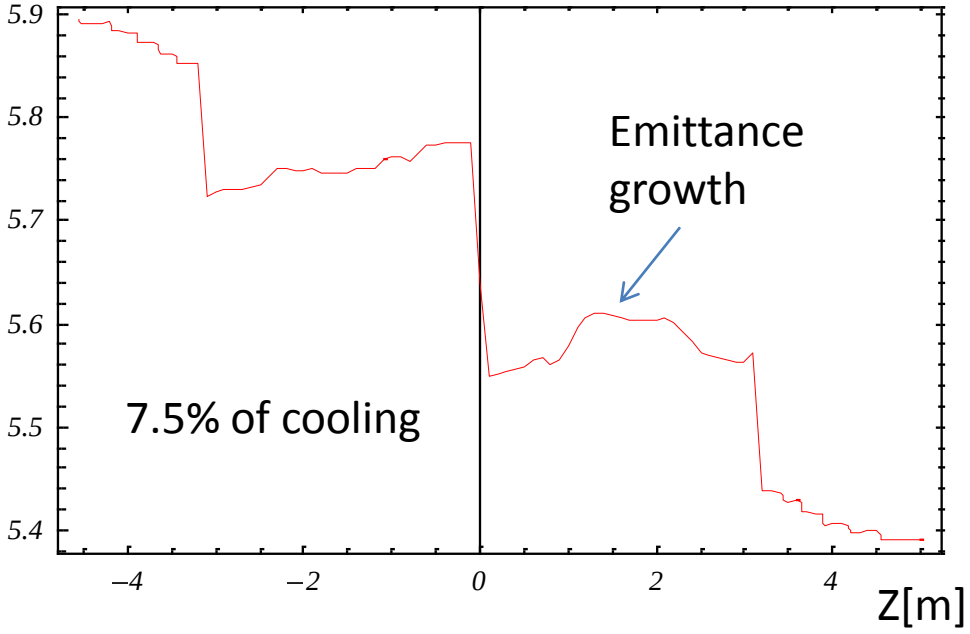


This shows that the optics is substantially perturbed by the presence of the SA absorbers and their effect is certainly not negligible.

Performance of reference lattice with SAs in SSs



Beta at MA – 50cm



Summary of findings so far

- Optics is substantially perturbed by the SAs, so they cannot be considered as a small perturbation
- SAs in SS indeed provide additional cooling by about 1.4% more.
- Beta remains fixed at SAs positioned in SSs (assuming matching from/into SS)
- How about prospects for 6D measurements?

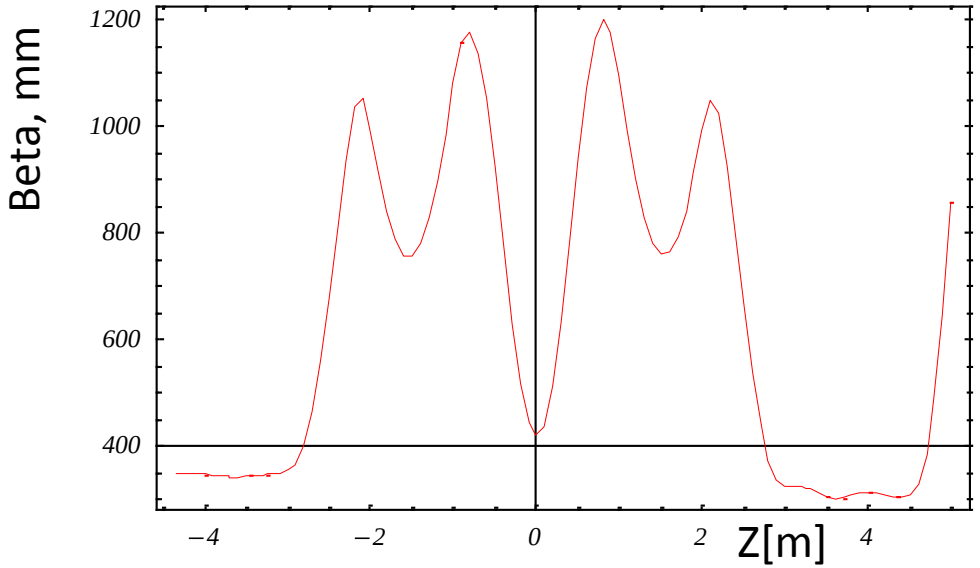
Personal opinion

- I prefer to be able to check “bare” lattice and to be able to adjust beta in SAs than to have additional 1.5% of cooling more.
- Let’s share the opinions...

Optics of the channel as a function of the distance between FCs.

Shorter lattice (cell of 1350mm) with SAs in SS

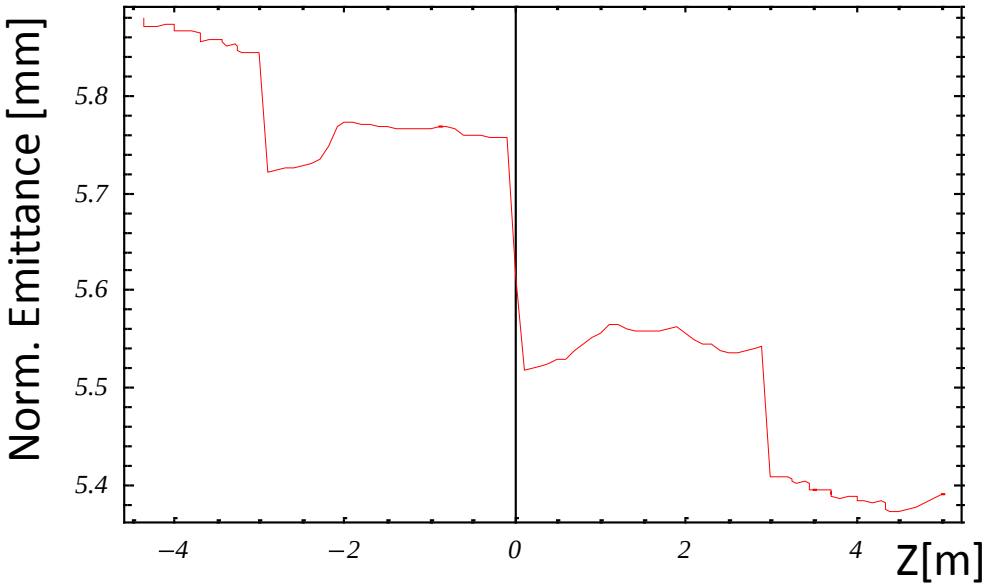
Small max beta



42 cm beta at the main absorber

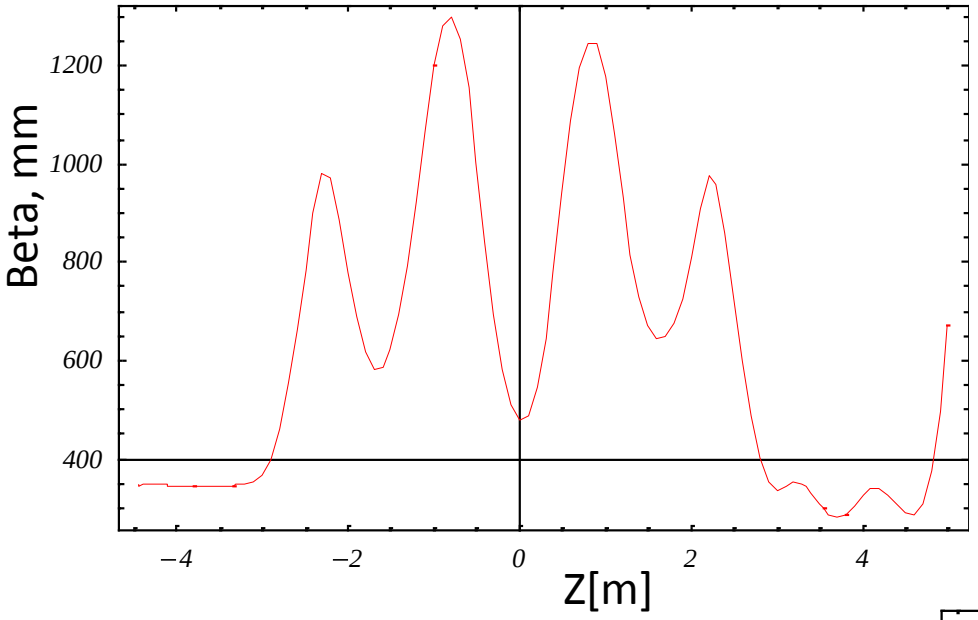
Note larger beta for the potential SAs in the SCM

A bit more emittance growth upstream, less downstream, total cooling ~7.5% too.

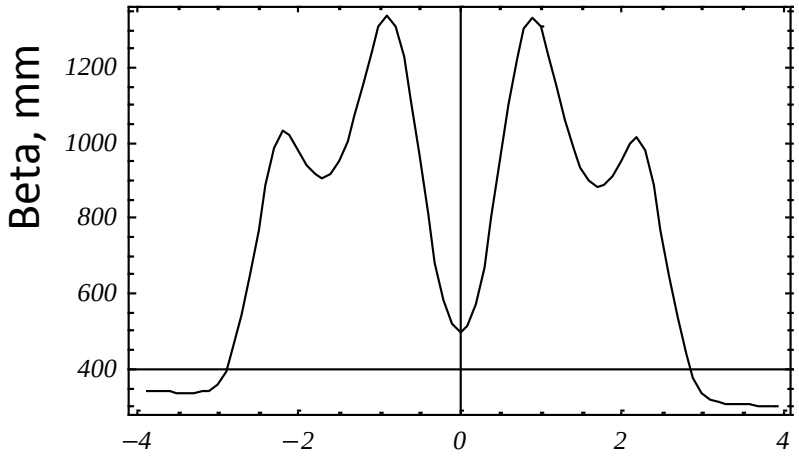


Shorter lattice (cell of 1537mm) with SAs in SCM

Small max beta

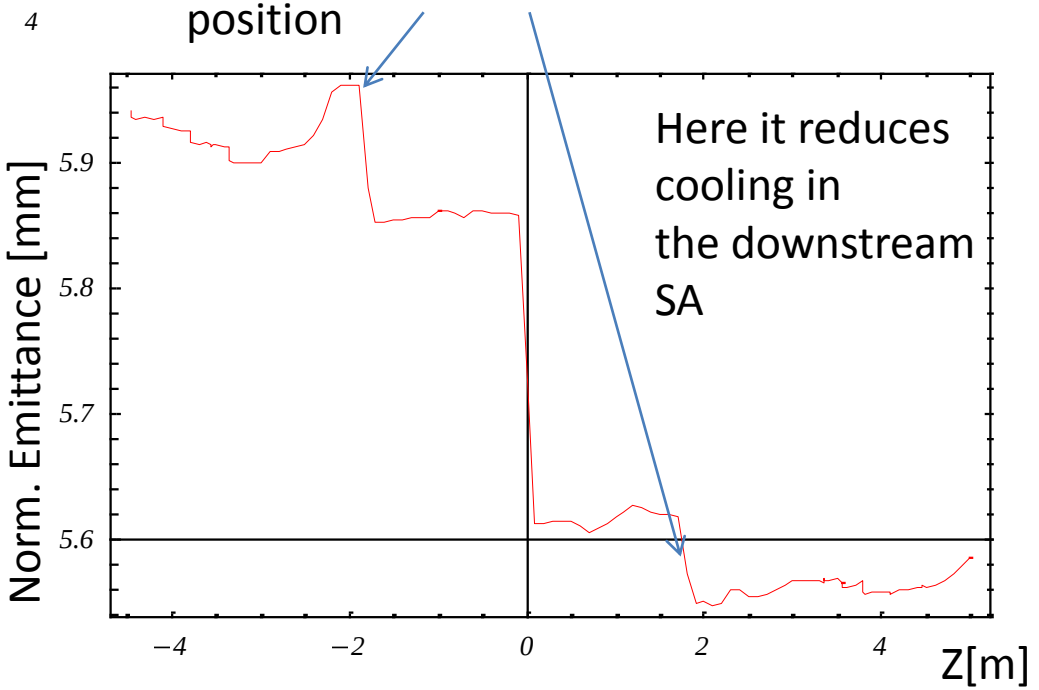


...however larger beta at M1 and higher J needed in M1 coil -> stronger focusing, potential source of nonlinearities and closer to the limits -> less flexibility for tuning.



Alternative setting with relaxed M1,
However beta at M1s and SAs are large.

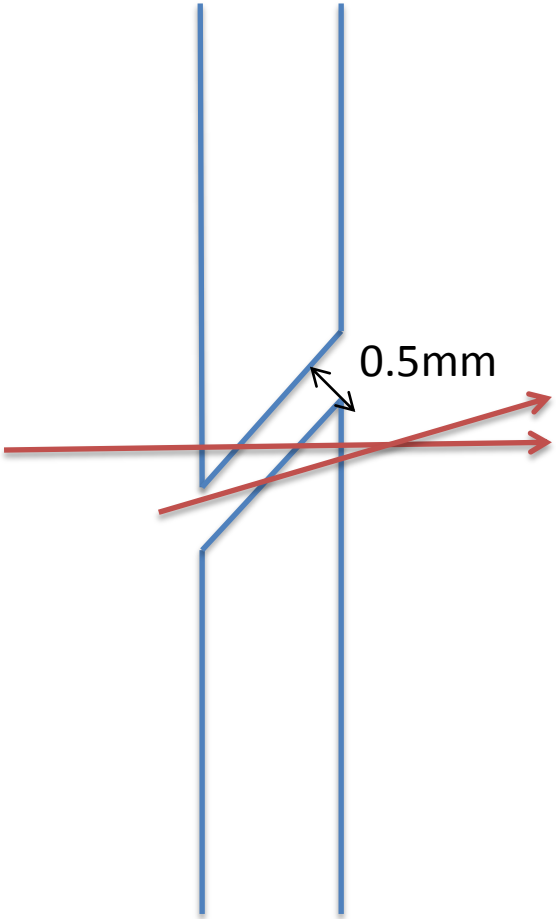
Emittance growth visible at around M1 position



Summary of findings so far

- The shorter the lattice is the smaller beta we can achieve in the MA, however beta in SAs at SCM is either growing or M1 coil setting required becomes stronger.
- Strength of M1 is a potential limitation as it was found to cause nonlinear emittance growth and DA limitations
- SAs in SS indeed provide additional cooling by about 1.4% more, however making the lattice shorter also affect beta at M1 (possibly growing). However beta at Sas in SSs remains fixed at small values.
- ...still we get approximately the same performance with beta 50 cm and beta 42 cm.

Reference lattice (CM40) remains a good, robust and flexible solution and we are probably close to the optimum (within cms).



Movable SAs geometry

- SAs angle - 45 degree
- Thickness 32.5 mm
- Minimal distance 0.5 mm
- Max particle angle 19.3 degree (lowest energy, highest emittance, small beta 60cm and at 3 sigma)

- delta L/L for straight track – 2.2%
- delta L/L for max angle track – 5.6%

This geometry would allow to reduce those values by a factor of two