Update on Collimation

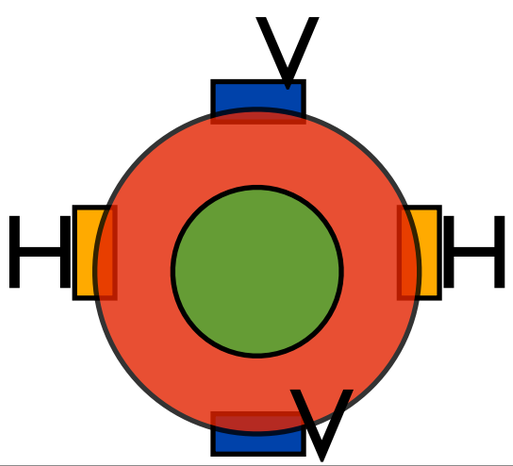
Androula Alekou, Christos Lazaridis

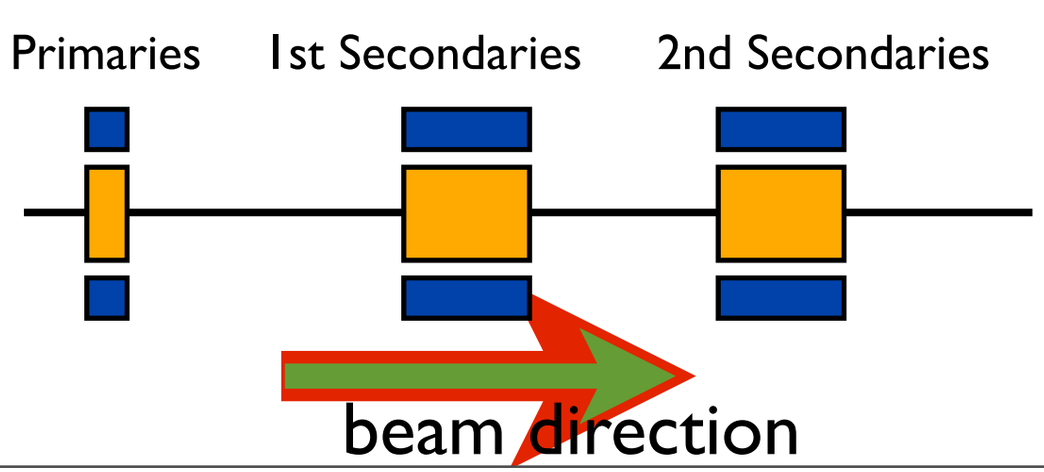
Super quick re-cap

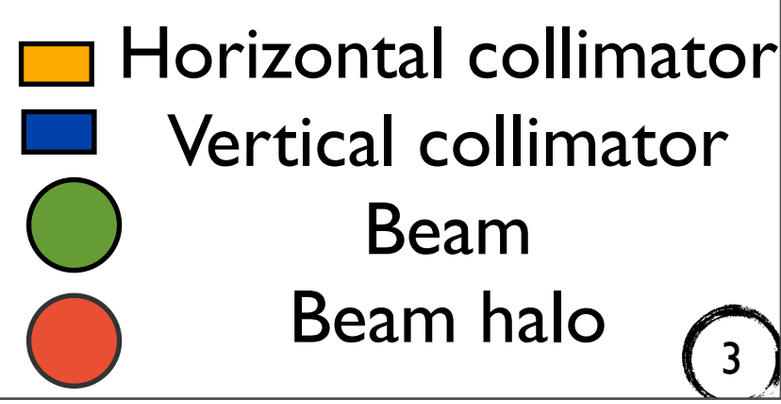
Why do we need collimators?

- To protect our machine from the beam halo
- We need 2 primary collimators (one in H and one in V)
- ...and 4 secondary collimators (2 first secondaries and 2 second secondaries)*

*there is also one H and V collimator at mirror-symmetric positions for each primary and secondary collimator







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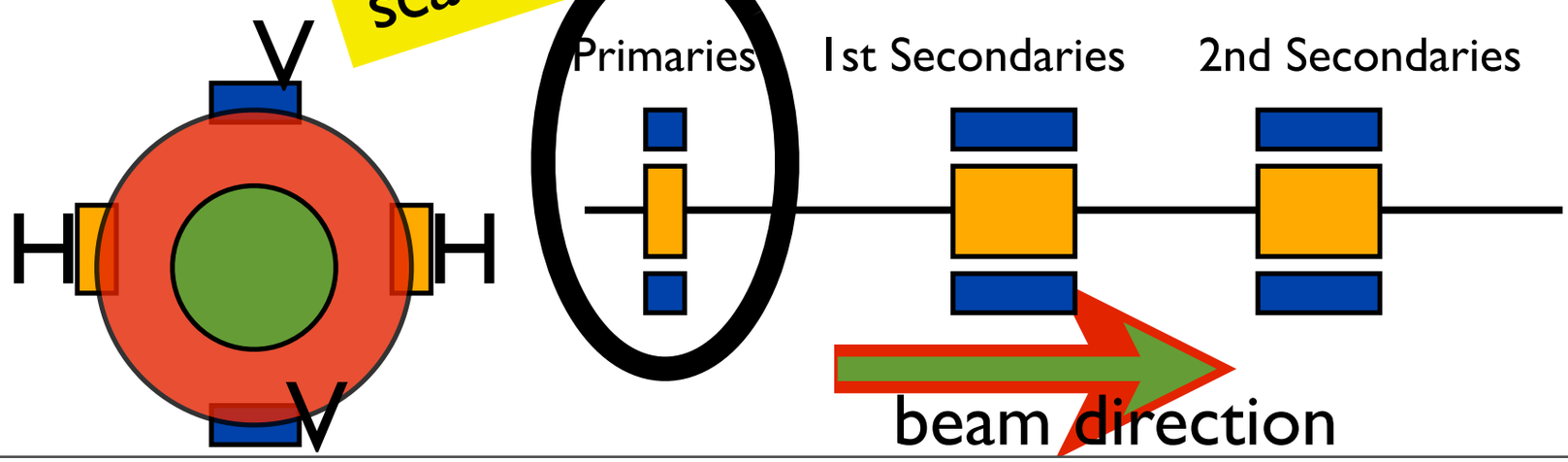

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act as absorbers

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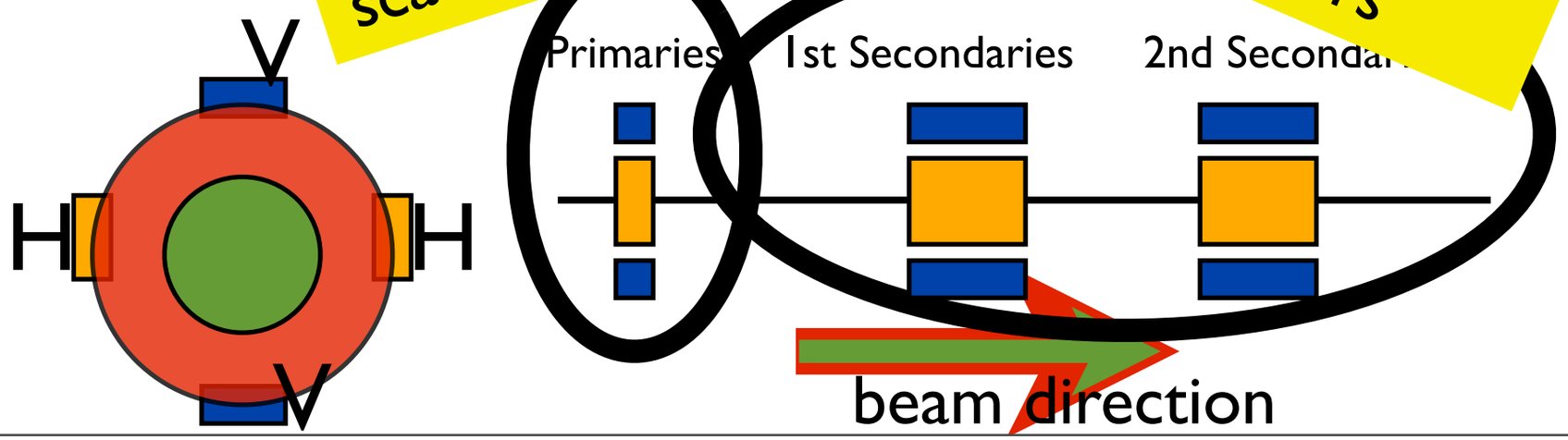

Where (at which s-position) should the collimators be placed?

- If we know the aperture of the primary and secondary collimators (Np and Ns) then:
  - primaries can be placed at first drift of straight section
  - first secondaries should be placed at s where phase advance satisfies: $\Delta\mu_{s1}=\arccos(Np/Ns)$
  - second secondaries should be placed at s where phase advance satisfies: $\Delta\mu_{s2}=\pi-\Delta\mu_{s1}$

$\Delta\mu_{s1}: \mu_{s1}-\mu_p$
$\Delta\mu_{s2}: \mu_{s2}-\mu_p$

s1,2: first/second secondary collimators
p:primary

- Assuming Np=2.5 σ and Ns=3.0 σ then the optimum s-positions for placing collimators would be at places where $\Delta\mu\_s1=33.57°$, $\Delta\mu\_s2=146.43°$
- Using HP-PS sequence* the first straight section (section with no bending magnets) was found to be between: 315-391 m

Collimators	HP	VP	HS1	HS2	VS1	VS2
Δμ [º]	-	-	25.8	148.6	38.4	147.9
s [m]	315.6	317.5	328.5	389.3	339.1	367.66

HP/VP: Horizontal/Vertical Primary Collimator
HS1/VS1: First Horizontal/Vertical Secondary Collimators
HS2/VS2: Second Horizontal/Vertical Secondary Collimators

*from Fanouria Antoniou

Other collimator initial conditions

Collimator	Primary H/V	Secondaries H1/V1/H2/V2
aperture (σ)	2.5	3
length [m]	0.02	1.0
material	C	W
βx [m]	35.88/38.56	21.87/28.12/35.56/32.97
βy [m]	18.67/17.36	35.32/17.36/18.33/38.65
angle [rad]	0/1.5708	0/1.5708/0/1.5708
offset [m]	0	0

Halo [σ]: 3

Smear [σ]: 0.958

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Huge, but for now aim was to make sure code works (particles will hit collimators and aperture)

Steps followed

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Install collimators in MAD-X and run MAD-X

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files are produced

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Run SixTrack (uses files produced by MAD-X)

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* Run code that checks at which collimators particles have been absorbed

* Run code that checks at which s-positions particles have radius larger than aperture

* Codes of collimator absorptions and aperture-radius comparison written by Javier Barranco (aperture-radius comparison code written now also in c++ and python and produces similar results to Javier's code)

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Plot histograms

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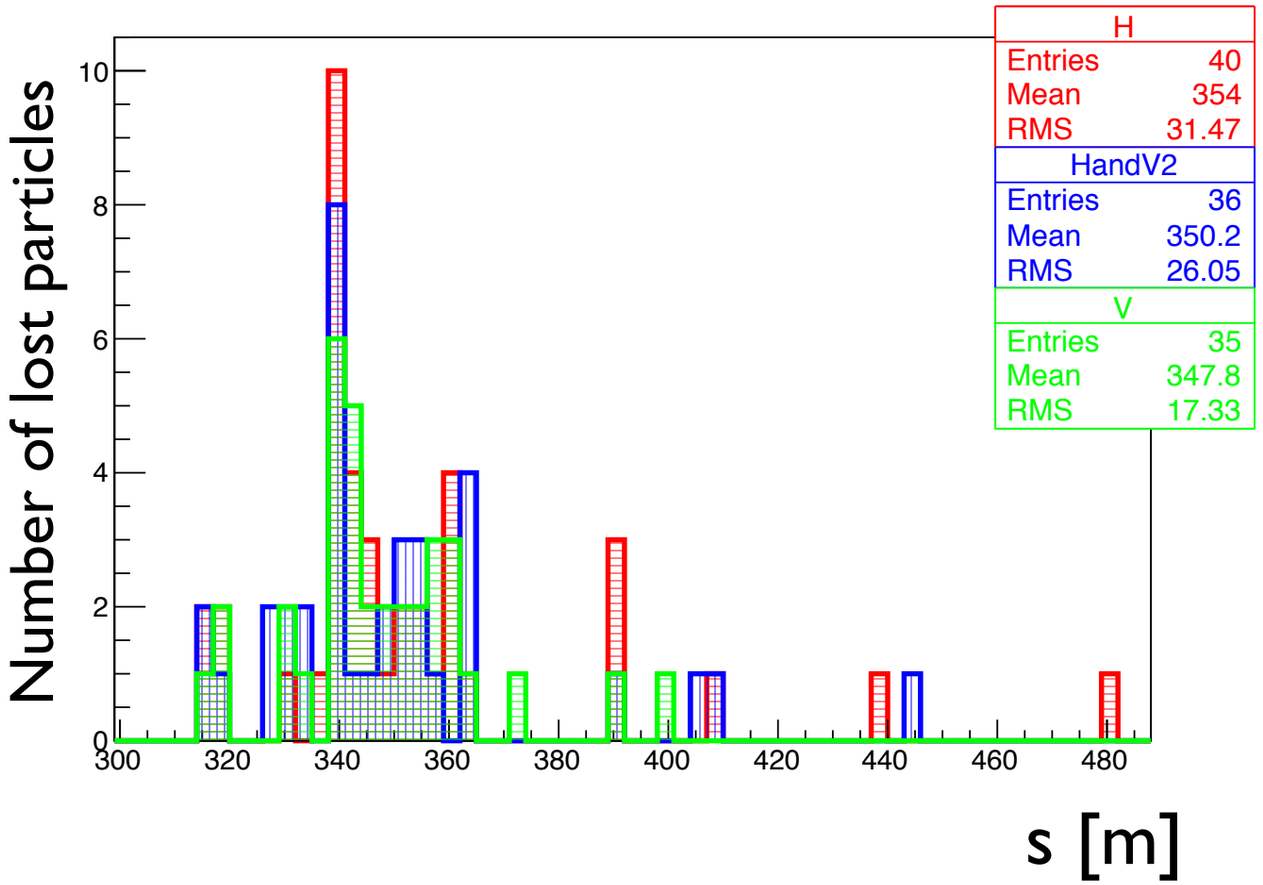
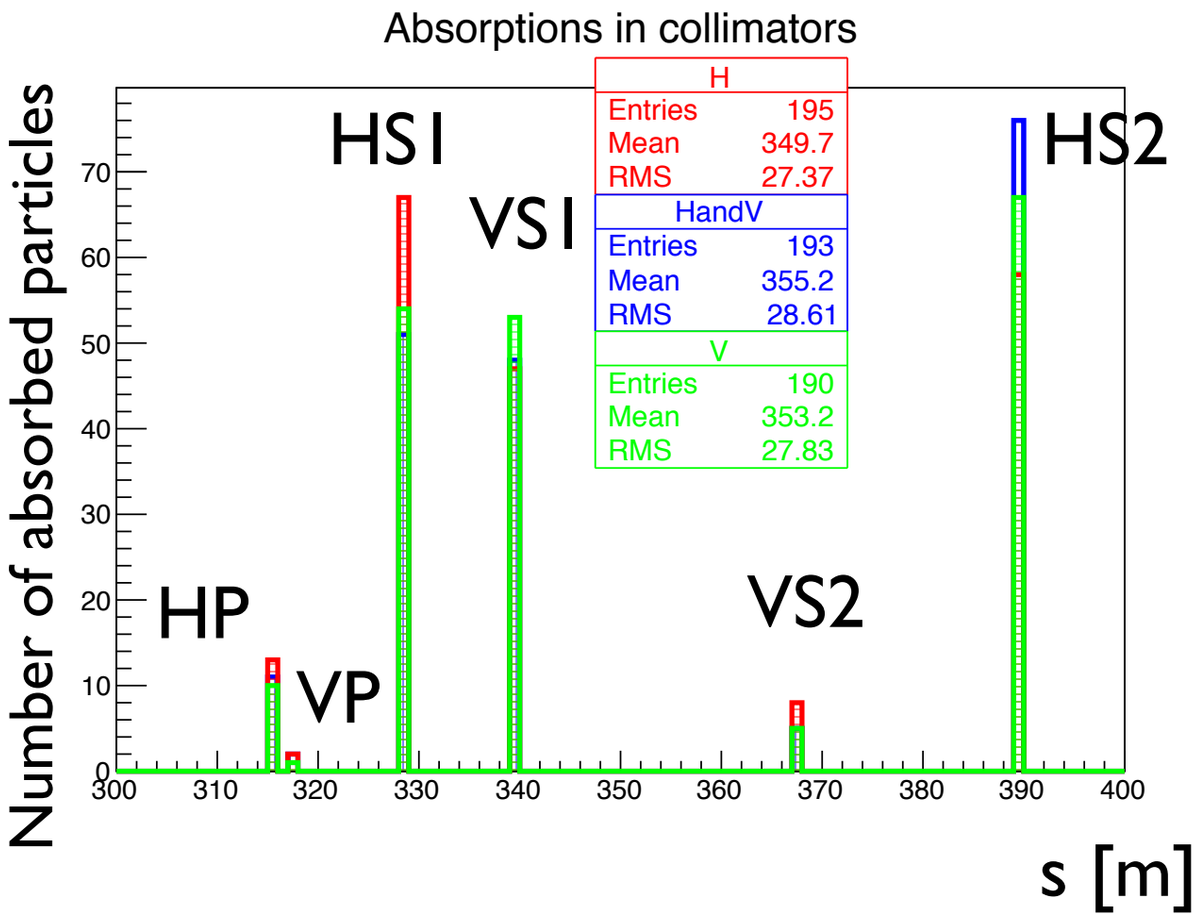
Results



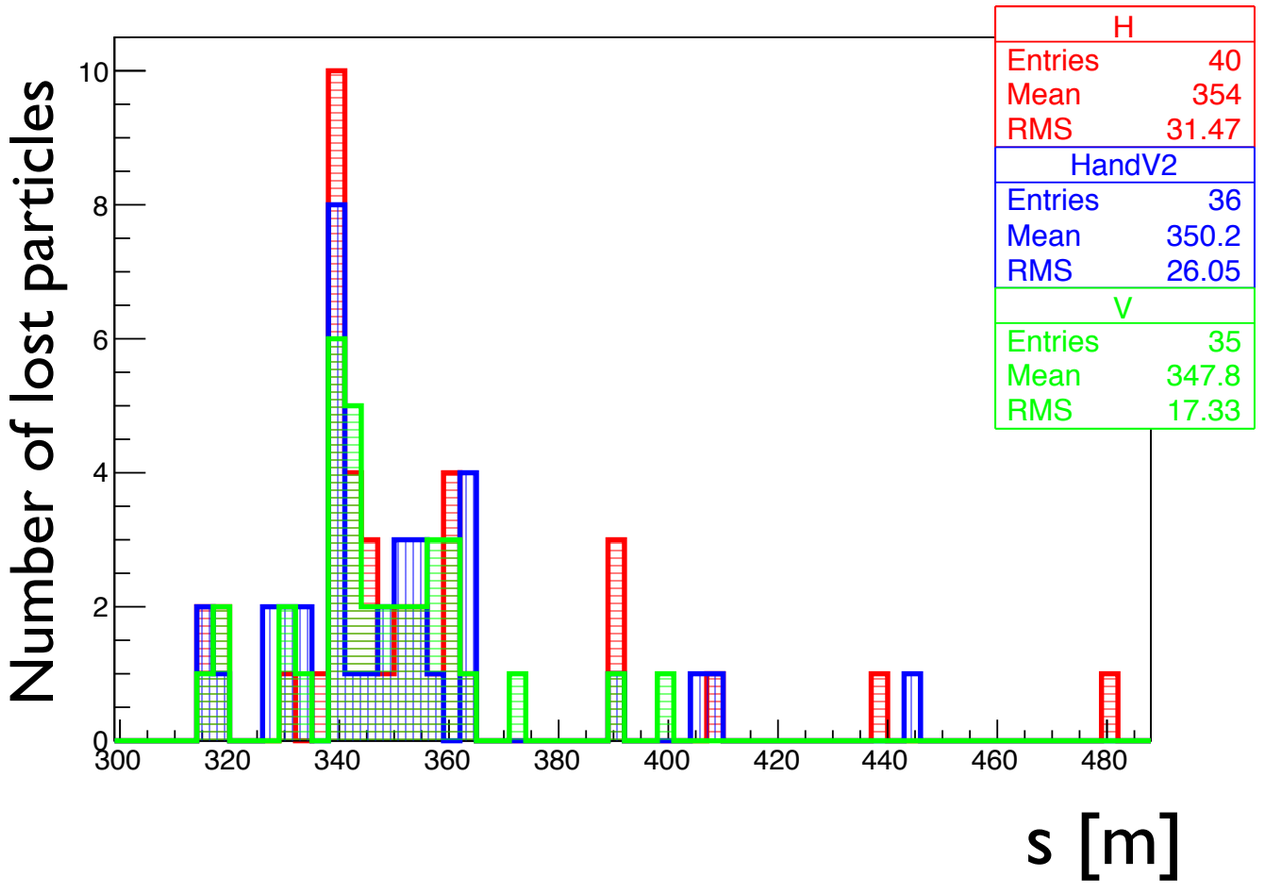


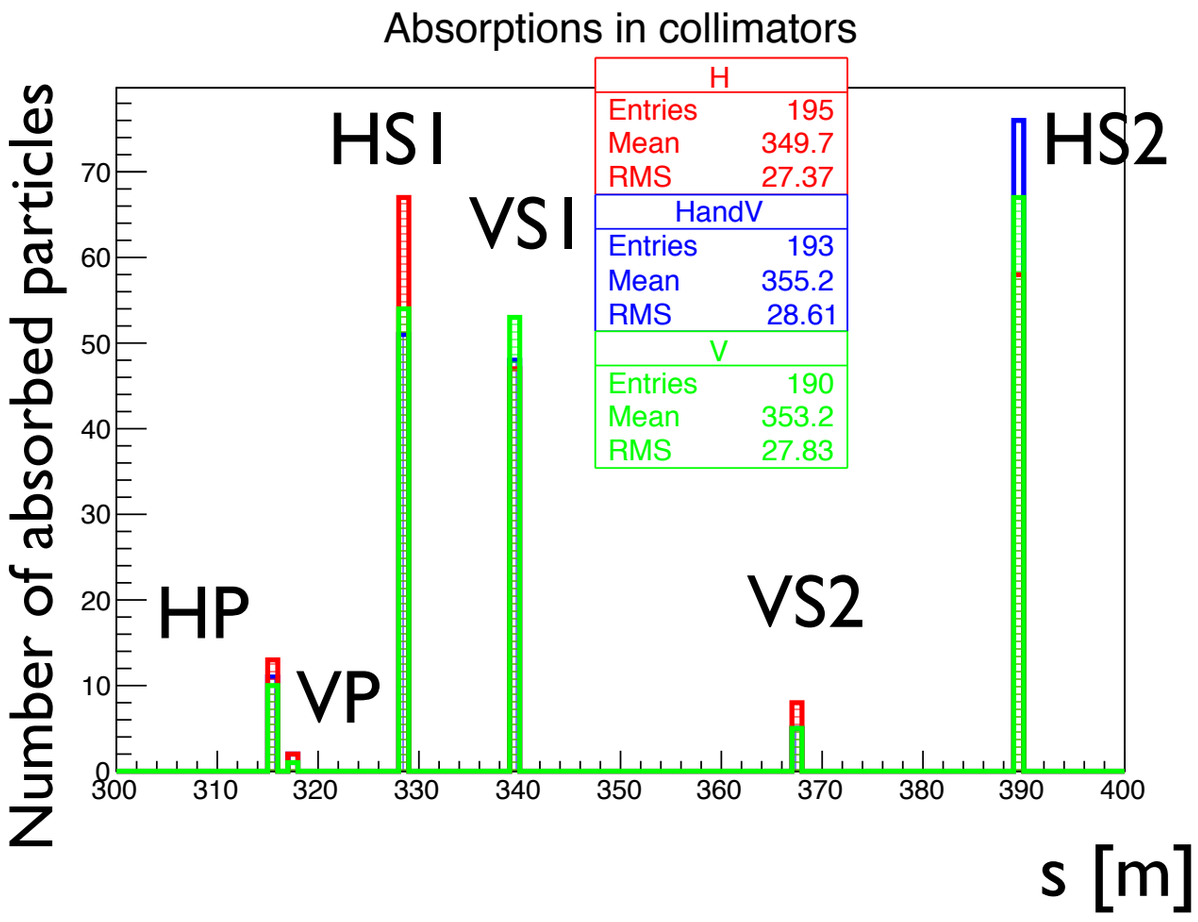
H: only H halo
HandV: H and V halo (equal size)
V: only V halo

Results

need to understand where do these losses come from (plot phase space with s)

why larger absorption in H collimator when there is V halo?





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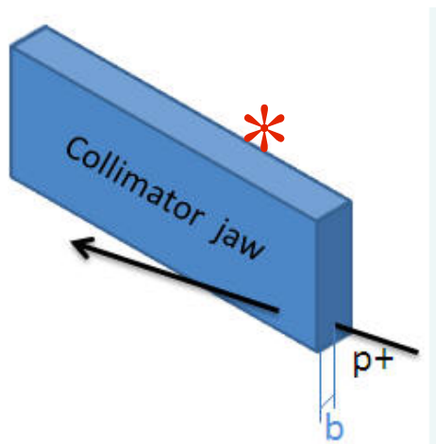
Next steps

- Find kick (θrms) as function of primary collimators' length
- Increase statistics
- Length traversed in the scatterer and kick received depends on impact parameter (b)
- Number of passages performed depend on length of scraper and impact parameter
- Scan length of primary collimators and find impact factor and length that results in fewer passes, i.e. at which length particles are absorbed in just ~5 turns (collimator efficiency)



*Tracking code for collimation studies:
http://lhc-collimation-project.web.cern.ch/lhc-collimation-project/code-tracking-2012.php

Thanks!
Any questions?