Halo Collimation Depth Using BDSIM

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- Halo Collimation Depth Studies
- Full BDS Collimation plans
- Example of BDSIM collimation capabilities
- Conclusion

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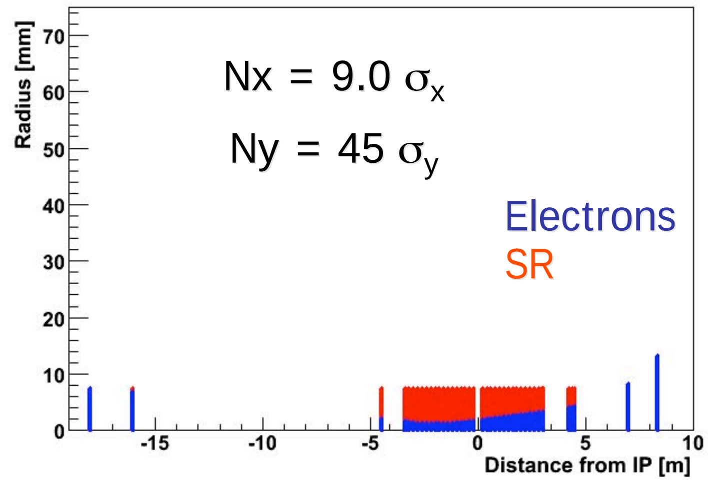
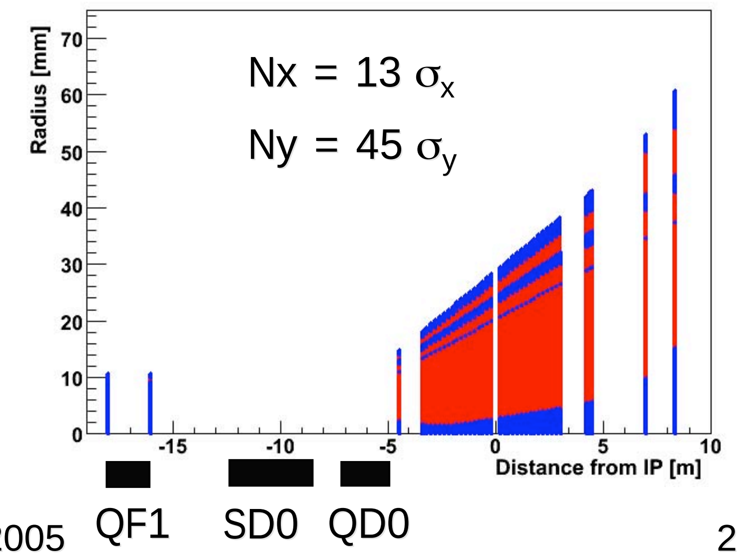
- Generate flat halo distributions at the entrance of the final doublet
  - Assumed Nominal 1TeV parameters @ IP:
    - β_x = 30mm, β_y = 0.3mm
  - 1% Energy spread on halo electrons
  - Track through LD solenoid field map, quadrupoles and sextupoles.
    - Full coupling between solenoid and quad/sextupole fields
  - SR Processes turned ON

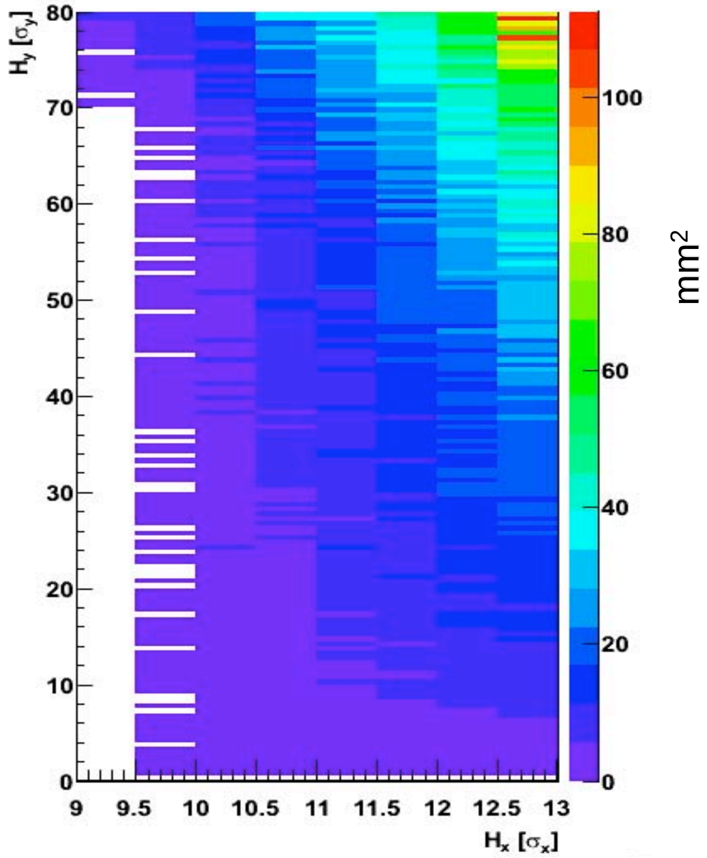


- Check halo material passes all apertures in the interaction region
- Have 3 main constraining apertures - QF1 pre-IP, BeamCal, QF1 pocket post-IP
- Find that incoming QF1 aperture (10mm radius) limits N_x to <13σ_x
  - N_x >= 13σ_x can travel through pocket relatively unfocused - but causes SR problems due to QD0



- Next limiting aperture is the BeamCal - assuming:
  - 15mm radius @ 4m from IP
  - 2mrad off axis w.r.t incoming beam - so halo material sees more of an elliptical shape
- Mapped out collimation depths from N_x = 9 to 12.5σ_x and N_y = 0.5 to 80σ_y in steps of half sigma
- Find:
  - N_x is limited to 9σ_x
  - N_y is limited to 69σ_y

Area of Halo SR distribution hitting BeamCal for N_x Vs N_y



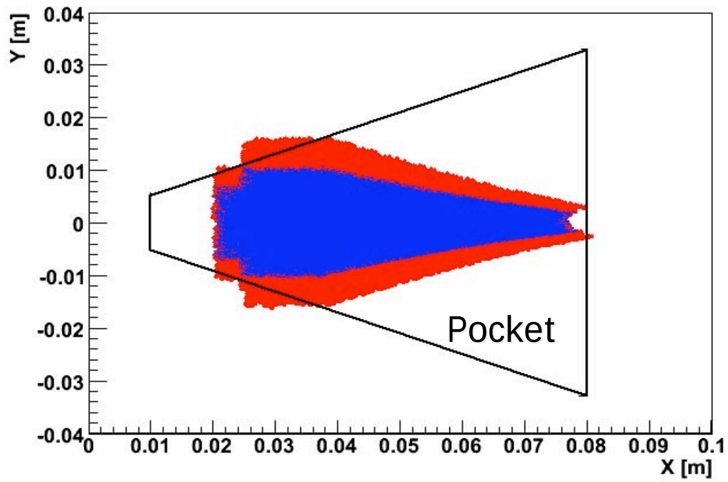
Halo Collimation Checks using BDSIM

- Next aperture is the QF1 pocket used for extraction
- Produced a similar collimation map as for BeamCal
  - Here assuming that the BeamCal radius is not an issue (hence higher N_x values)
- Assuming a requirement of NO hits on QF1:
  - $N_x < 9\sigma_x$ with $N_y < 45\sigma_y$

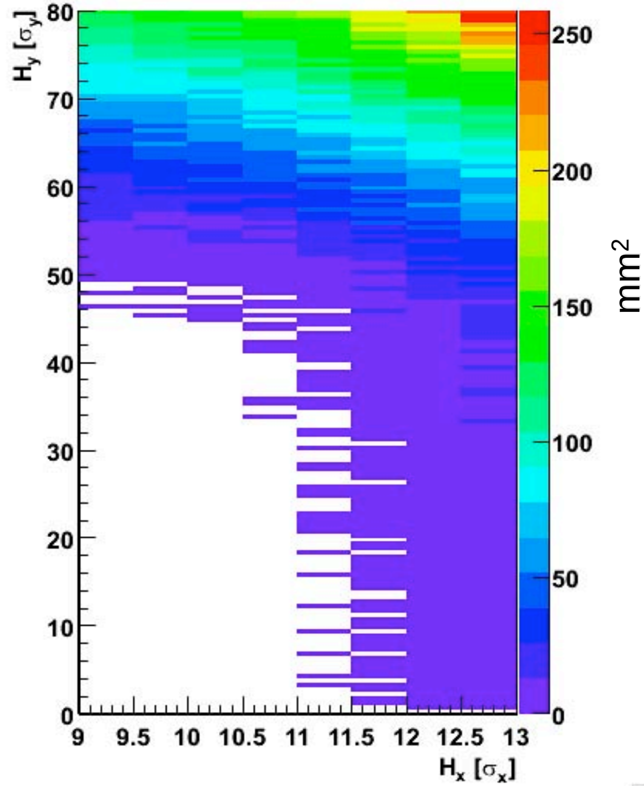
Halo Synchrotron distributions at QF1

Nx = 9.0, Ny = 45

Nx = 9.0, Ny = 68



Area of Halo SR distribution hitting QF1 for N_x Vs N_y

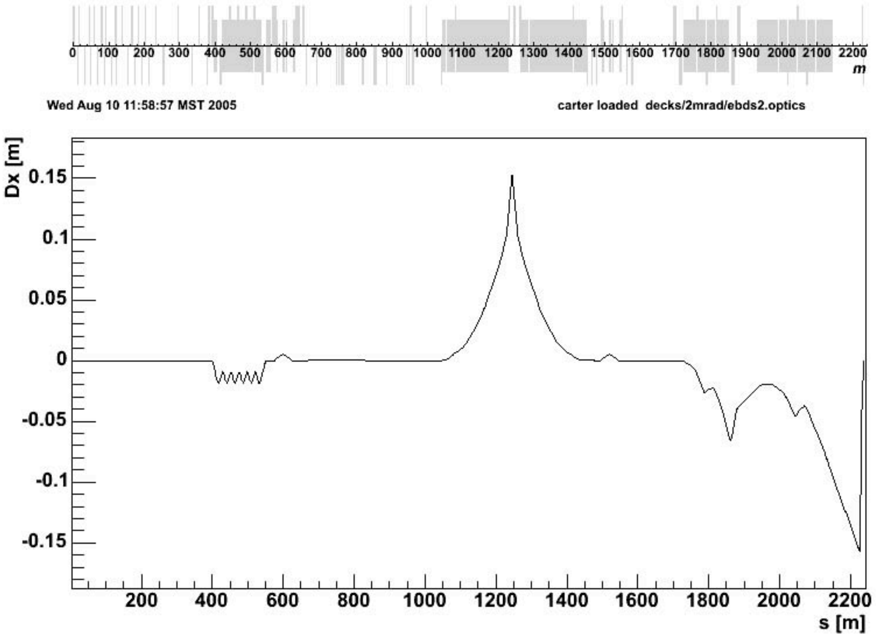


- Halo SR hitting QF1 post-IP may not be a serious issue for the VXD - increasing N_y to $68\sigma_y$ and firing 100,000 initial halo electrons showed no backscattered **photons** from QF1 reached the VXD.
- However, low energy secondary electrons created from photons hitting the QF1 wall **DO** leave hits in the VXD - currently investigating to what extent.

- Next step is to take 2mrad BDS deck from linac exit to final focus:

  www.slac.stanford.edu/~mdw/ILC/Beam_Delivery/20050316/ebds2.mad

- Use the "locally" computed halo collimation depth to set the collimators
  - Check collimation performance
    - Hard and Soft collimation
    - Collimation Vs Backgrounds in IR

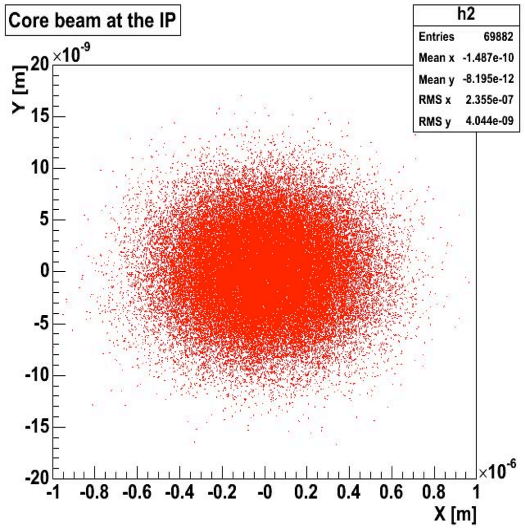


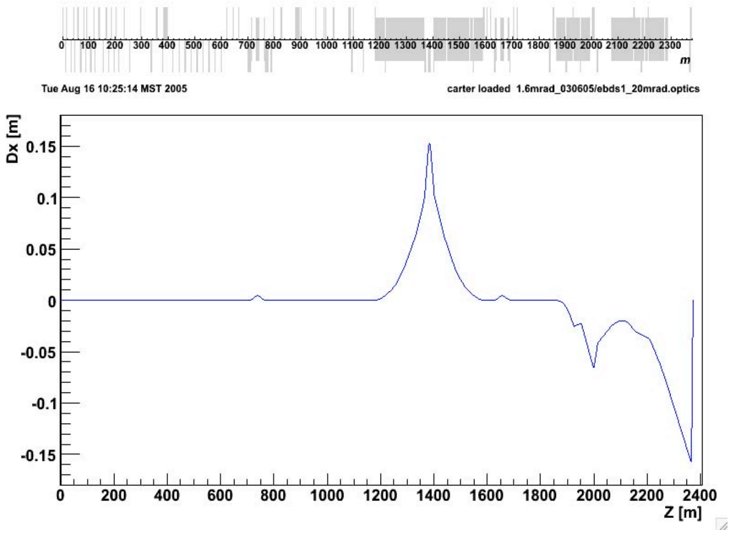
- In preparation for this, BDSIM has been modified to include the combined function magnets used in the large bend

Full BDS Tracking
Example of capability BDSIM using 20mrad

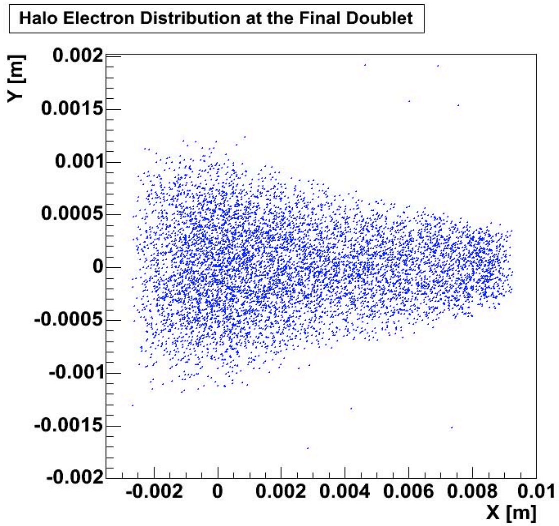
- Tracked core and halo particles along the 20mrad BDS from exit of linac to IP
- Using default collimation settings

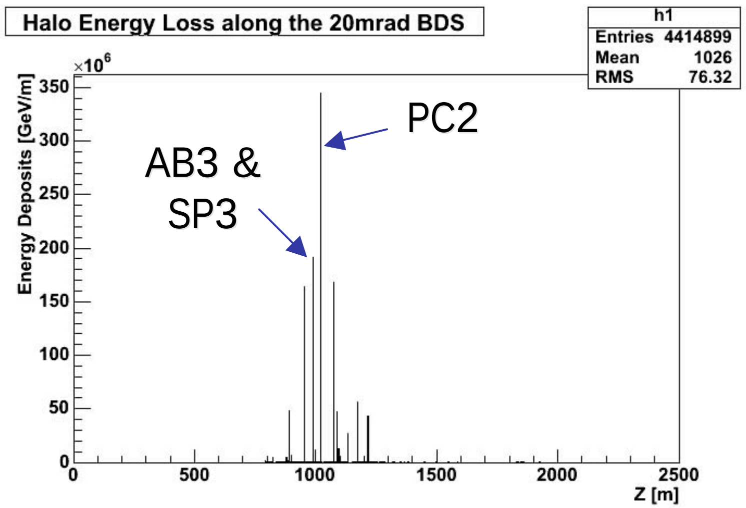
$7x10^4$ Core beam events fired.





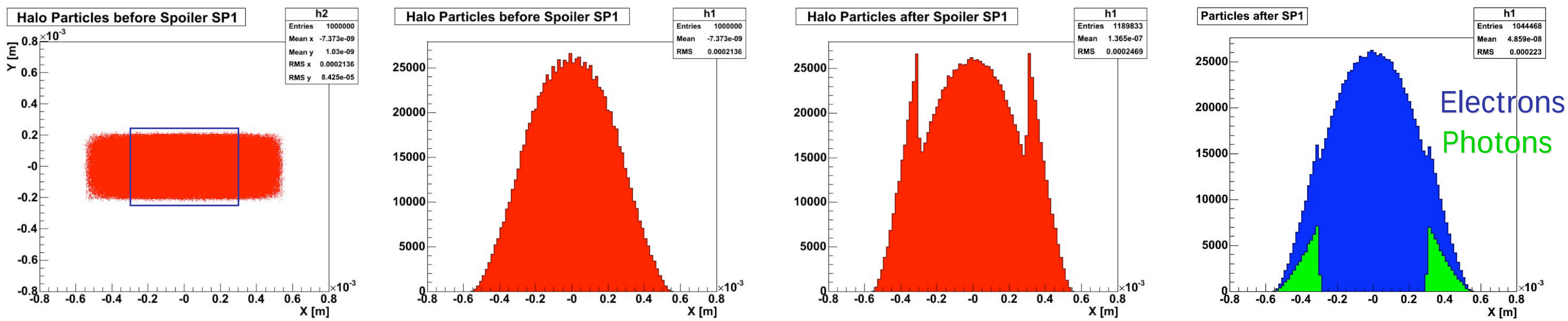
$1x10^6$ Halo events fired. Only $\sim 9x10^3$ reach FD



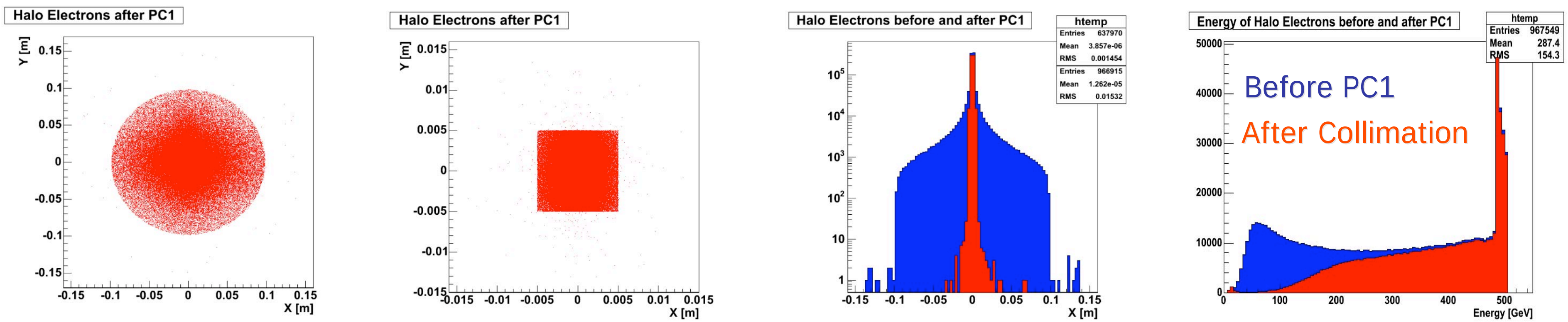


Full BDS Tracking
Example of capability BDSIM using 20mrad

- Check collimation before and after spoilers: (all plots for Halo simulation)



- Check energy collimation:



(E Cuts: 100 GeV for photons ,0.1 GeV for electrons. SR processes turned OFF)

Conclusions

- Halo Collimation Depth checks have been done for the new 2mrad crossing angle FD parameters using BDSIM.
  - The BeamCal radius looks to be the most constraining aperture
  - QF1 pocket can add a further complication if backscattering proves to be a major issue
  - Large events currently being run to increase statistics to fully check backscattering issues with this new 2mrad FD design
- BDSIM has been modified to now allow for a full collimation check using the entire 2mrad BDS
  - Addition of support for combined function magnets by creating improved steppers
  - Capabilities of BDSIM (w.r.t collimation issues) have been shown using the 20mrad BDS as an example
- Currently looking to modify BDSIM further to include support for vertical chicanes
  - Can then track synchrotron photons down the extraction line
- Plan to run a series of collimation crosschecks and tool benchmarking between BDSIM and MERLIN