Simulation of loss maps from dust particles

Collimation WG Meeting

Yngve Inntjore Levinsen
CERN and Univ. of Oslo

Helmut Burkhardt
CERN

30. August, 2010

Content

- Quickly present the beam-gas module in Sixtrack and the beam-gas simulations.
- Used the “beam-gas framework” to produce simulated loss maps from dust particles.

Beam-gas Module

- Sixtrack using the collimation tracking module extended with a "beam-gas module".
- In Mad-X, pressure markers are placed at locations you want the beam to collide with gas/objects.
- When these markers are reached, beam-gas subroutine called which changes the particle coordinates accordingly.
- The collision events are read from external file (simple ascii format), Monte Carlo simulation done with DPMJET.
- Written in this "astuce format" on top of current trunk, which means it can be submitted upstream if we are requested to do so..
- Available in git repository (beamgas branch): /afs/.../ylevinse/scratch1/public/git/sixtracksvn-git/

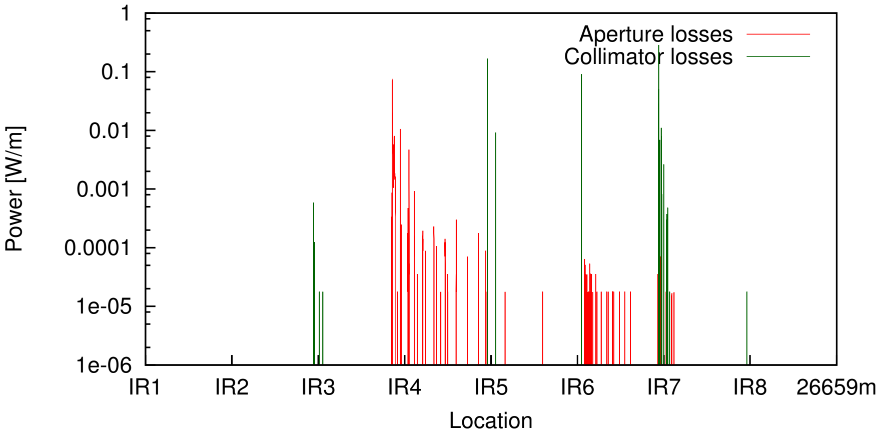
Dust Particles

- Seven (?) recent events initiated a beam dump, cause not known.
- Fast, dump level reached within $\sim 2\ \mathrm{ms}$ from start of loss signal.
- Looks like local events.
- In most cases, the beam dump happened in a stable period.
- Vacuum bump or the release of dust particles are suggested as possible causes.

Dust Particles

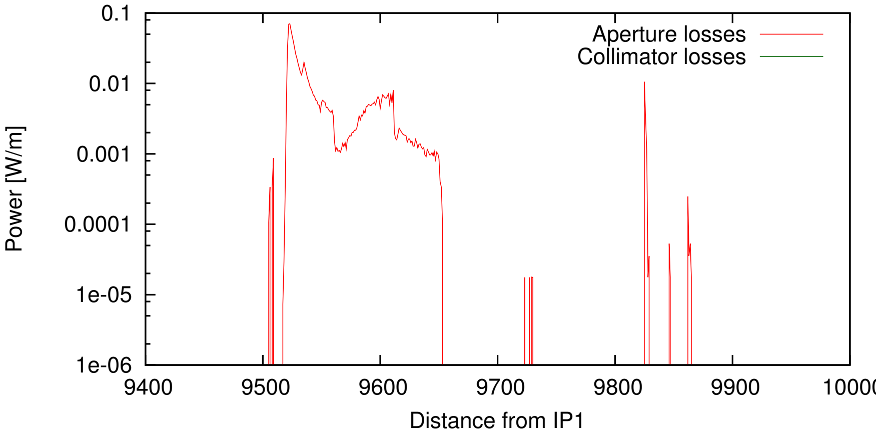
- Sixtrack with added beam-gas module is readily available with configuration to run both the simulation and most analysis on lxplus.
- By inserting these scattering locations manually at the location where we expect a local dust particle or other object, we can simulate loss maps from such an event.
- These loss maps can then be compared to actual data to see how well they agree.
- The events tagged as "event 3" and "event 4" are simulated so far, both originating on beam 1.

- The simulation does not assume a “specific” obstacle type/shape, could be e.g. local vacuum bump as well.
- We simulate proton on proton at rest. Should be good enough for a first approximation.
- We use $\beta^* = 2\ \mathrm{m}$ optics, with TCT's at 15 σ.
- Assume 10^7 collisions with the object, to get some meaningful vertical axis.



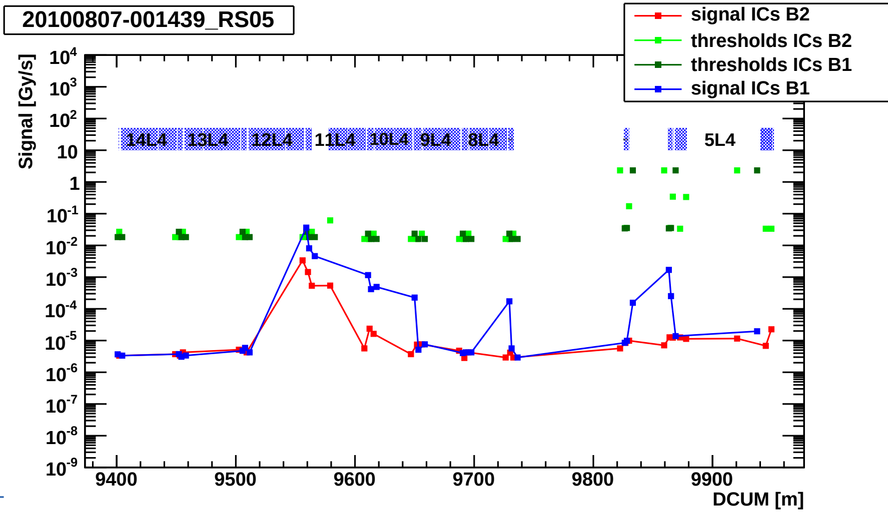
Global losses around the ring

Dust Particles, Case # 3



Local losses downstream of “obstacle point”

Dust Particles, Case # 3

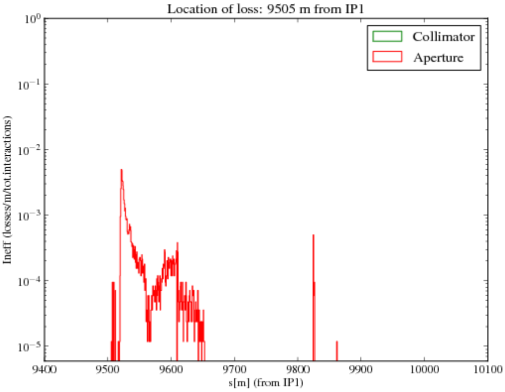


Measurement (Annika Nordt)

Location of loss

It was suggested to try to move the location of the losses slightly, to see how well we would know the origin of the event.
To first order, it seems that we do not see much differences from different locations between two dipoles.
The first loss spike seems to come at the first dipole downstream of the location we choose.

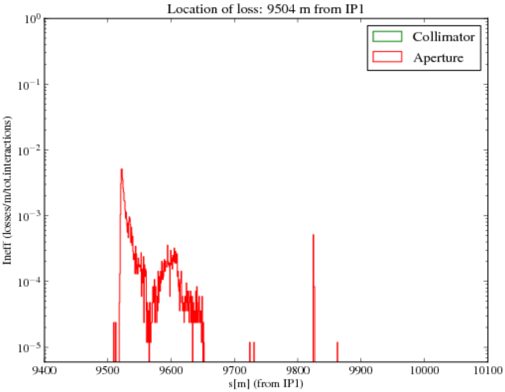
Location of loss



Loss maps from different locations

Skip

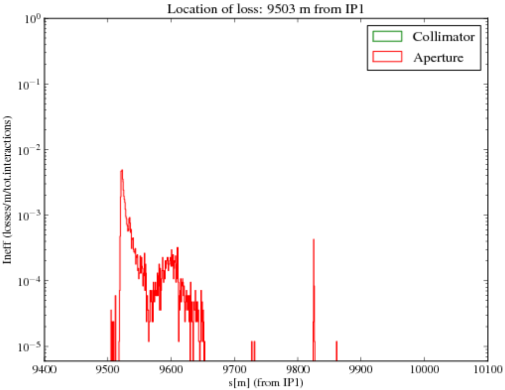
Location of loss



Loss maps from different locations

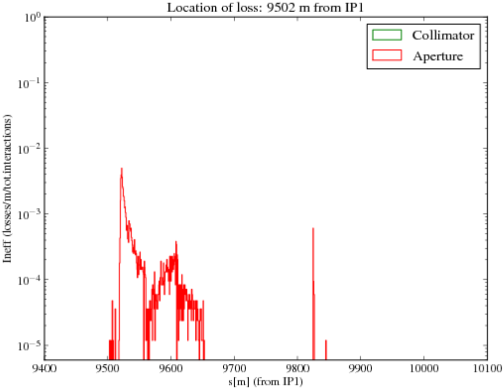
▸ Skip

Location of loss



Loss maps from different locations

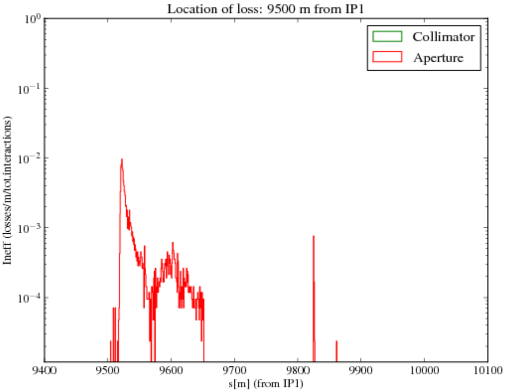
Skip



Loss maps from different locations

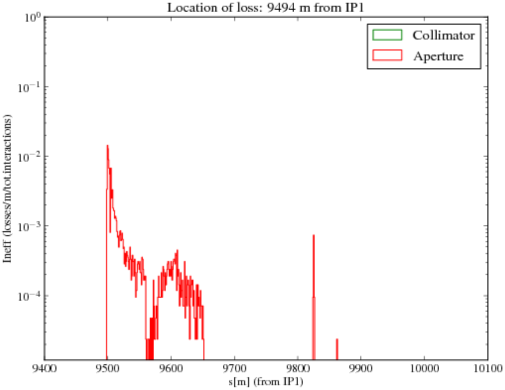
Skip

Location of loss



Loss maps from different locations

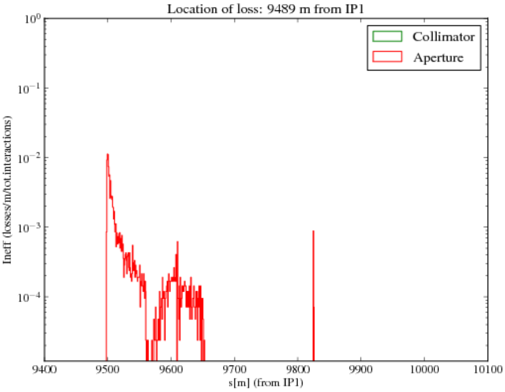
Skip



Loss maps from different locations

Skip

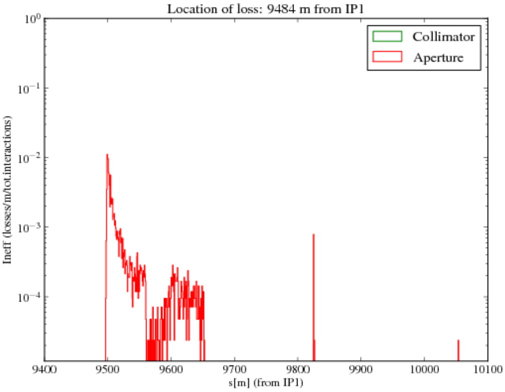
Location of loss



Loss maps from different locations

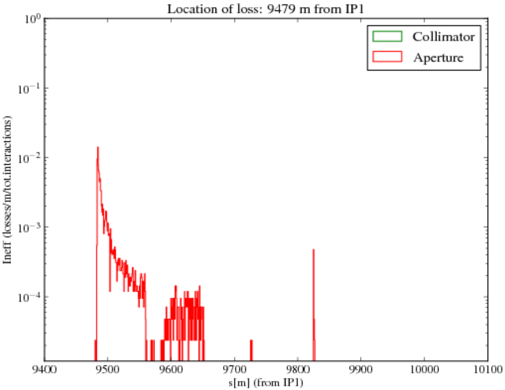
Skip

Location of loss



Loss maps from different locations

Skip



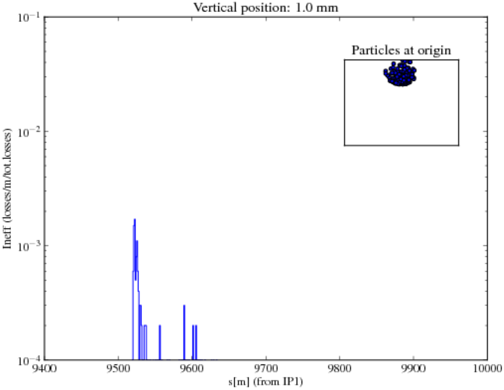
Loss maps from different locations

Skip

Time dependency

- Since we save all information about loss origin (necessary when we want to rescale loss maps for adjusted pressure maps etc.), we can get “timed loss maps” from an object falling through the beam.
- In certain cases, it was shown that some BLM signals were delayed. This could potentially be coming from a dust particle touching different parts of the beam (?).

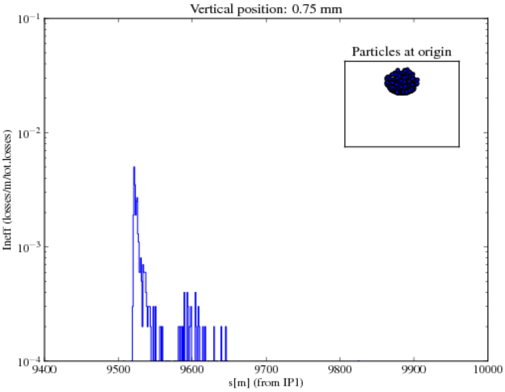
Time dependency



Particle falling through the centre of the beam.

Skip

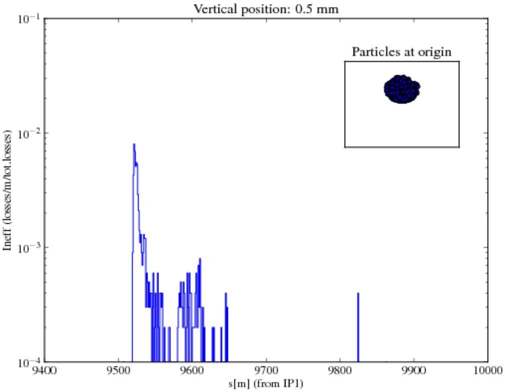
Time dependency



Particle falling through the centre of the beam.

▸ Skip

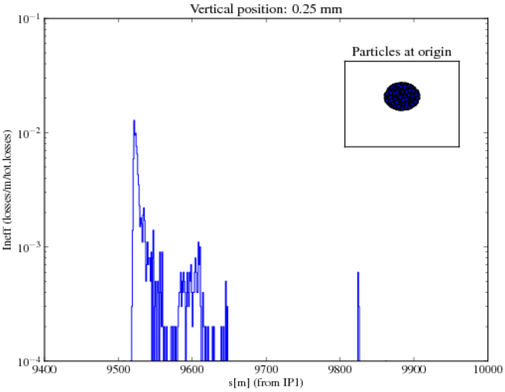
Time dependency



Particle falling through the centre of the beam.

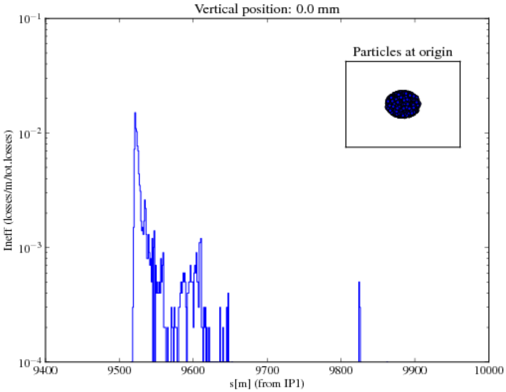
Skip

Time dependency



Particle falling through the centre of the beam.

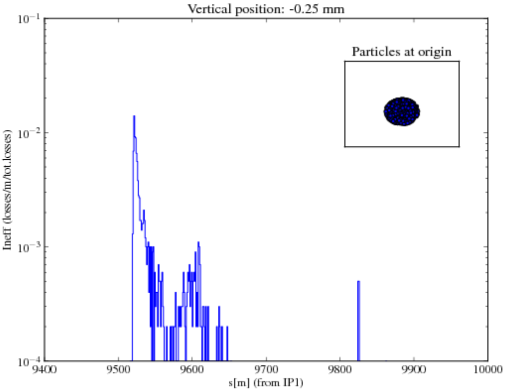
Skip



Particle falling through the centre of the beam.

Skip

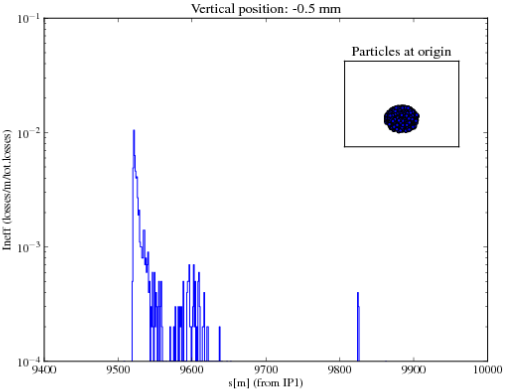
Time dependency



Particle falling through the centre of the beam.

Skip

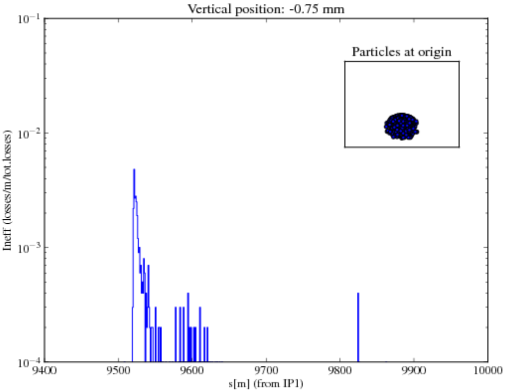
Time dependency



Particle falling through the centre of the beam.

▸ Skip

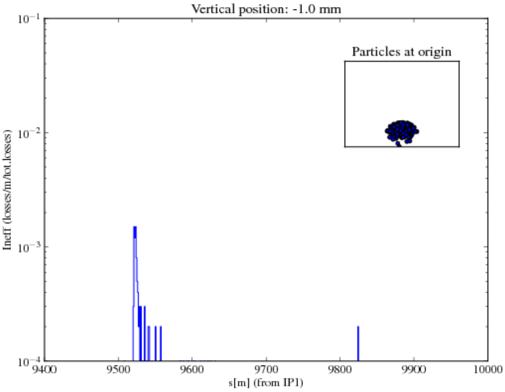
Time dependency



Particle falling through the centre of the beam.

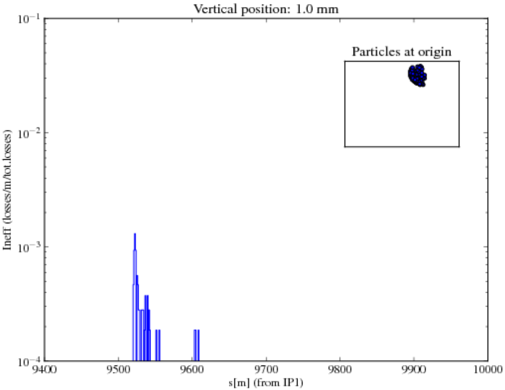
Skip

Time dependency



Particle falling through the centre of the beam.

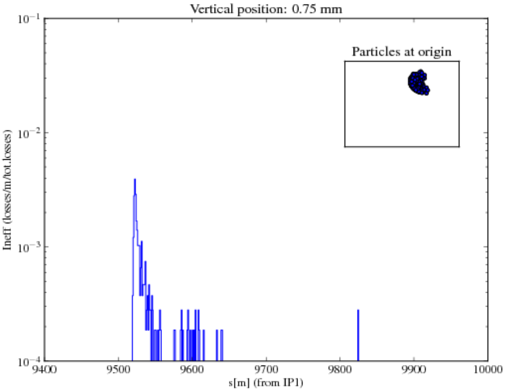
Skip



Particle falling through the beam on one side.

Skip

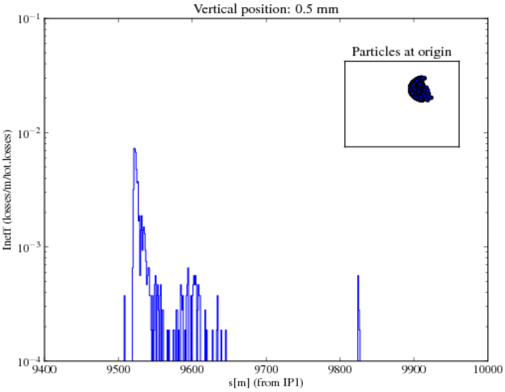
Time dependency



Particle falling through the beam on one side.

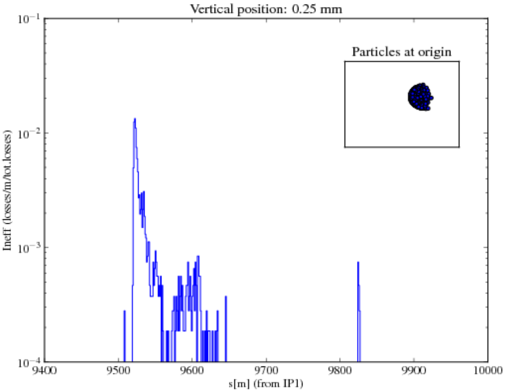
Skip

Time dependency



Particle falling through the beam on one side.

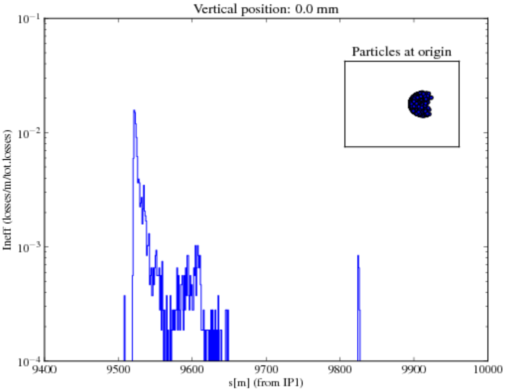
Skip



Particle falling through the beam on one side.

Skip

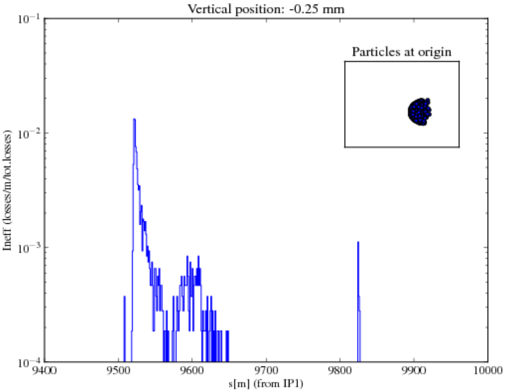
Time dependency



Particle falling through the beam on one side.

Skip

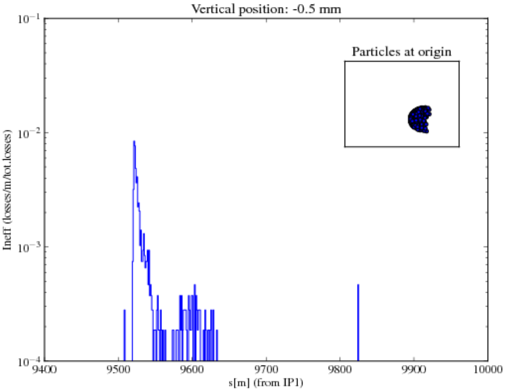
Time dependency



Particle falling through the beam on one side.

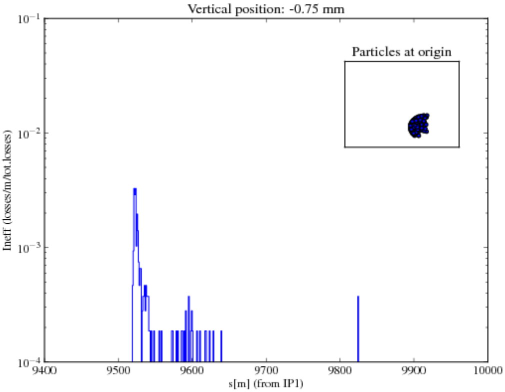
▸ Skip

Time dependency



Particle falling through the beam on one side.

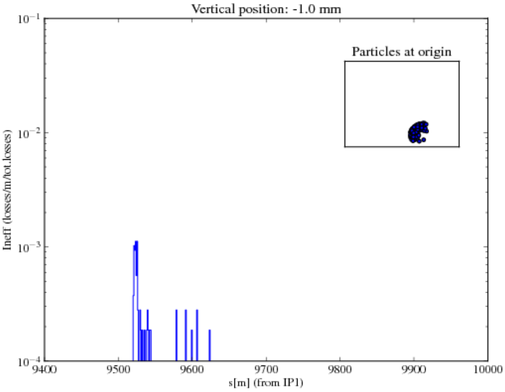
Skip



Particle falling through the beam on one side.

Skip

Time dependency



Particle falling through the beam on one side.

Skip

Summary

- Two cases simulated so far.
- To first order, the simulated and measured loss maps look similar.
- Pinpointing the location of the loss seems to be limited by the distance between dipoles.
- We might learn more by studying time dependencies.
- This study will be extended with simulation of loss maps from laser wire scans. This will be a good benchmark of the beam-gas module and valuable to the machine protection studies.