Synchrotron Radiation background simulation

Status

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DESY

Impact of Misalignment and Beam Halo on PXD occupancy

Preamble

1. Generation of primary charged particle (beam) and simulation of SynchRad photon emission during propagation of initial particles through magnetic field (primary simulation, GEANT4 based) requires very large (unreal) CPU to get full picture of synchrotron radiation background (needs to generate hits in a few ROF to observe scattered photons).

An idea to generate only SynRad photons using vertex information for SynRad photons from primary simulation has been actualized (PV,YS) and speedup significantly the simulation.

Primary simulation is performed every time when geometry (lattice,beam pipe design etc.) is changed. Output of primary simulation is transformed into HEPEVt file which is used as input for the next step of simulation (occupancy estimation,creation of the background files etc).

2. Estimation of PXD occupancy and creation of background files for ideal alignment of the central beam pipe has been performed. Cross check: PySynRad (AM python based) and GEANT4 based approaches gives similar results for PXD occupancy (with the same lattice files).

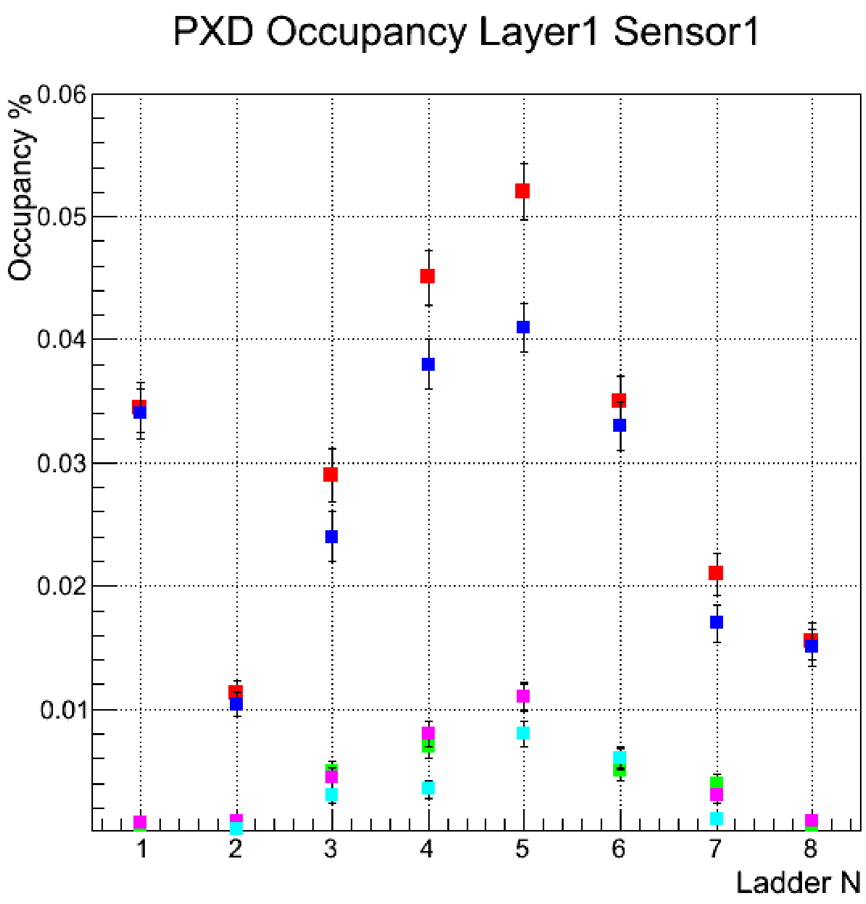
Recently I have found the way how to modify *GeoBeamPipeCreator.cc* code, which I seem to have missed earlier, to include misalignment of central beam pipe in the simulation → PXD occupancy with misalignment.

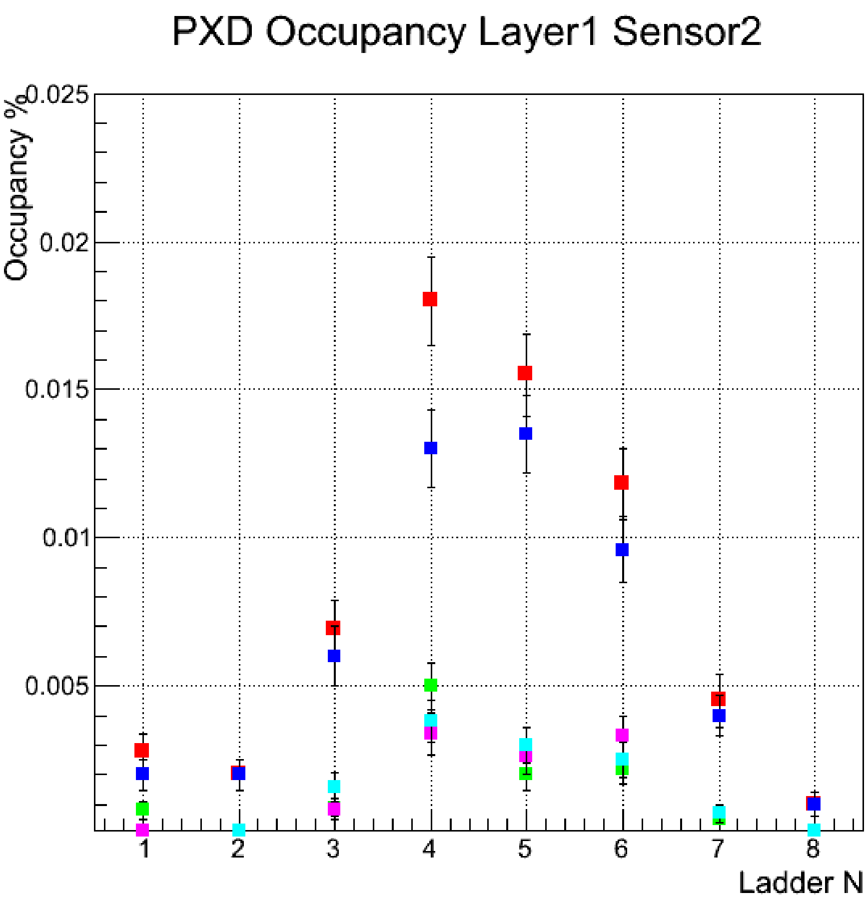
3. Beam Halo.
Conservative estimation:
Uniform halo – 2D circular flat distribution of (X,X')/(Y,Y') in normalized coordinates with radius ***20****√**εx/εy** (half width = 20σxy of the core).
Normalization factor - assuming that fraction of tails beyond 10σxy = 1e-5 of the core. (KEKB TDR)
The fraction of tails beyond 10σx and beyond 30σy estimated from beam-beam simulation for SuperKEKB ≤ 5e-7 of the core.

All results correspond to 4ROF (80μsec), for HER.

PXD occupancy Layer1

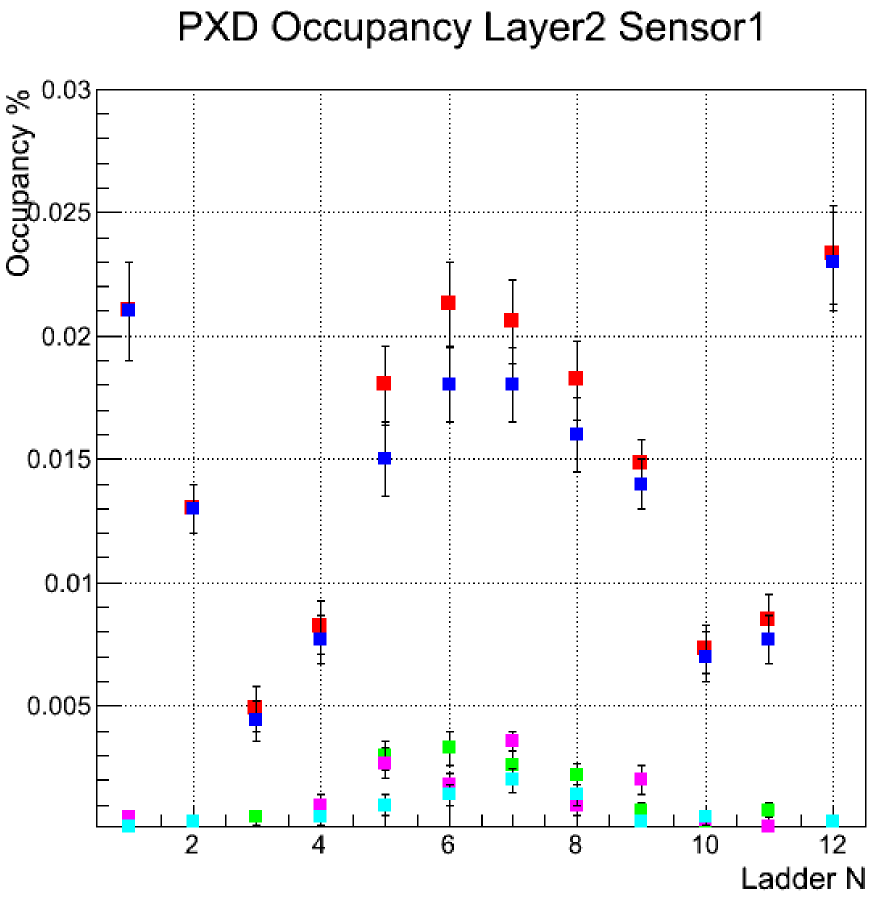
Color Code
Ideal alignment
Misalignment -0.5mm
Misalignment +0.5mm
Uniform Beam Halo
Total =Ideal + Uniform Halo

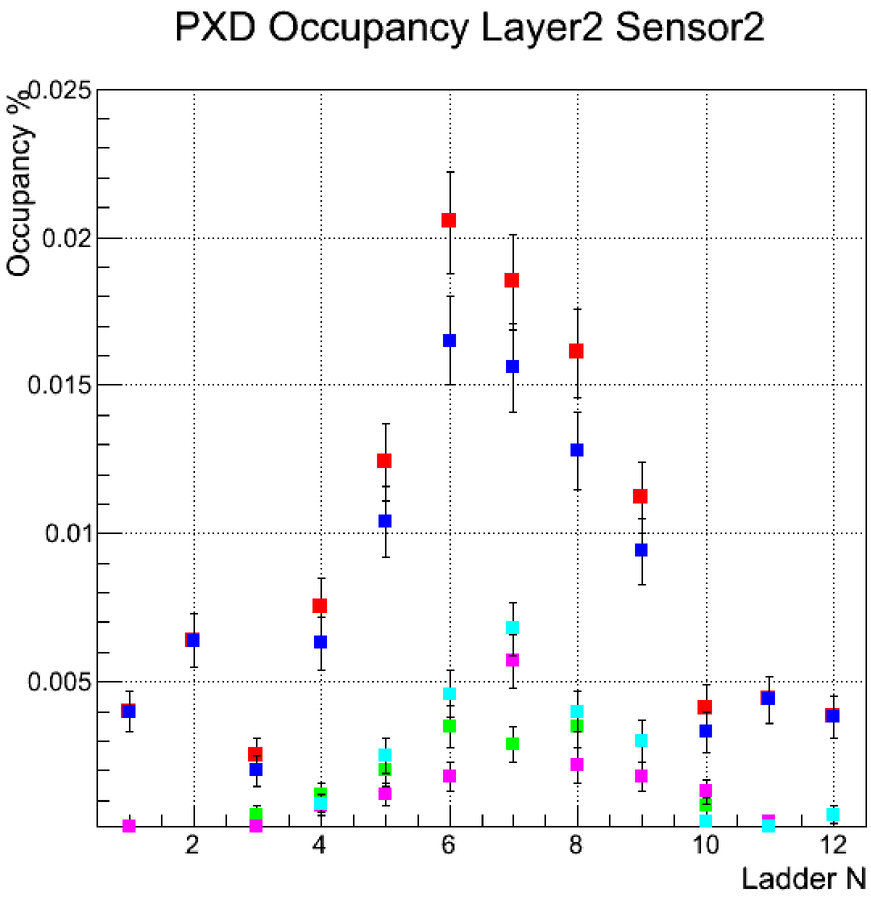




PXD occupancy Layer2

Color Code
Ideal alignment
Misalignment -0.5mm
Misalignment +0.5mm
Uniform Beam Halo
Total =Ideal + Uniform Halo





Conclusion

Maximum expected occupancy

1. PXD occupancy for the beam core - **~(0.011 ± 0.001)%** at φ ~ π,both for ideal and misalignment cases.

2. Contribution of Beam Halo tails :
   (0.041 ± 0.002)% , assuming fraction of tails beyond 10σxy = 10e-5 (KEKB TDR), (conservative estimation).
   (0.0021 ± 0.0001)%, fraction of tails beyond 10σxy = 5e-7 (beam-beam simulation) at φ ~ π.

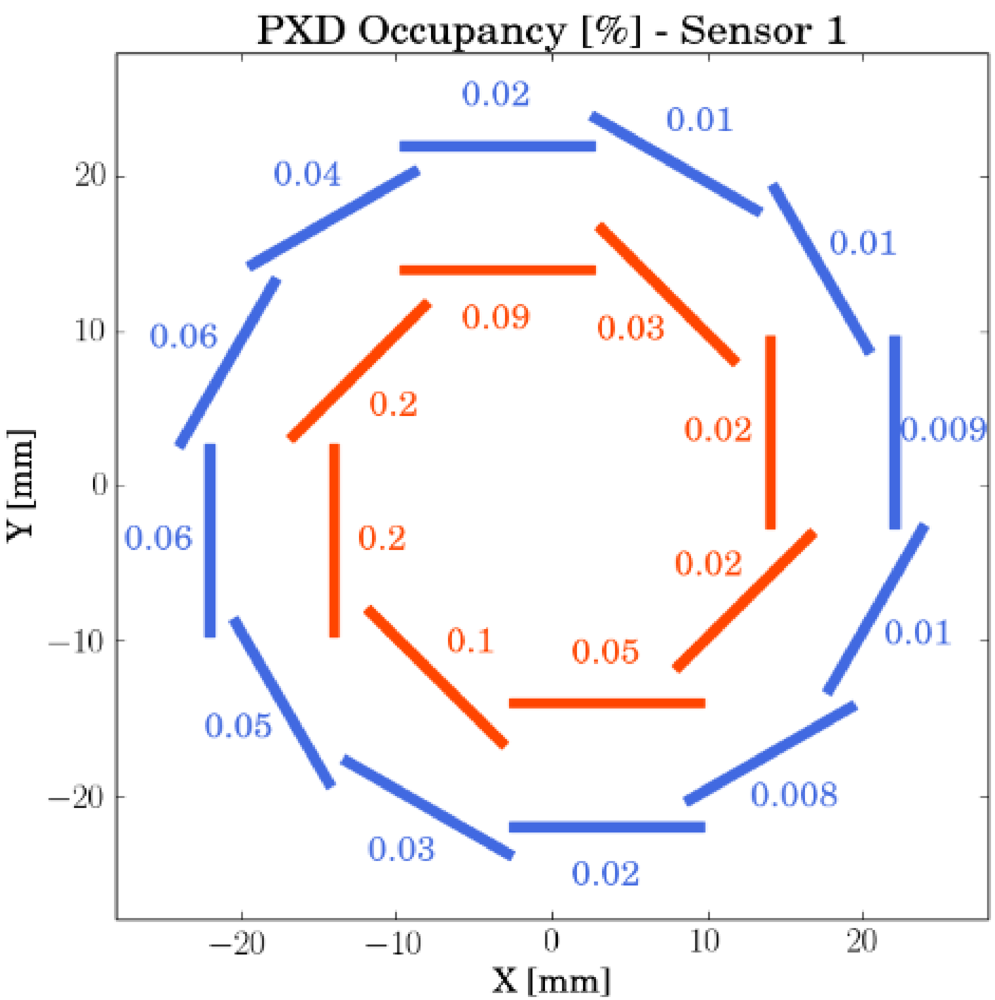
3. Total occupancy: **(0.052 ± 0.002)% (**conservative estimation).

Thank you for your attention

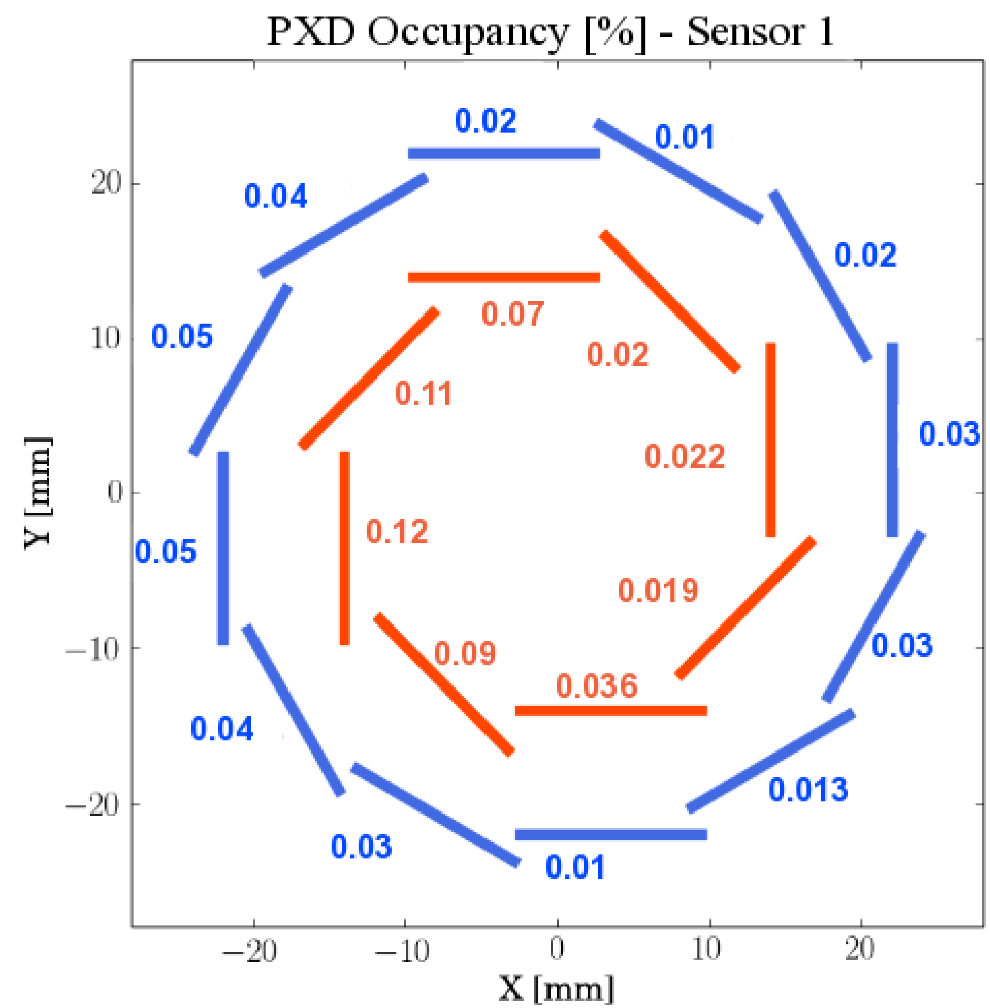
Additional material

Forward sensors

PySynRad

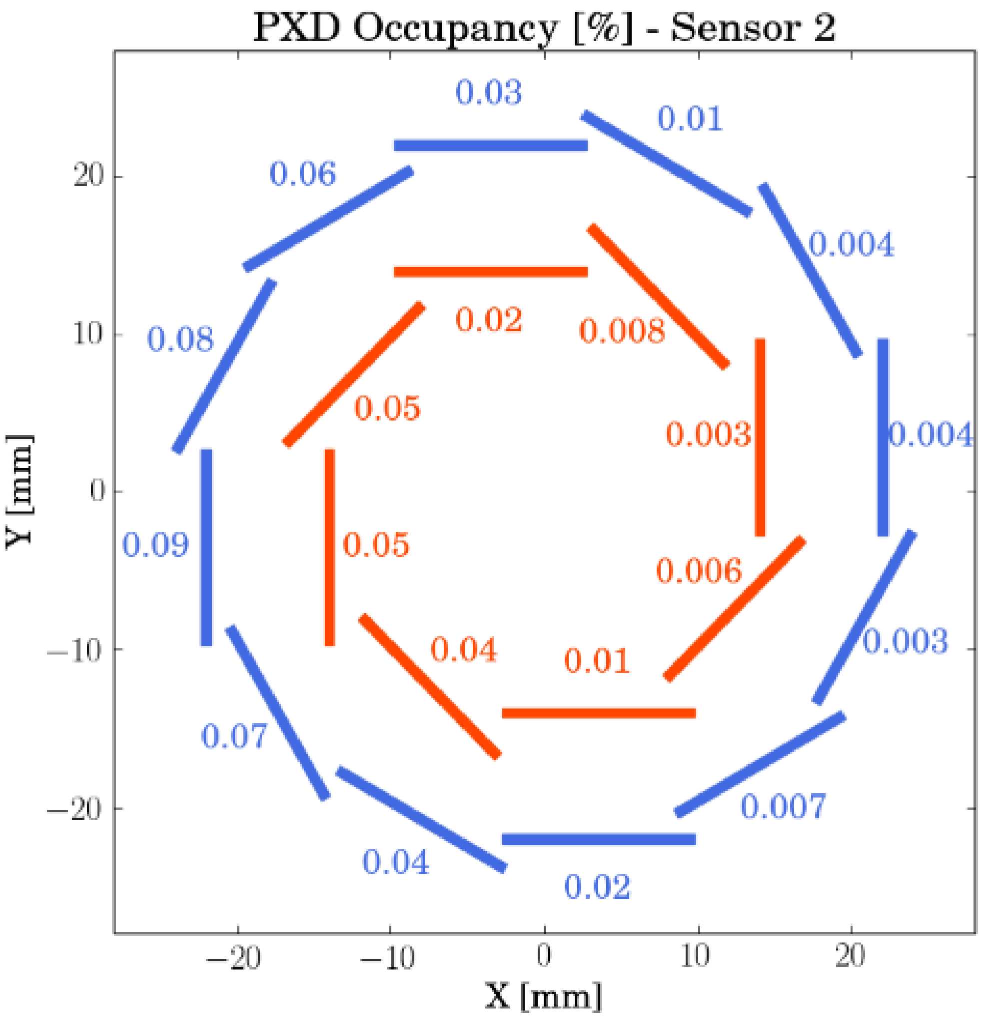


GEANT4
with lattice from PySynRad

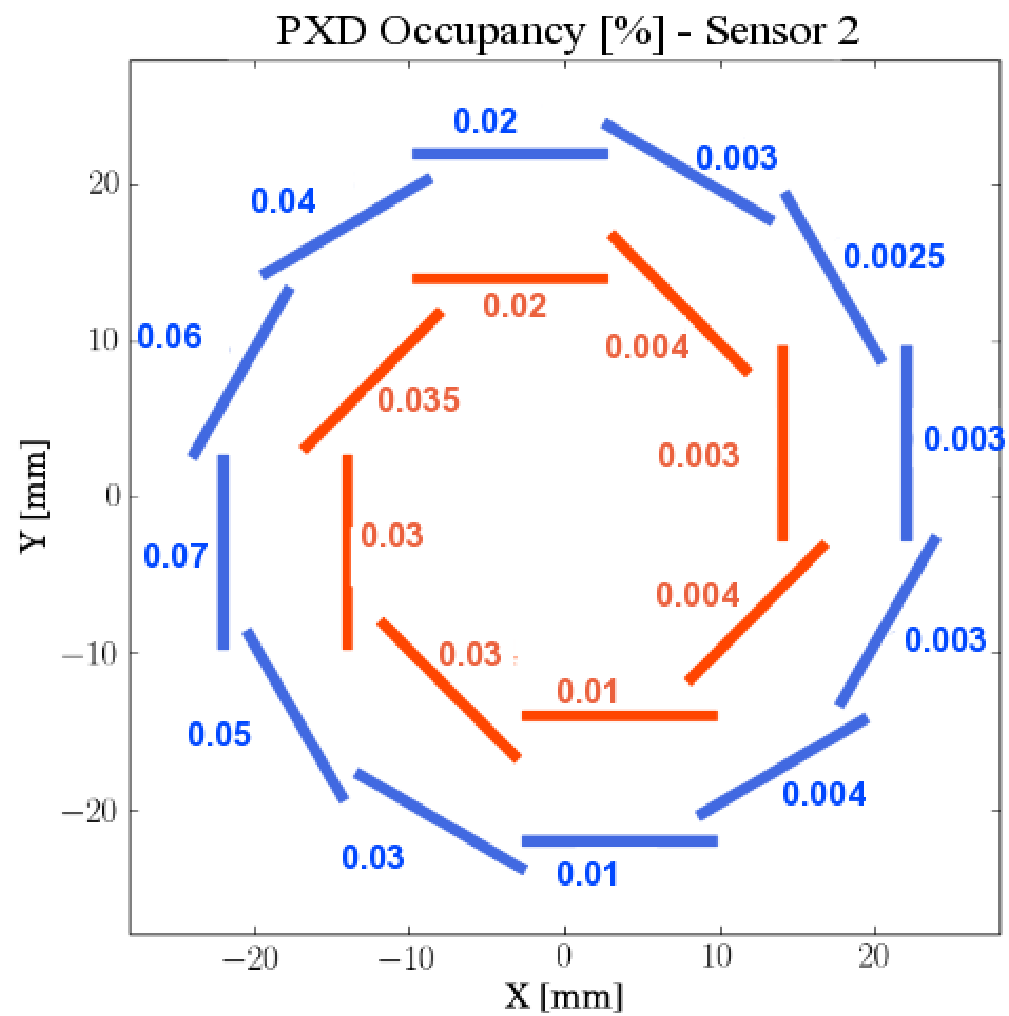


Backward sensors

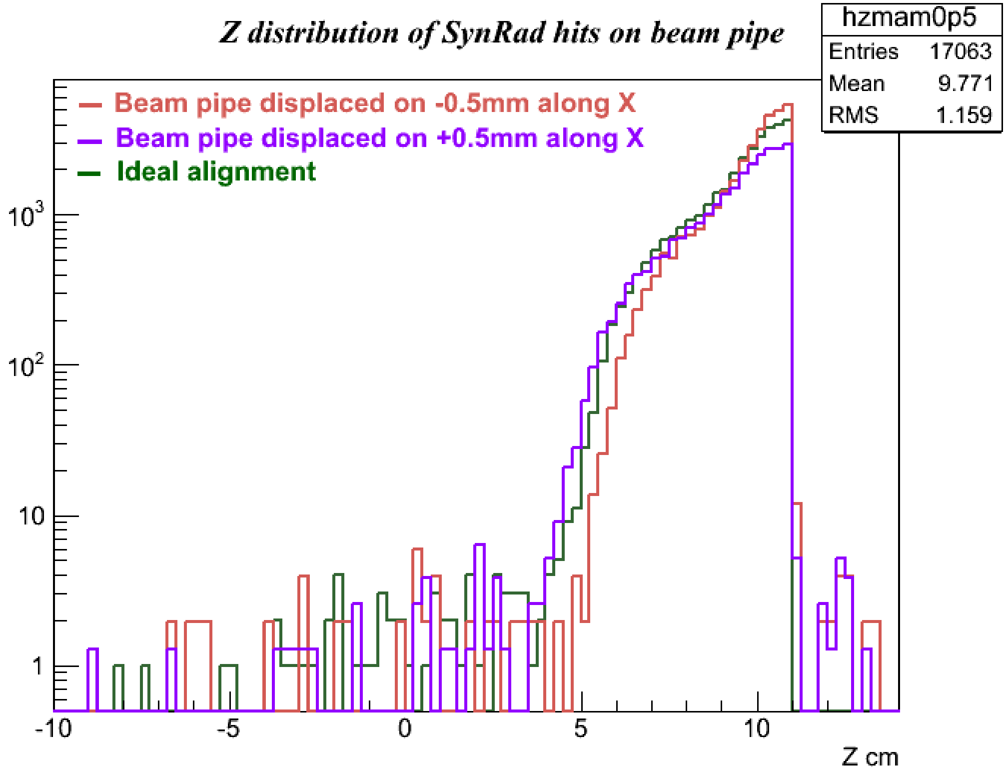
PySynRad



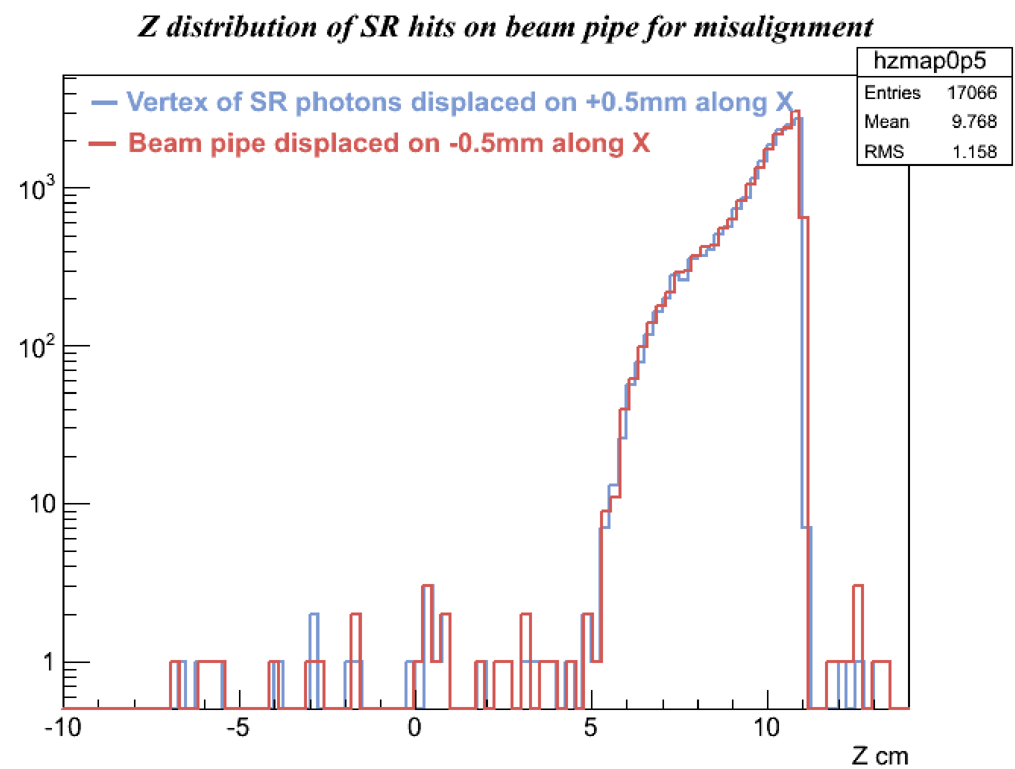
GEANT4
with lattice from PySynRad



Misalignment – Z distribution of hits



Ideal alignment versus misalignment



Control plot