

SVT Background study using FullSim



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Goal for this background study

- Plots of significant background quantities:
 - **Hits frequency** (Mhz/cm²), occupancy
 - **Equivalent fluency of 1MeV neutron** (cm⁻²), bulk doping and inversion
 - **Radiation Dose** (Mrad), damage to electronics
- ... vs geometrical parameters:
 - SVT Layer0 inner radius
 - Beampipe inner radius
- Note: only electrons and positrons (primary and secondary), but not photons, are taken for computing bkg quantities

FullSim version and geometry

- **Bruno v00-01-04, r247**
 - Only Svt code has been committed
- **Geometry:**
 - Beampipe (BP) thickness: 1mm
 - SVT Layer 0 is a tube, not a pin-wheel
 - SVT L0 length 10 cm, thickness 300um, Rmin 1 cm
 - BaBar SVT
 - Gold foil outside BP: 10um
 - BP and L0 centered at $z = 0$

Background events

- **Beam-strahlung (radiative Bhabha's)**
 - 1k evts
 - Processing time: 30 evts/hour
 - Generator embedded into Bruno
- **Pairs production**
 - 40k events
 - External standalone generator
 - Processing time: 10k evts/hour
 - Main known bkg for SVT
- Not a big statistics for Svt outer layers and Dch
- More events can be generated or any other bkg events, if readable by Bruno, can be used to produce easily the same plots

Clean-up, fixes and additions

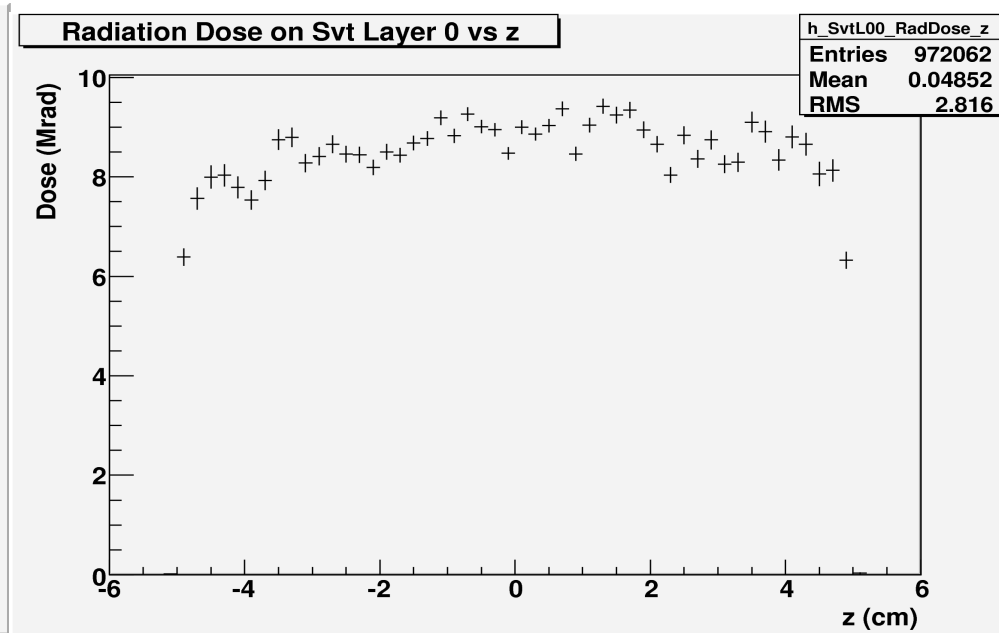
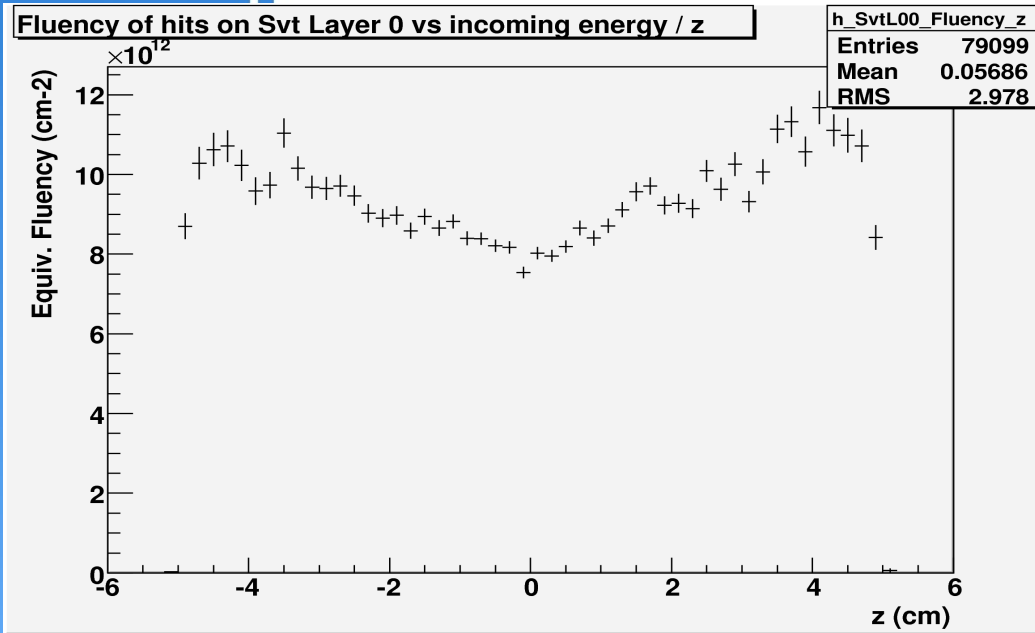
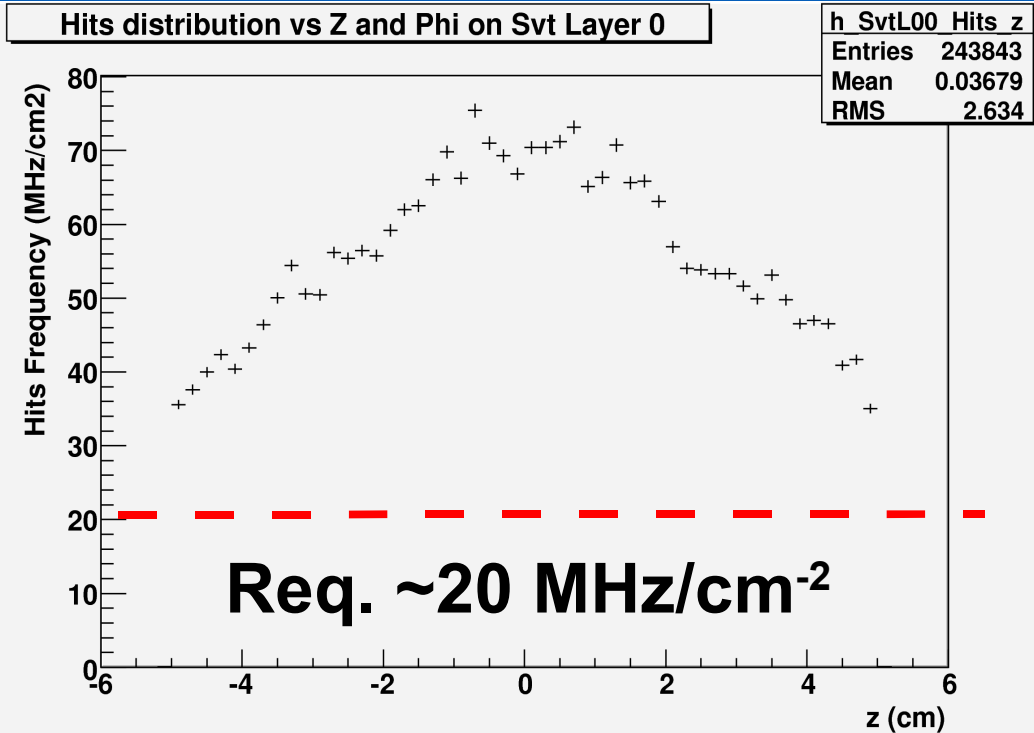
- Main geom parameters to be changed written in a single file, **SuperB_constants.xml**, included in different GDML modules
- Geometrical par's, like L0 radius, can be written into the Root file as TParameter
- G4 geometry tolerance set to main volume size to avoid crashing jobs
- Geometry checked for overlapping over all the volume levels:
 - Output file @CNAF:
/home/BABAR/cenci/simu_sb/Bruno/out/geomtestfull/geomtestfull_090930.log
 - Problems in SVT, many from EMC (visualization problem with HepRep), still need to go through it

Bruno Hits

- Hits stored corresponds to G4Step
- Many similar classes for different subsysts, starting to write a common class and derive specific ones when needed (not yet in repo)
- **Bruno hits**
 - Starting point coordinates, time, step length, incident and released energy, particle and track ID
- **SVT hits**
 - BrnHits plus Svt layer
 - Merging hits in the same pixel/strip 50x50um
 - Additional methods of MyRootSvtHit for checking hits distance (pixel size can be changed without running Bruno again)
 - First results compatible with Eugenio's plots filled during Bruno running

SVT Results

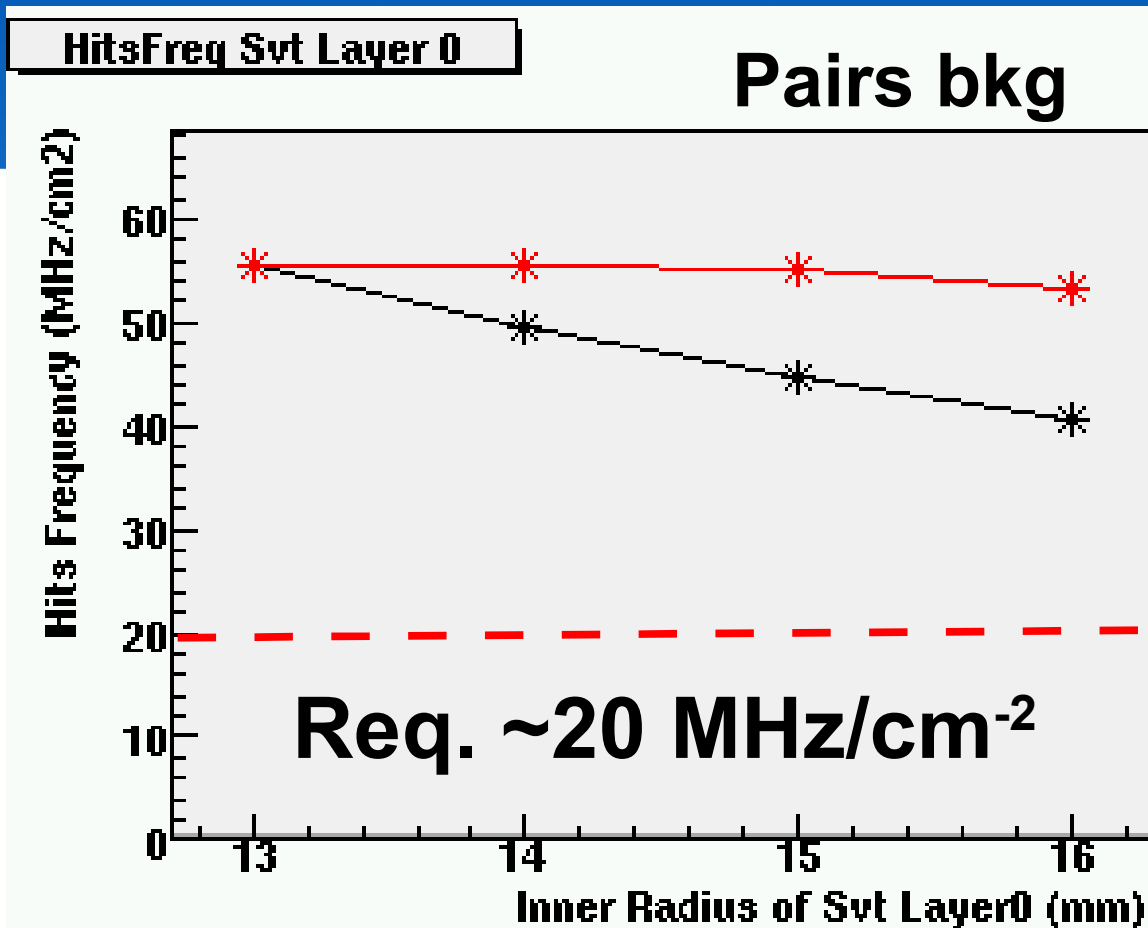
- Basic configuration
 - BP @ 10mm
 - L0 @ 13 mm
- Z on x axis



- All the considerations from here made with a **safety factor of 5**

SVT Results

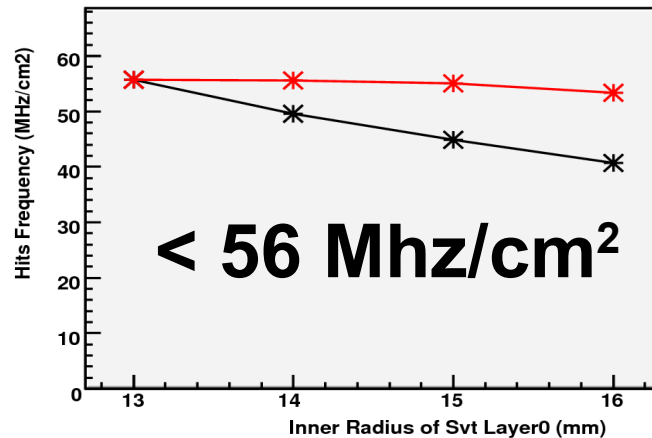
- Average over the whole layer
- X axis: inner Layer0 radius 13 – 16 mm



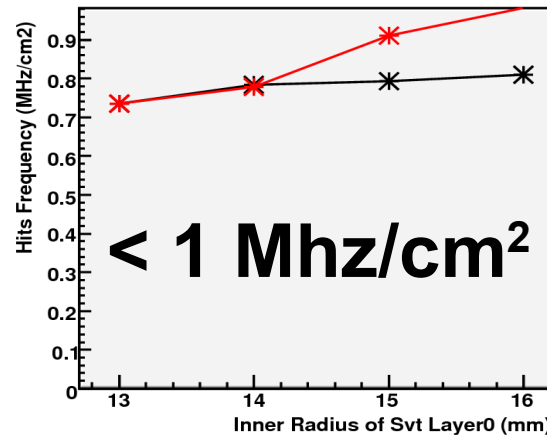
- Configurations:
 - **Black:** BP close to L0, BP inner radius is equal to the inner L0 one minus 3 mm (BP thickness + clearance + pin-wheel average)
 - **Red:** BP inner radius fixed at 10mm
- **Black** is clearly the best option

Hits Frequency, pairs bkg

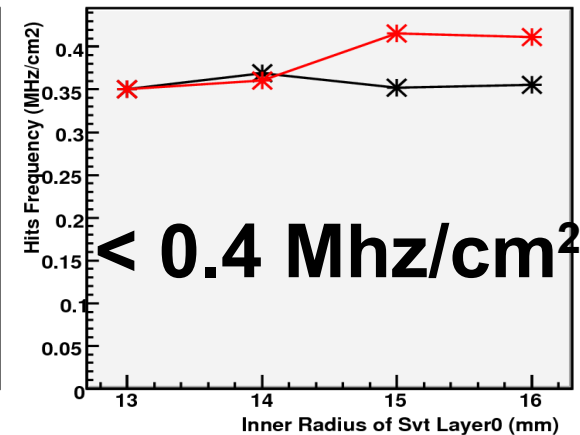
HitsFreq Svt Layer 0



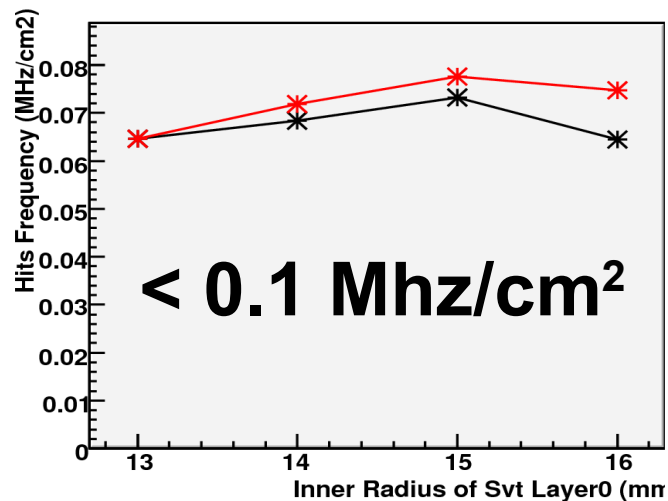
HitsFreq Svt Layer 1



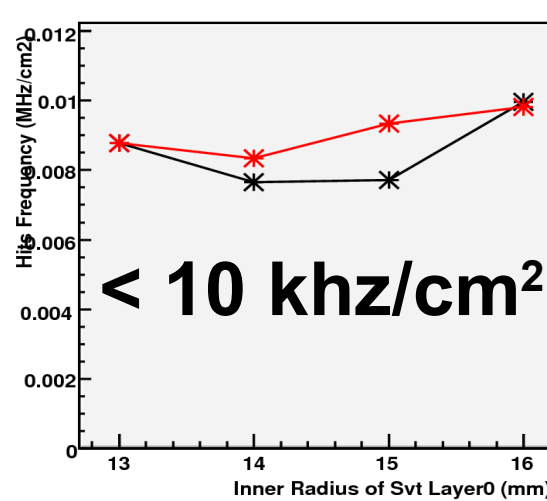
HitsFreq Svt Layer 2



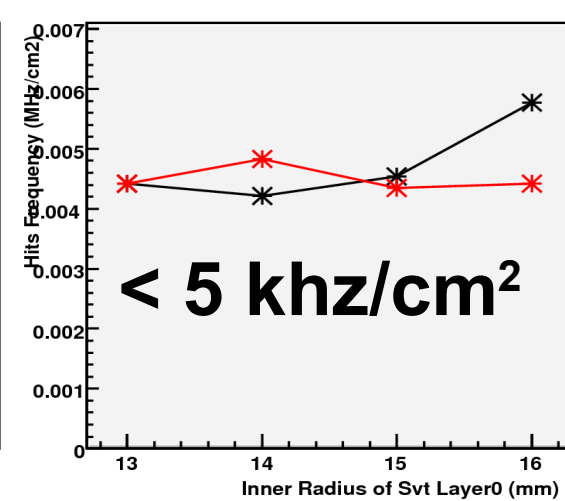
HitsFreq Svt Layer 3



HitsFreq Svt Layer 4



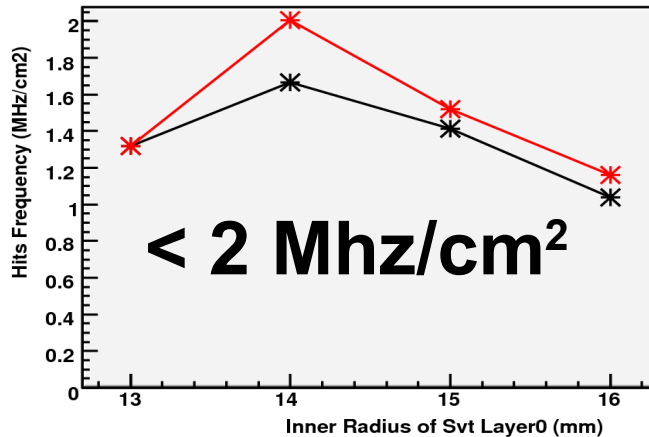
HitsFreq Svt Layer 5



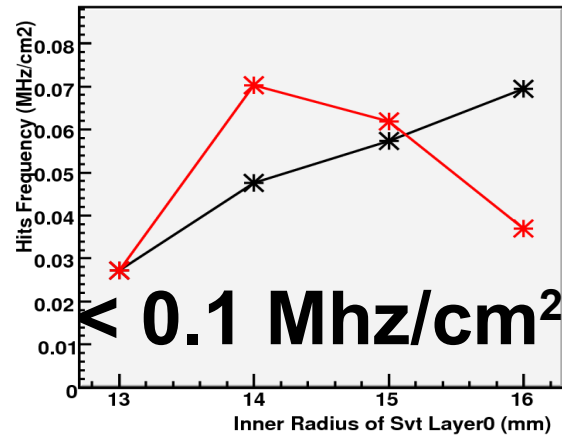
- Fluctuations due to lack of statistics, error bars needed

Hits Frequency, bbbrem bkg

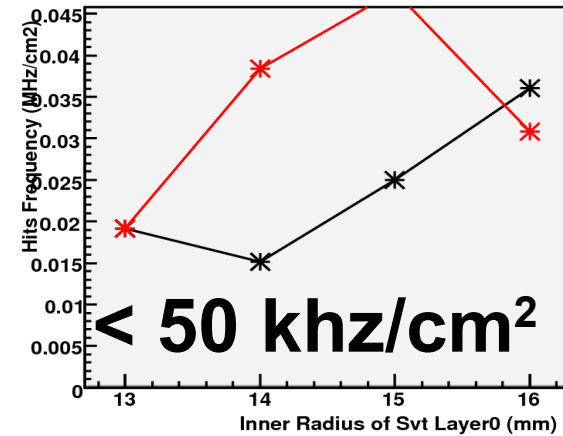
HitsFreq Svt Layer 0



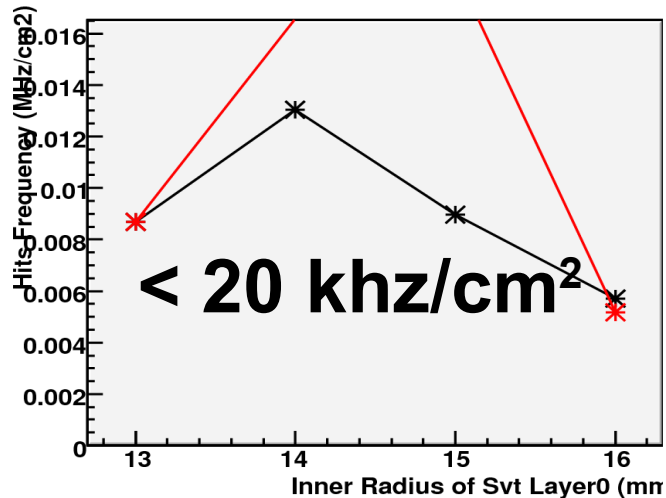
HitsFreq Svt Layer 1



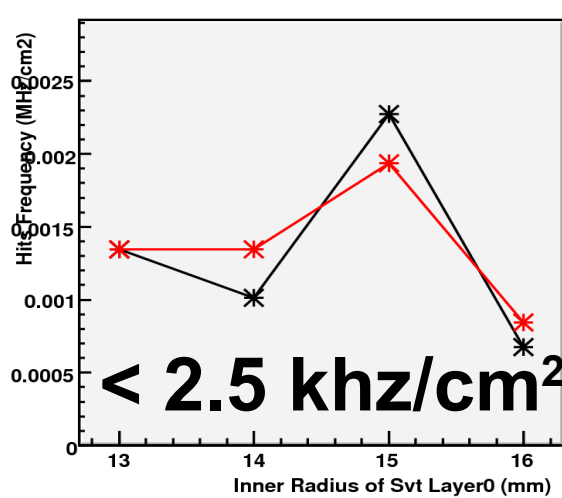
HitsFreq Svt Layer 2



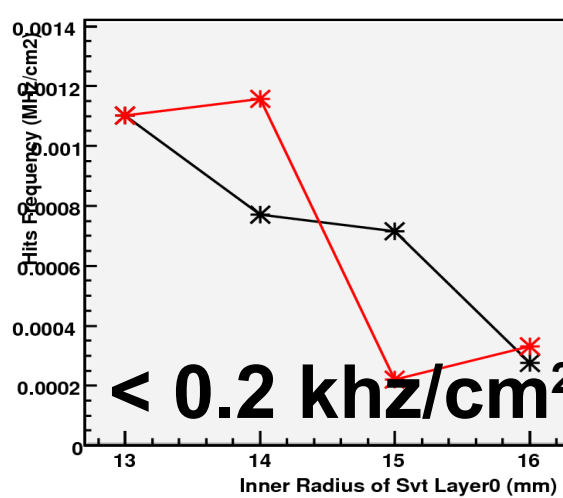
HitsFreq Svt Layer 3



HitsFreq Svt Layer 4

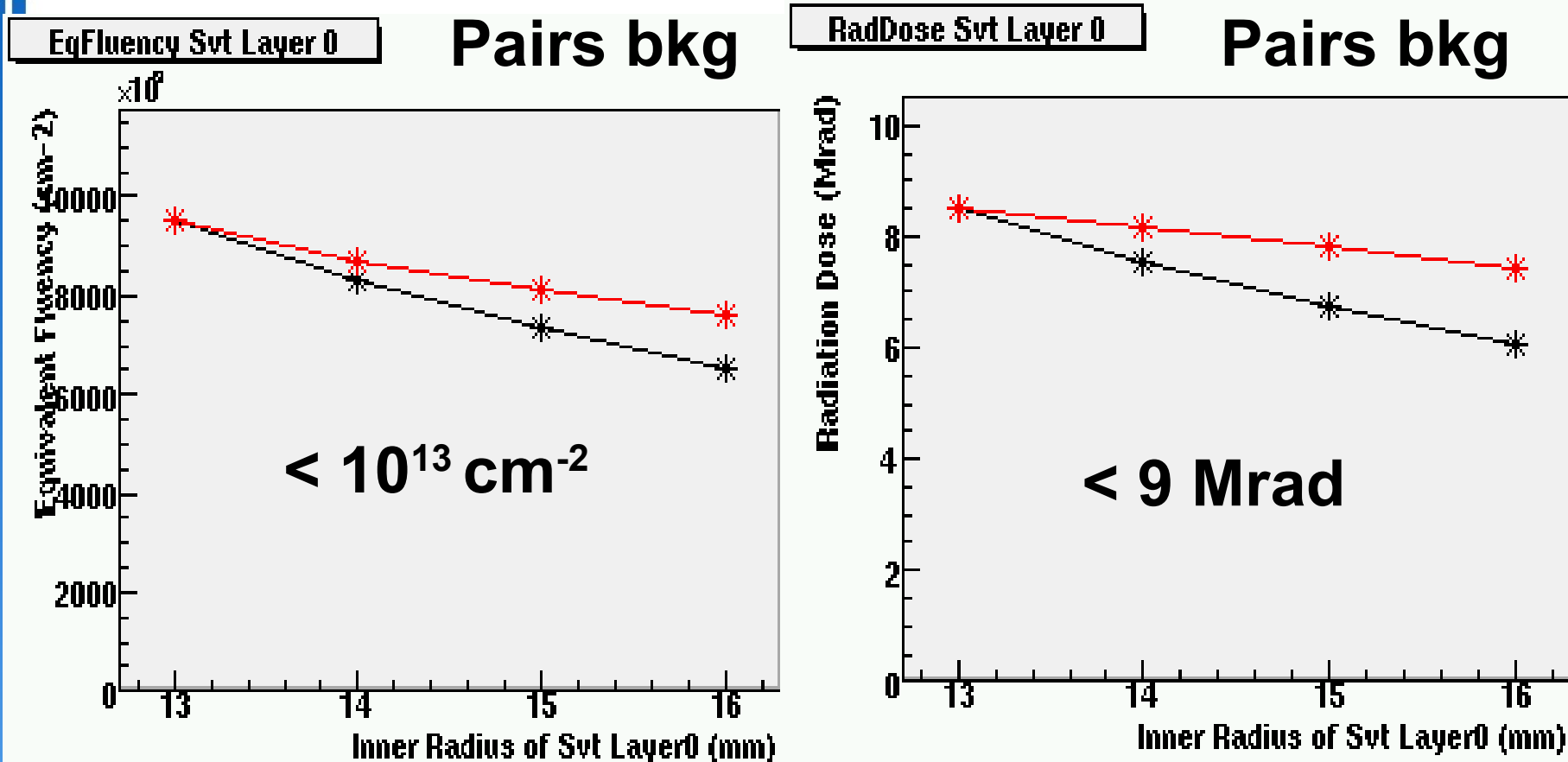


HitsFreq Svt Layer 5



- Fluctuations due to lack of statistics, error bars needed

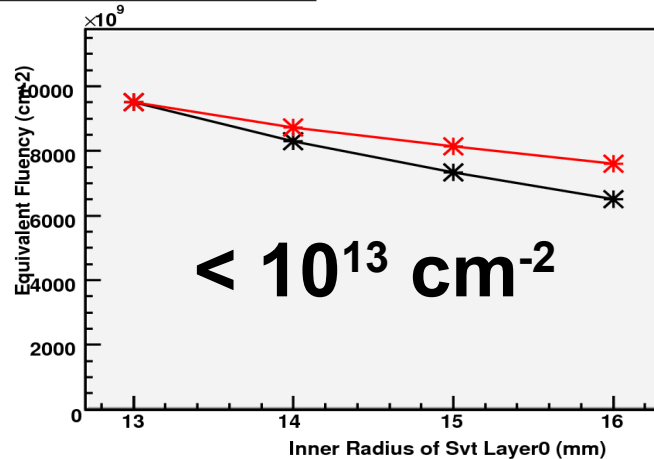
Results for EqFluency and Rad Dose (10^7 sec)



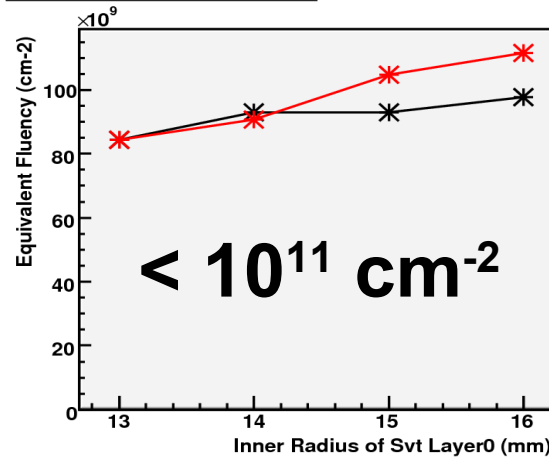
- Same behaviour with different configurations
- Both of those are slightly critical including safety factor
- For outer layers, Fluency $< 10^{11} \text{ cm}^{-2}$ and Dose < 100 krad, but we need to consider also other bkg sources

Equivalent Fluency (10^7 sec), pairs bkg

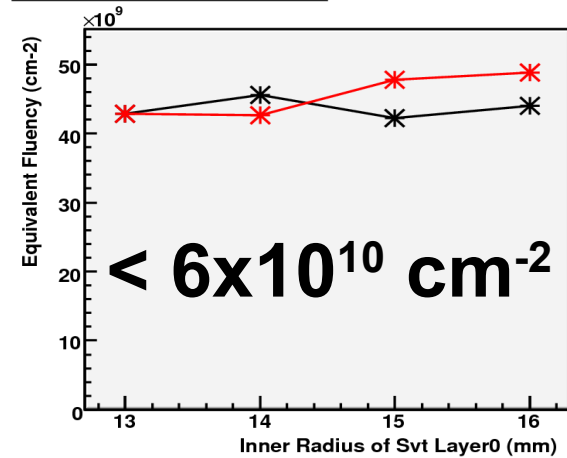
EgFluency Svt Layer 0



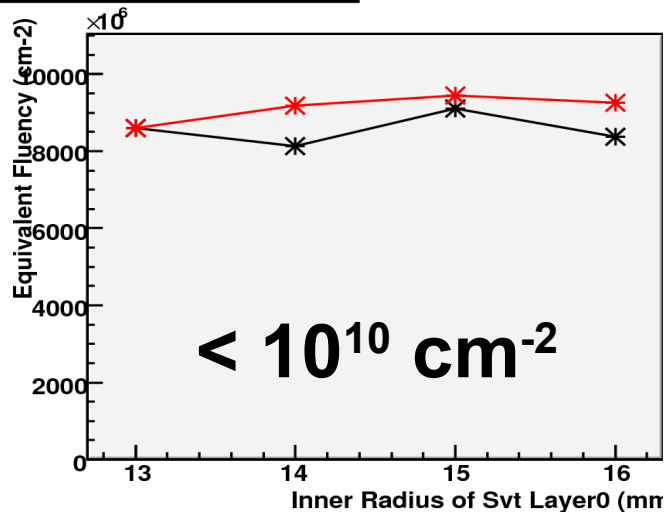
EgFluency Svt Layer 1



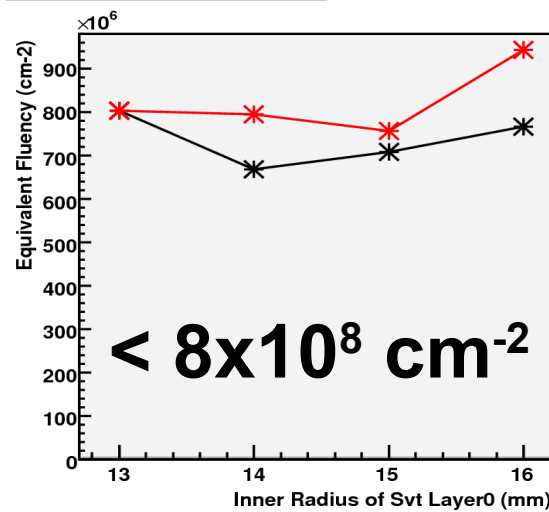
EgFluency Svt Layer 2



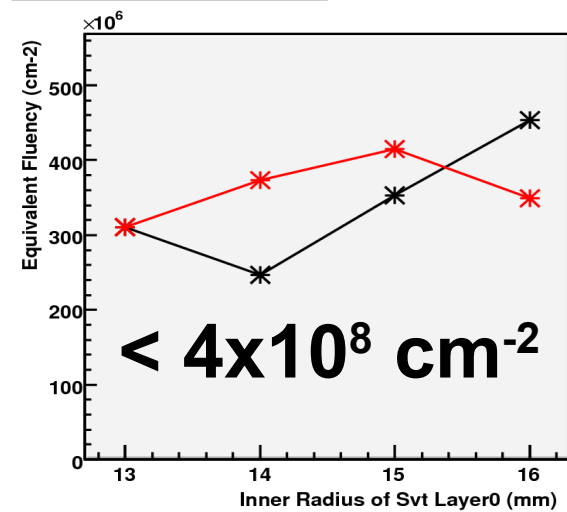
EgFluency Svt Layer 3



EgFluency Svt Layer 4



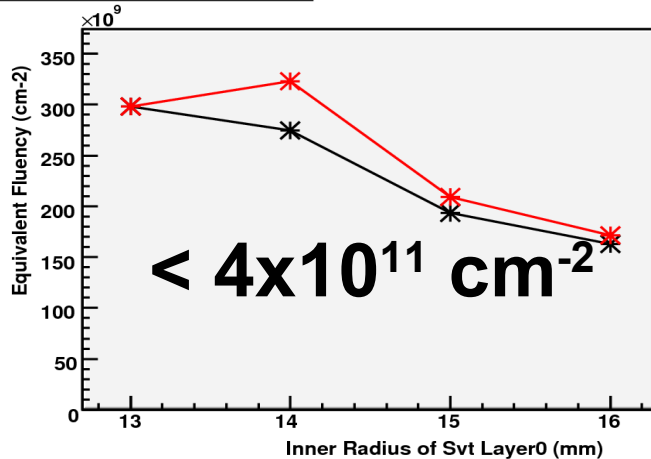
EgFluency Svt Layer 5



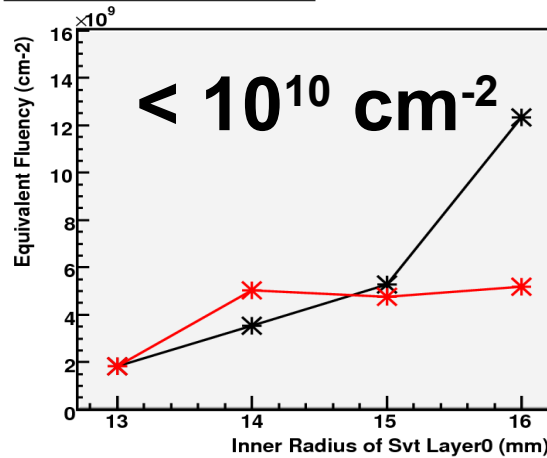
- Fluctuations due to lack of statistics, error bars needed

Equivalent Fluency (10^7 sec), bbbrem bkg

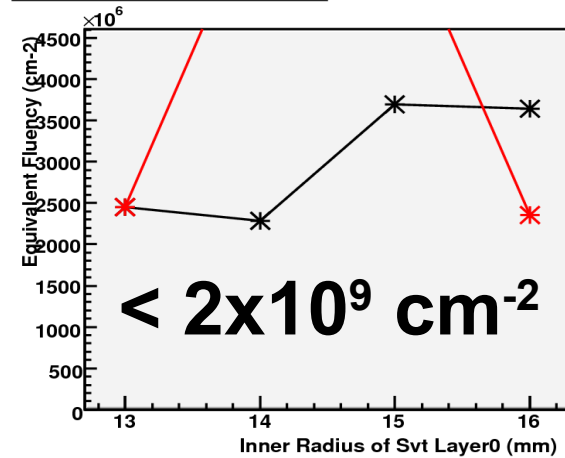
EgFluency Svt Layer 0



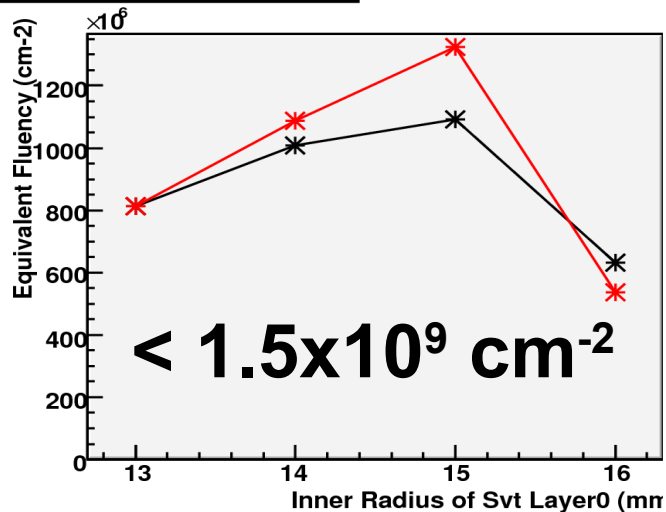
EgFluency Svt Layer 1



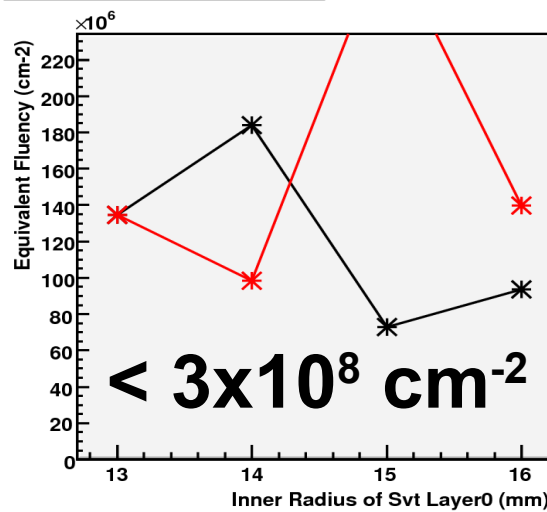
EgFluency Svt Layer 2



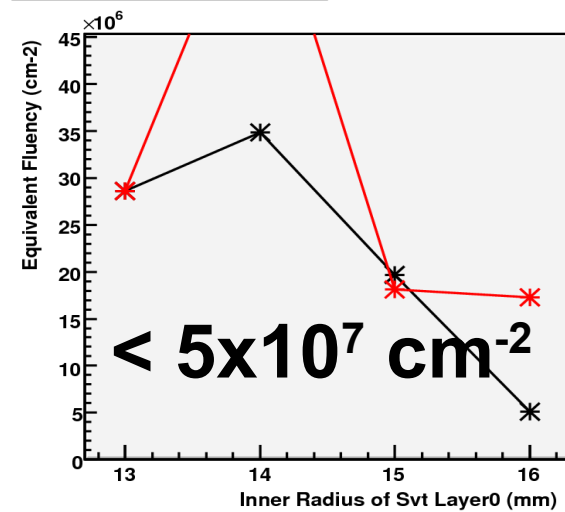
EgFluency Svt Layer 3



EgFluency Svt Layer 4



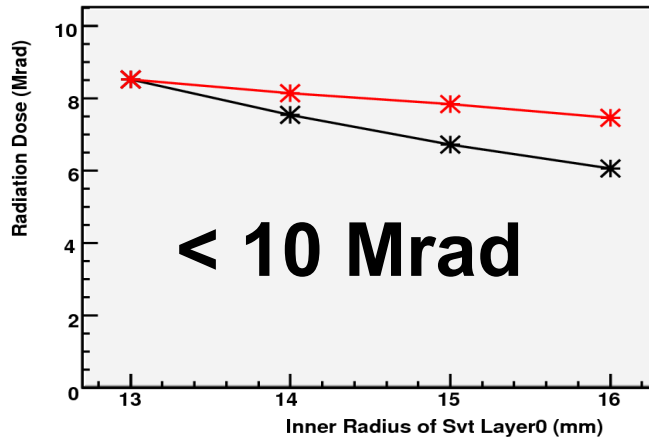
EgFluency Svt Layer 5



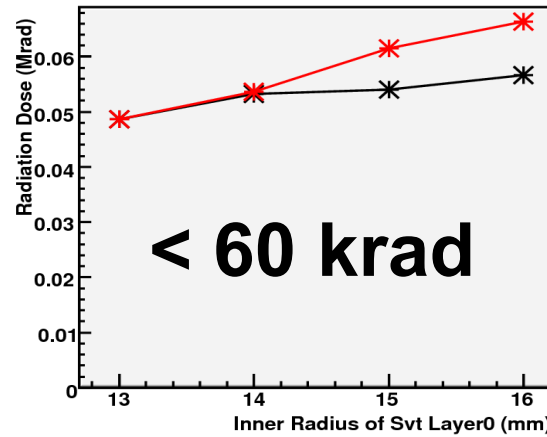
- Fluctuations due to lack of statistics, error bars needed

Radiation Dose (10^7 sec), pairs bkg

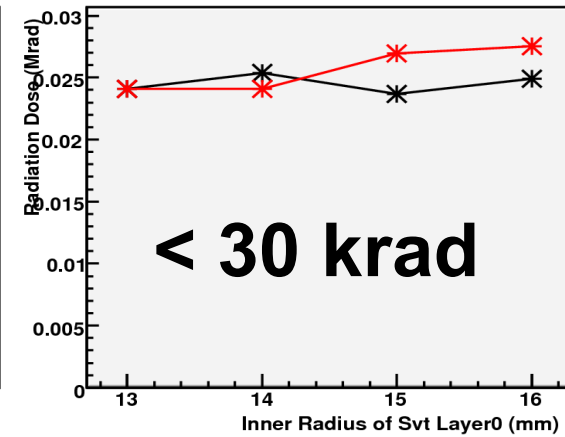
RadDose Svt Layer 0



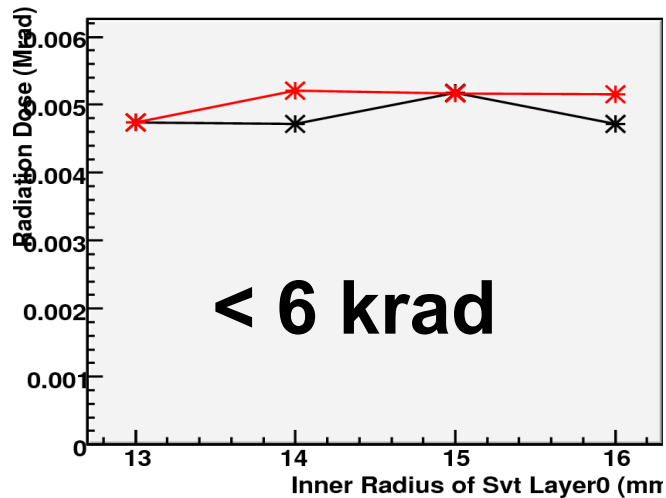
RadDose Svt Layer 1



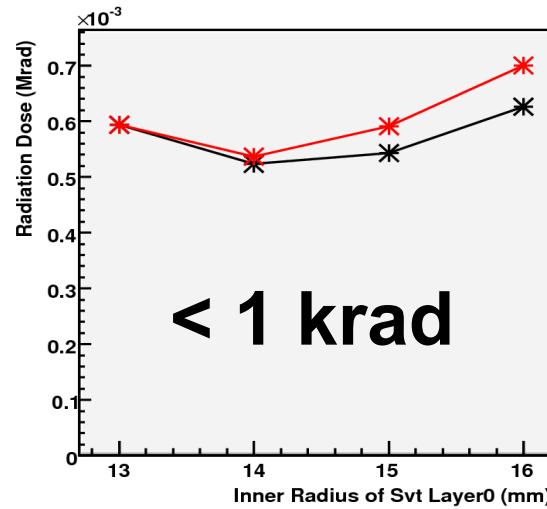
RadDose Svt Layer 2



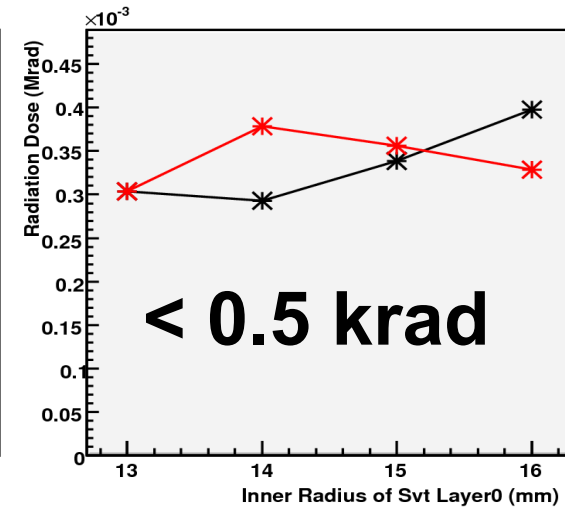
RadDose Svt Layer 3



RadDose Svt Layer 4



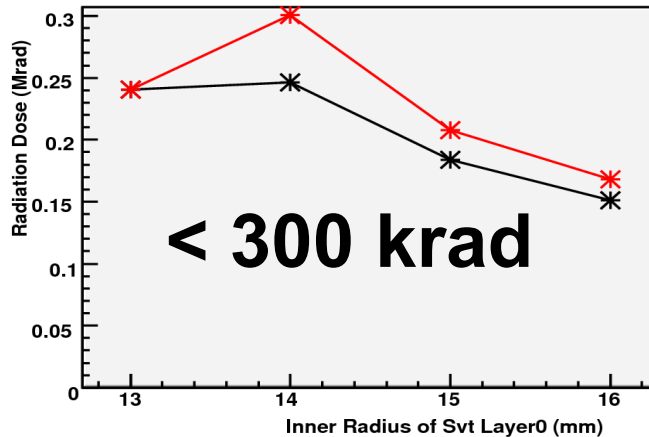
RadDose Svt Layer 5



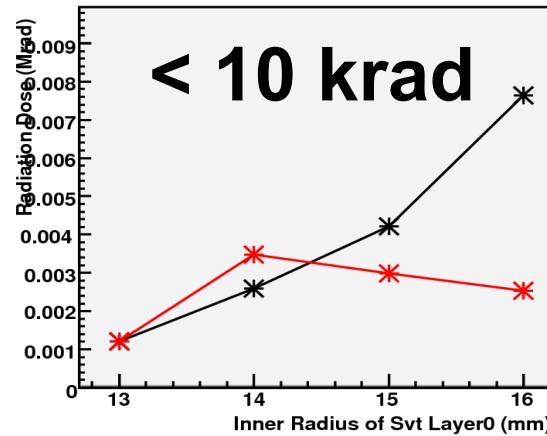
- Fluctuations due to lack of statistics, error bars needed

Radiation Dose (10^7 sec), bbbrem bkg

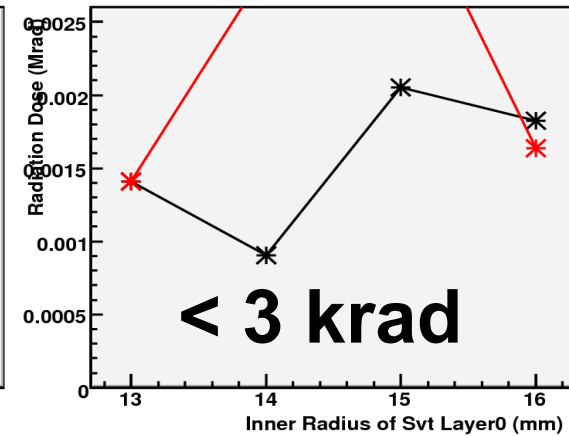
RadDose Svt Layer 0



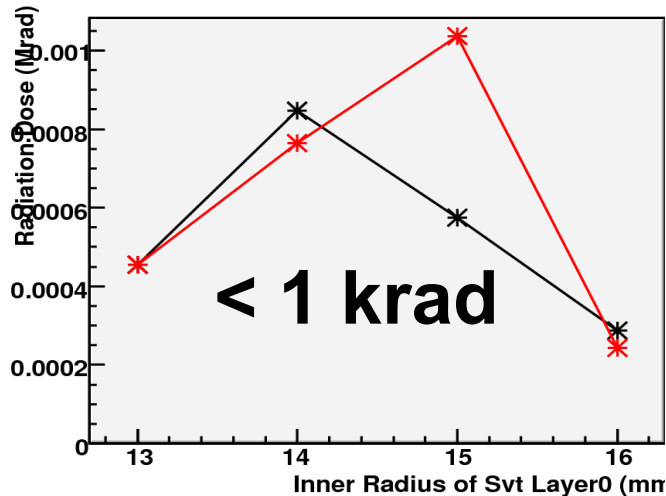
RadDose Svt Layer 1



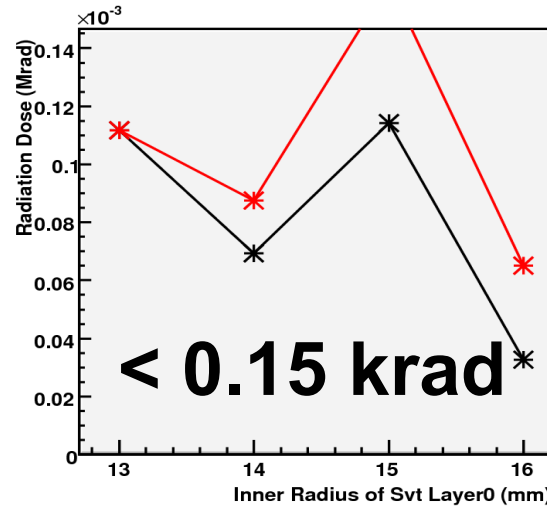
RadDose Svt Layer 2



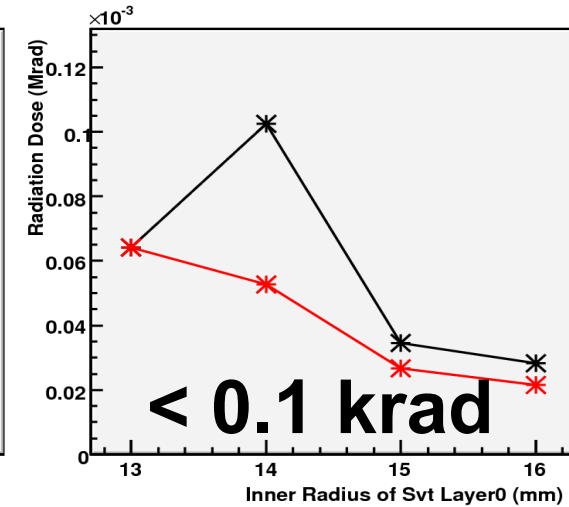
RadDose Svt Layer 3



RadDose Svt Layer 4



RadDose Svt Layer 5



- Fluctuations due to lack of statistics, error bars needed

Conclusions

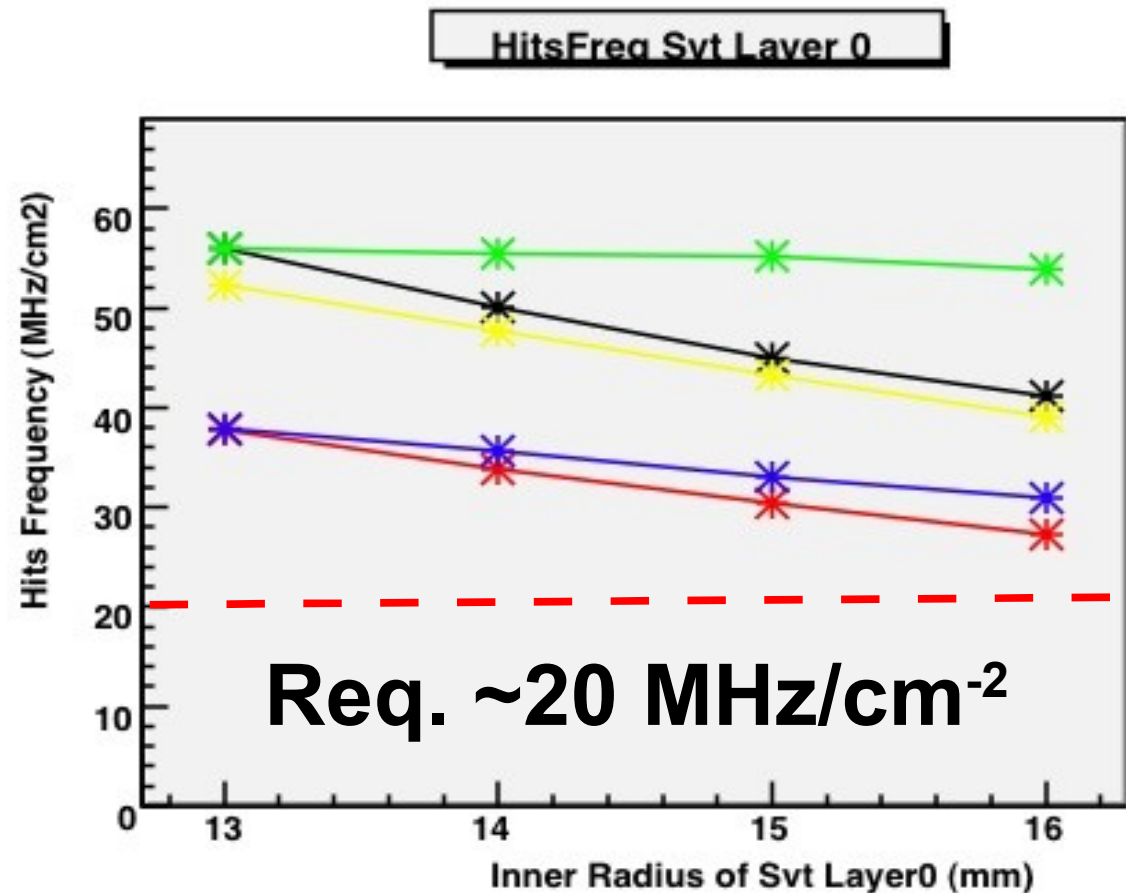
- Tools for producing background plots as needed by subsystems
- Easy to get them from Bruno using different bkg types and geometrical configurations
- Some settings, like pixel size, can be modified even after running FullSim
- Results:
 - Pairs production remain the first kbg source for SVT, while Radiative Bhabha are ~ 10 times less than this
 - Bkg variables are correlated but hits frequency is the most worrying one (efficiency and output rate limit)
 - Beampipe should stay close to L0
- Many requests from people: priority list, but they are encouraged to look into the code and get their own plots

General Todo List (not in priority order)

- Check geometry at all levels
- Interaction region
 - Modify according last design by Mike
 - Test different shielding configuration
- SVT
 - Add realistic silicon on L0, same as FastSim
 - Test different rad length for BP (0.4-0.6%) and clearance BP-L0 (0.5-1mm)
 - Hits are from some particular point apart from IP?
- Make a FullSim Production
- Add error bars on bkg quantities
- Other bkg sources, try to embed them into Bruno, if possible
- Clean-up the code and std naming for classes

Results

- Average over the whole layer
- X axis: inner Layer0 radius
13 – 16 mm

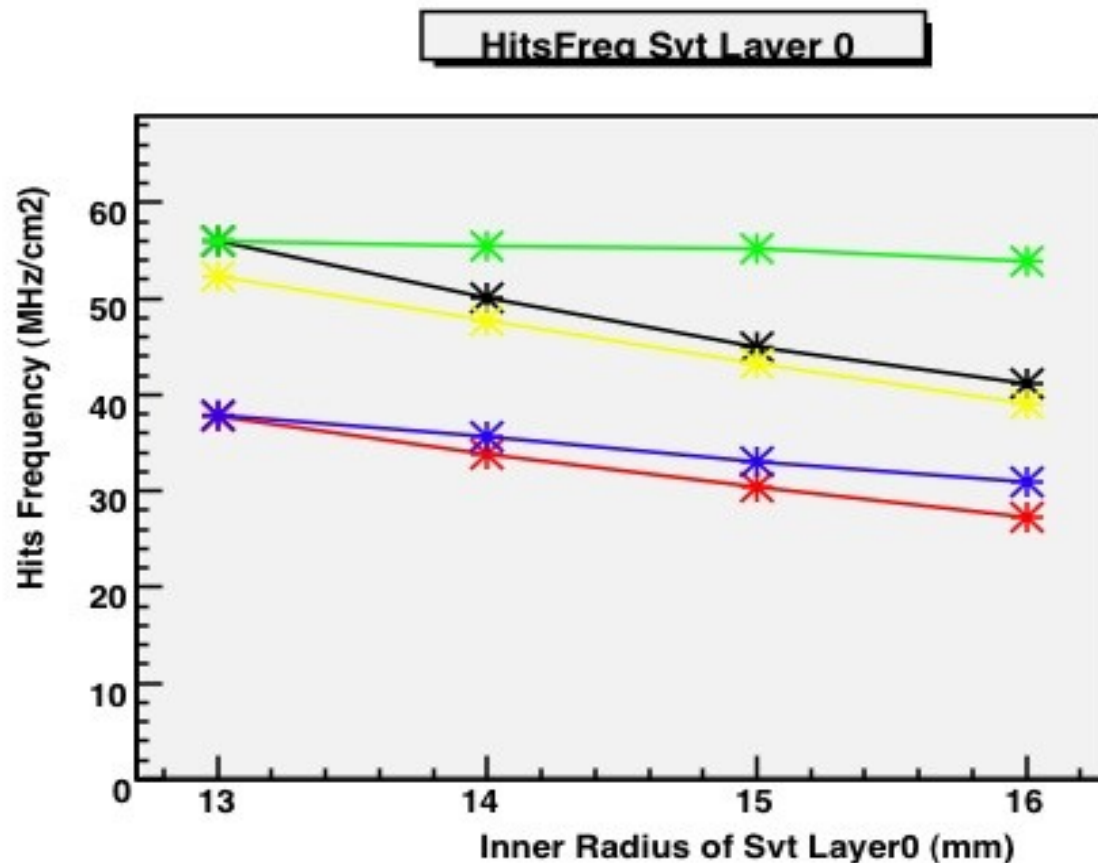


Configurations:

- BP close to L0, BP inner radius is equal to the inner L0 one minus 3 mm (BP thickness + clearance + pin-wheel average)
- like black one, with the gold foil moved from BP to inner L0 surface
- BP inner radius fixed at 10mm
- like green one but the gold foil moved on inner L0 surface
- like black but the gold foil is both on the BP and on L0 inner surface

Comments

- Considering only pair production
- Results confirm to keep BP as close as possible to L0 (yellow vs green, not so effective when moving gold foil, blue vs red)



- Moving the gold coating from BP to L0 brings a nice improvement. The effect should be due to particles that arrive on the outer surface of BP: with a gold foil, they can be deflected more and are easy to hit the L0. Need to check if it's feasible technically
- Not useful to put gold coating on both BP and L0
- Hits frequency is still a bit higher than reqstd (28 MHz/cm²)