BDSIM-GEANT4 modeling of beam halo regeneration from vertical beamlosses in BDUMP beam pipe

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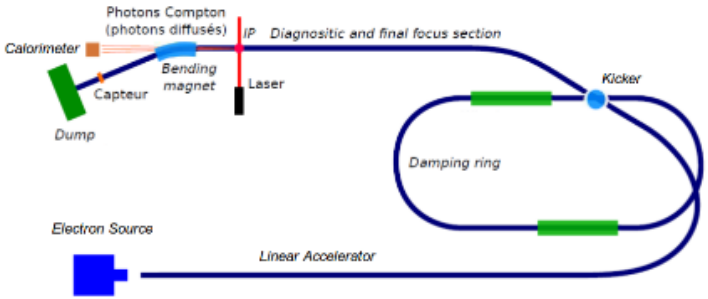
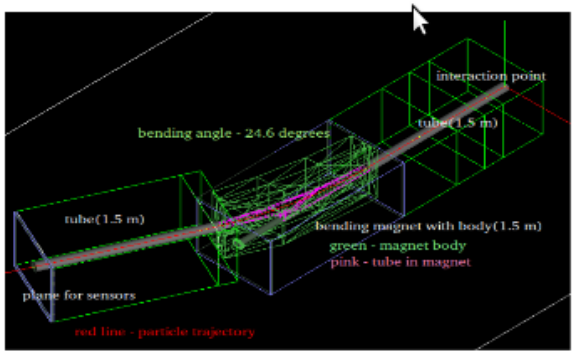
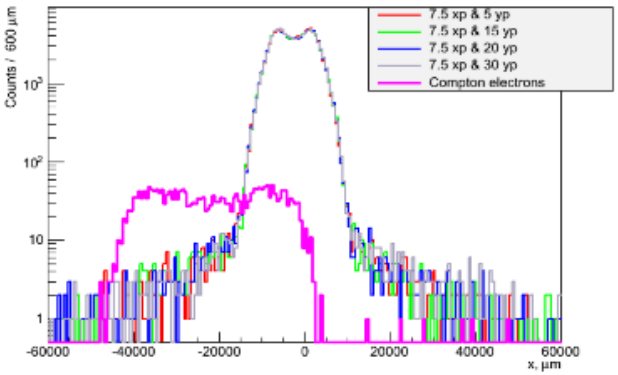
Outline



1. System and parameters

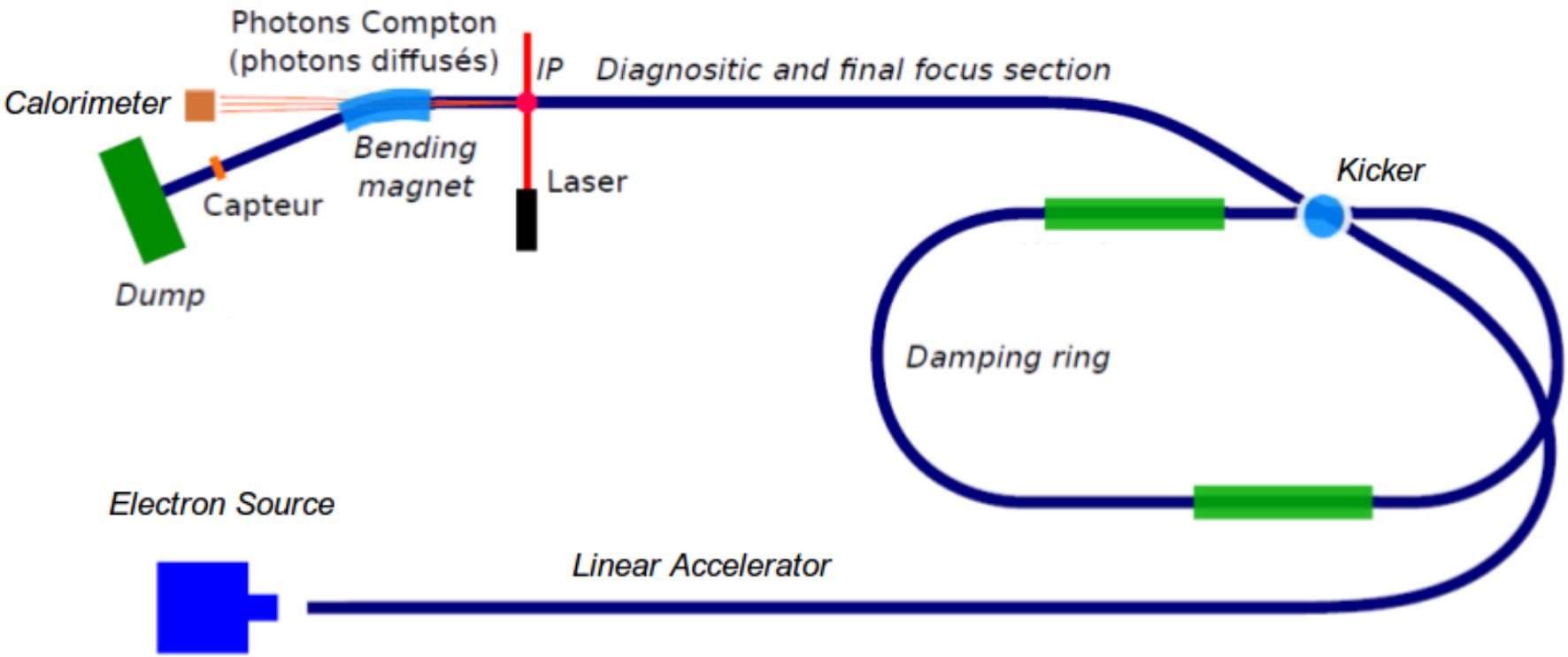


2. Programs



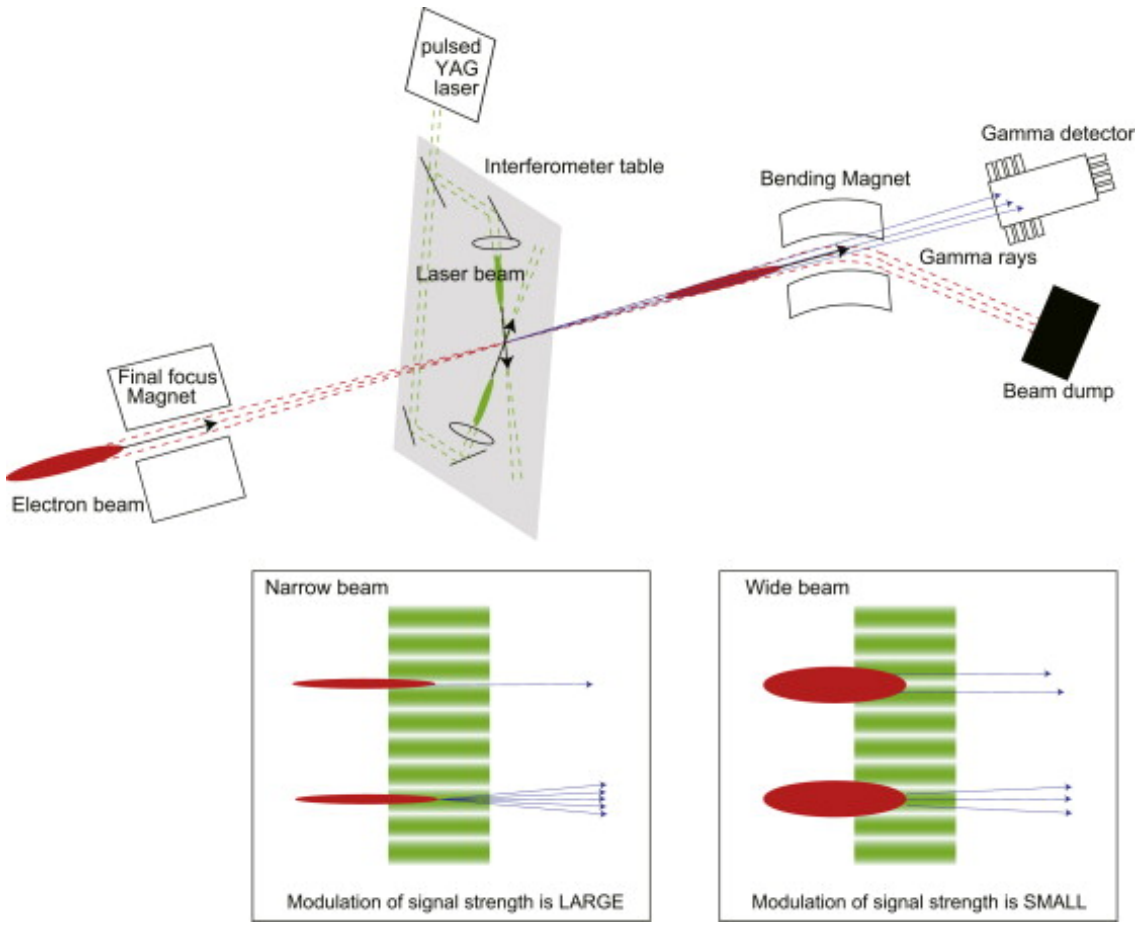
3. Conclusions and Future Plans

ATF2 @ LAL



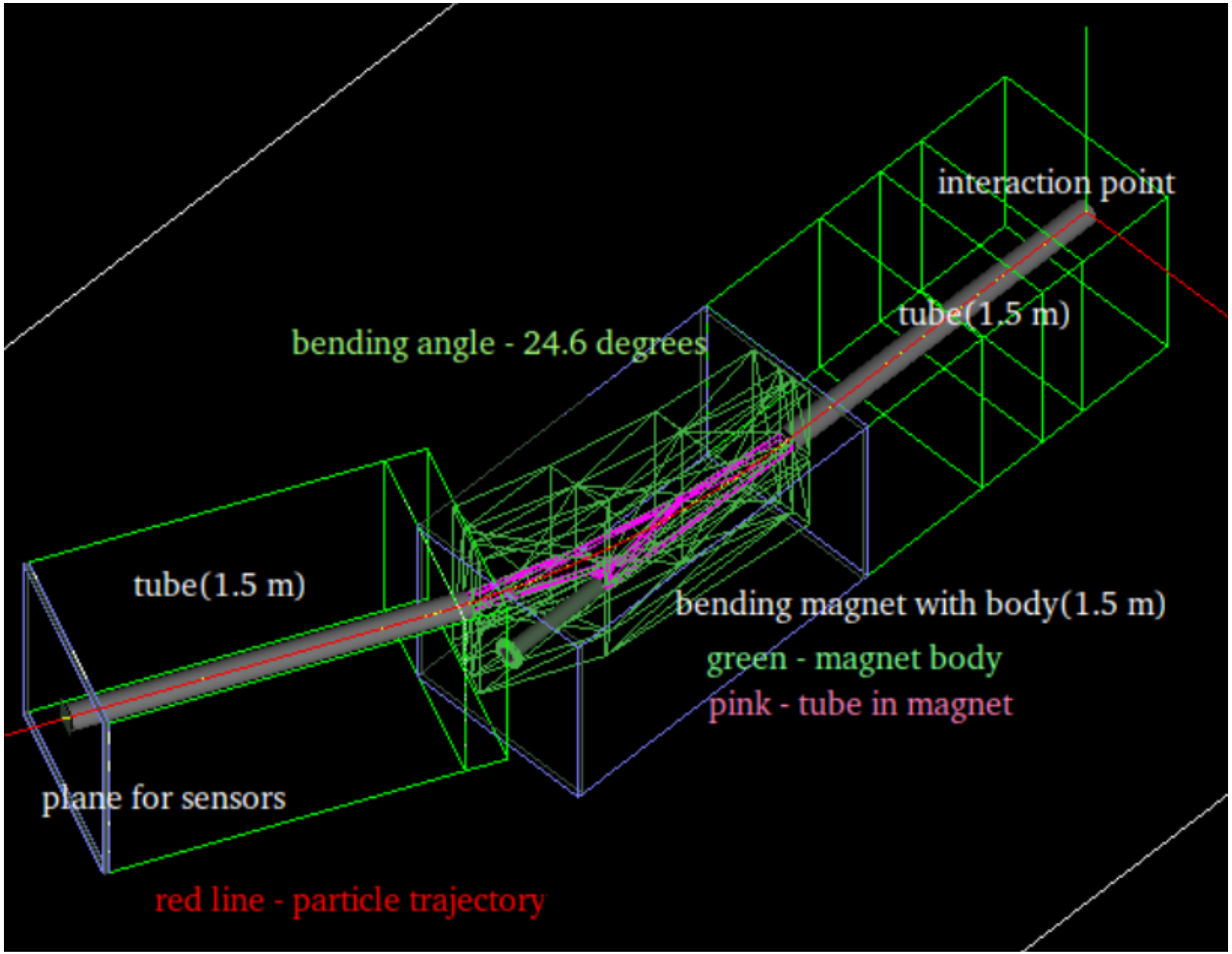
In simulation was considered just Endline, part of accelerating system after IP.

The beam size measurement at IP



The beam size is measured with Shintake monitor. After Shintake monitor we derive Compton scattering electrons and photons. **The main goal of studying is to develop a methodology for counting Compton electrons.**

Considering system in simulation



Main goal of studying

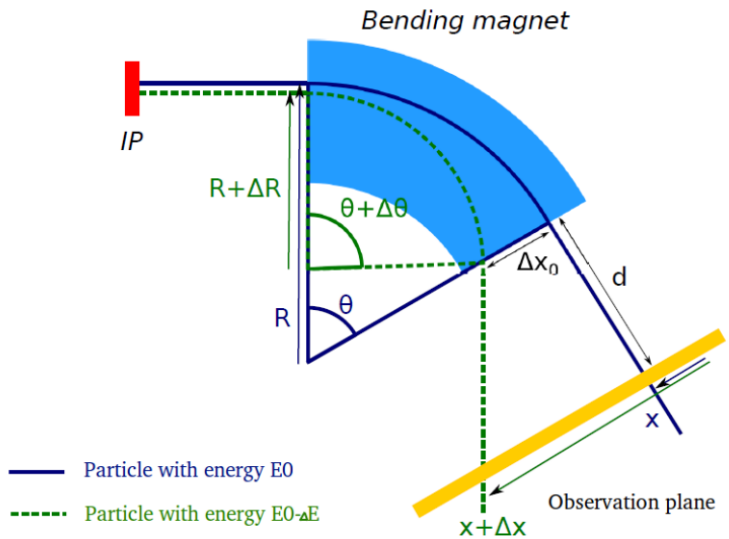
- Simulate different halo in Endline(flat and essential distribution) and analyse it behaviour in detectors?
- Simulate Compton scattering electrons and analyse it behavior in detectors.
- Compare Compton and halo electrons and answer question: **should halo electrons be collimated to observe Compton electrons in detectors**

Programs for simulating and analysis

- **Geant4:** is a platform for the simulation of the passage of particles through matter.
- **BDSIM:** Geant4 extension toolkit for simulation of particle transport in accelerator beamlines.
- **CAIN:** Program for simulation Compton scattering electrons.
- **ROOT:** Toolkit for data analysis.

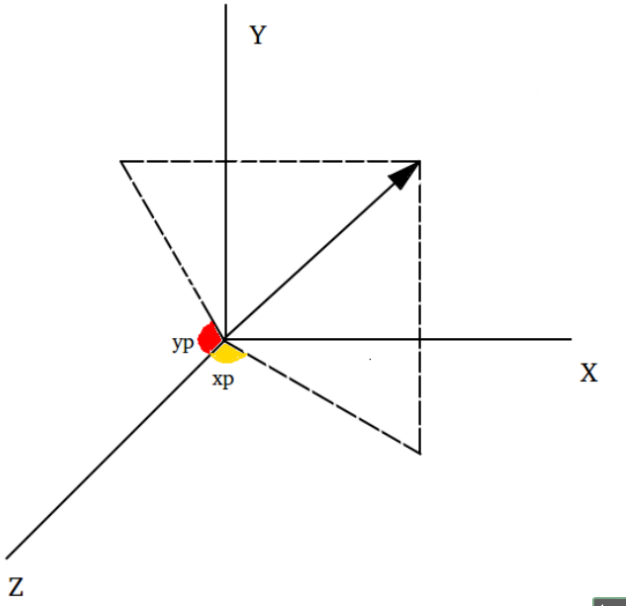
Spatial deflection in observation plane

- Initial electrons: Gauss distribution($E_0 = 1.3 GeV, \sigma = 10.4 MeV$).
- **Question: How particles, which has energy that differ from E on ΔE will deflects in plane, where we want to set detectors?**
- Theoretical calculation:
  $\Delta x = R\frac{1-cos\theta}{sin2\theta}\frac{\Delta E}{E} + d\frac{sin\theta}{cos\theta}\frac{\Delta E}{E} = 688\mu m.$
- From BDSIM: $\Delta x = 756.1 \pm 5.3\mu m$.
- Detectors could be just 1 mm in width.

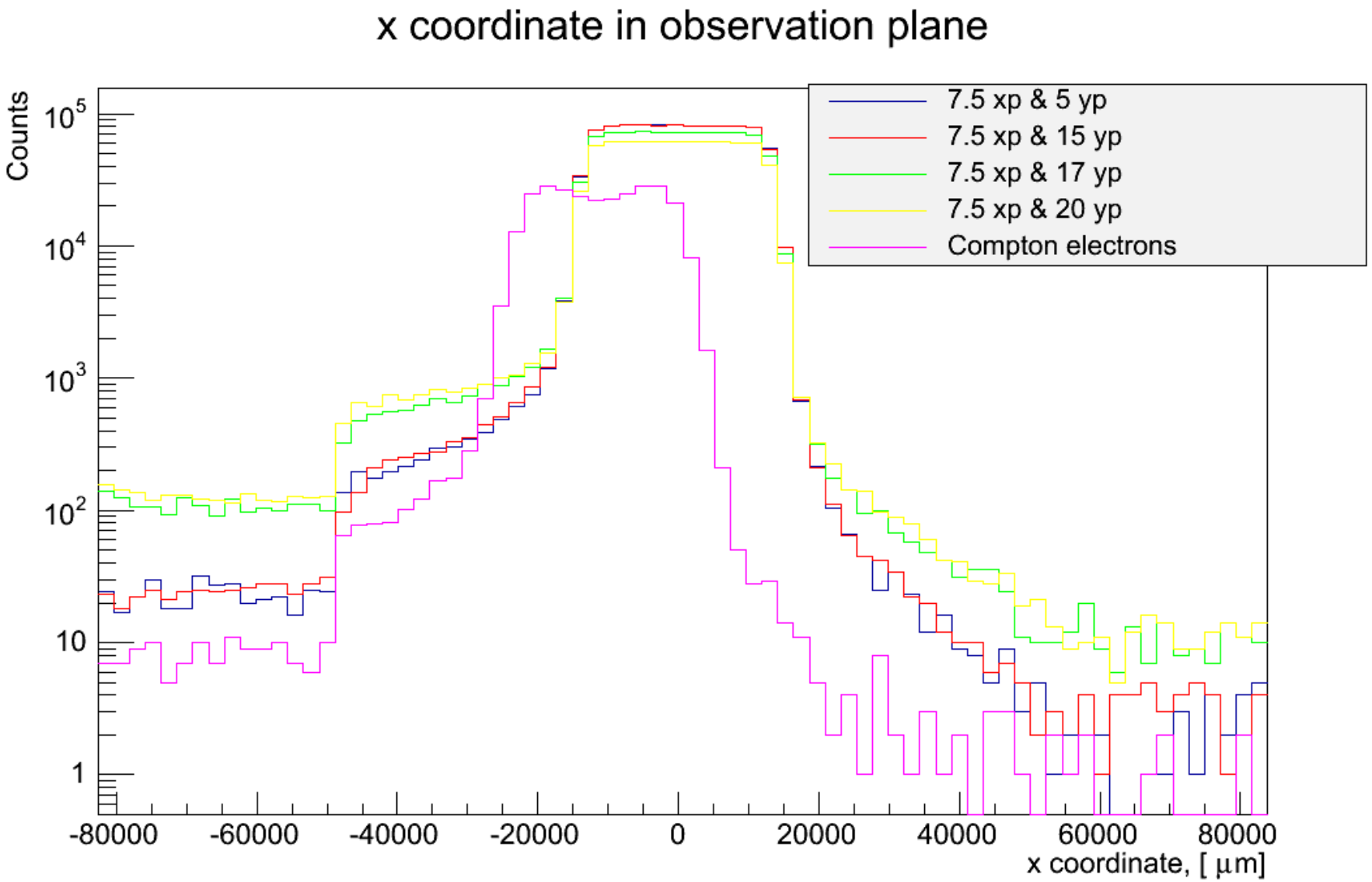


Xp and Yp halo parameters

- Starting parameters for halo electrons depends from beam parameters at the IP.
- The width in xp and yp directions depends from sigma xp(0.45 mrad) and yp(0.35 mrad) beam distribution.
- For xp I use 7.5 times bigger than nominal beam sigma.
- For yp I use different values: from 5(when halo doesn't hit the pipe) till 30(when most of halo particles hit the pipe) times bigger.



x coordinate in observation plane for **flat** distribution halo and Compton electrons



Typical values for real Halo at IP

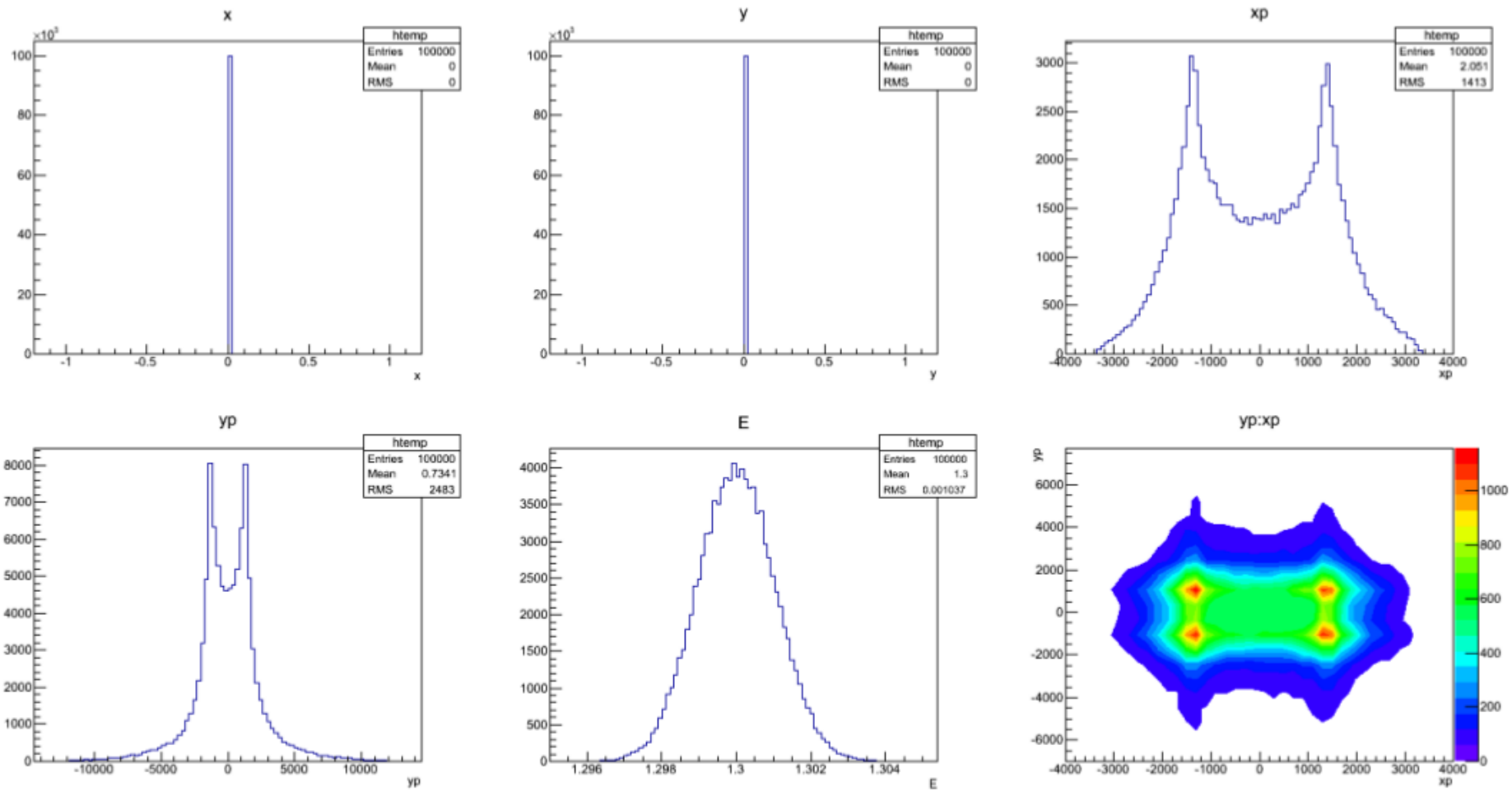
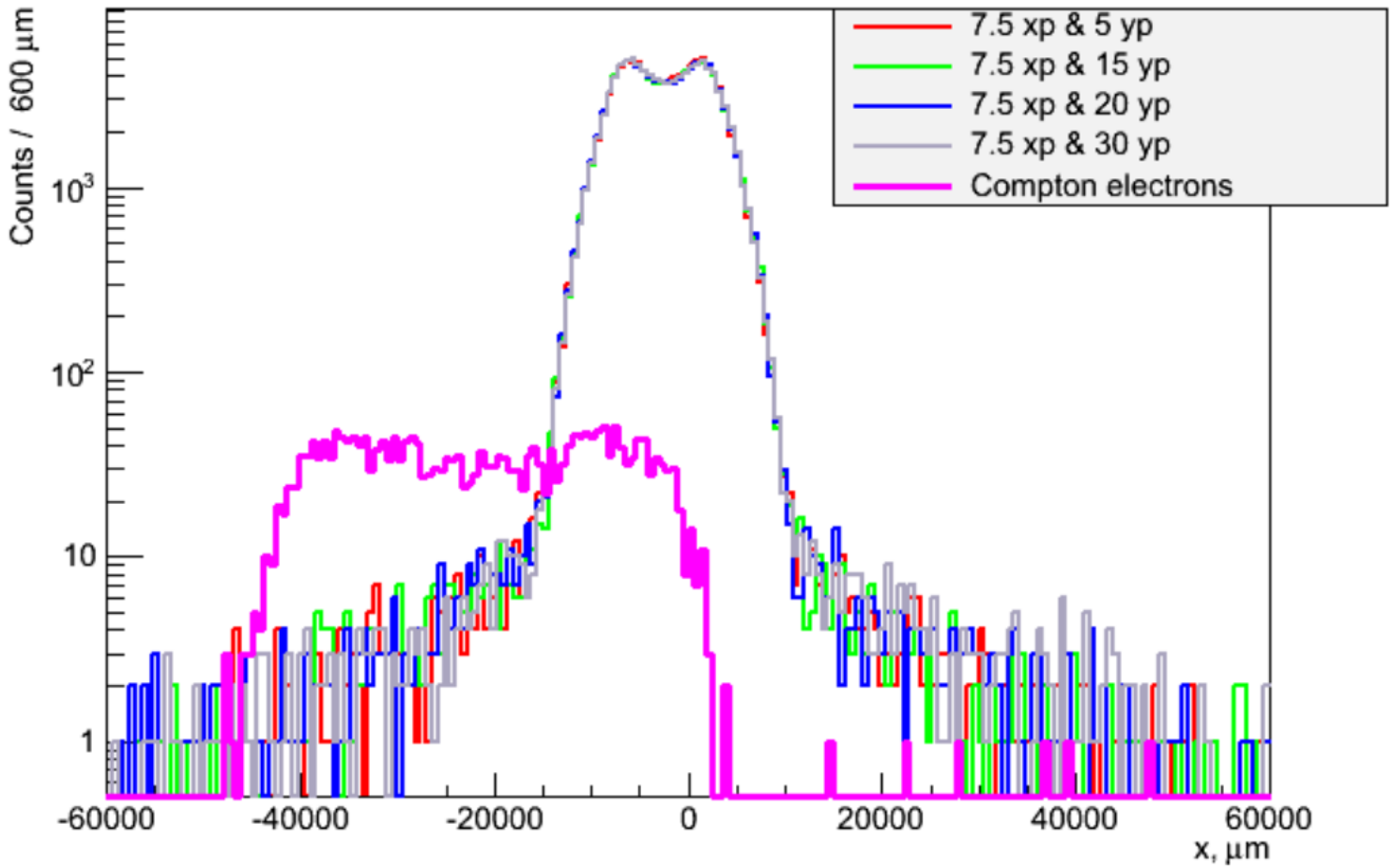


Figure: x,y,xp,yp, Energy and 2D xp-yp plot for real Halo distribution electrons

x coordinate in observation plane for **real** distribution halo and Compton electrons



We can't observe assymetric in x coordinate. The reason - low statistics!

Solution:

We can use flat distribution halo with high statistics for generating xy spectrum for preferable halo angle distribution function

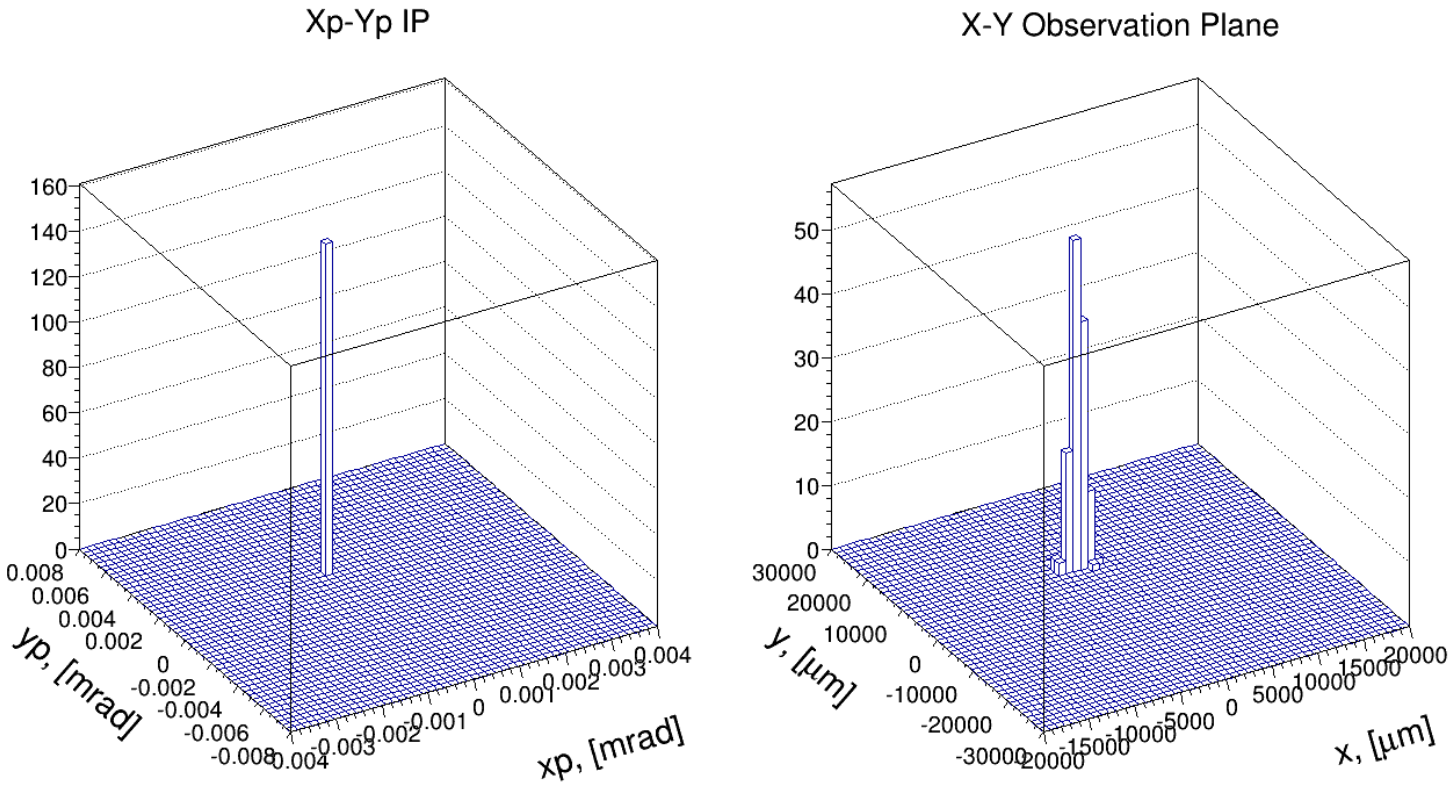


Figure: Delta function for chosen bin at IP(left picture, xp-yp coordinates) which transformes into some distribution at observation plane(right picture, x-y coordinates)

Solution:

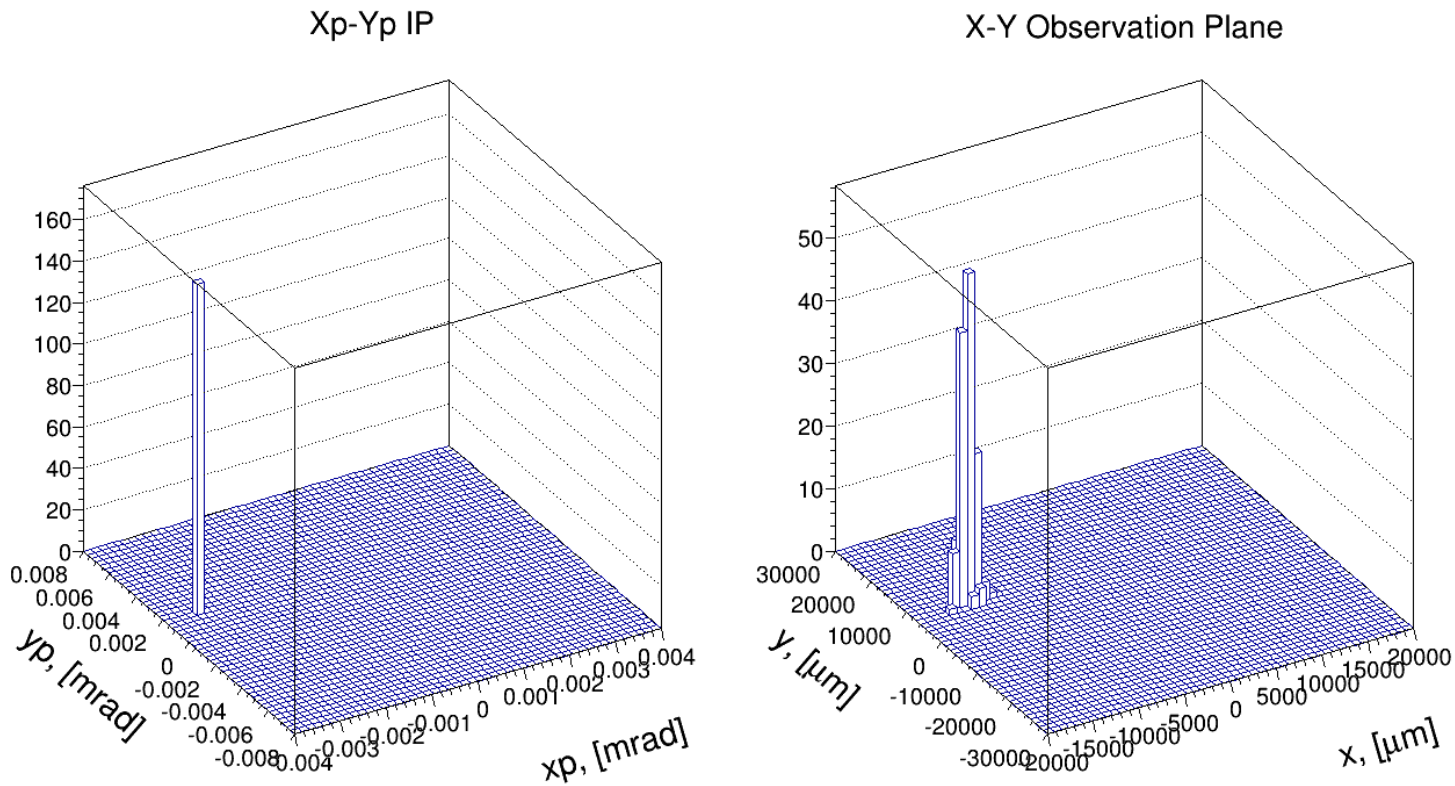


Figure: Delta function for chosen bin at IP(left picture, xp-yp coordinates) which transformes into some distribution at observation plane(right picture, x-y coordinates)

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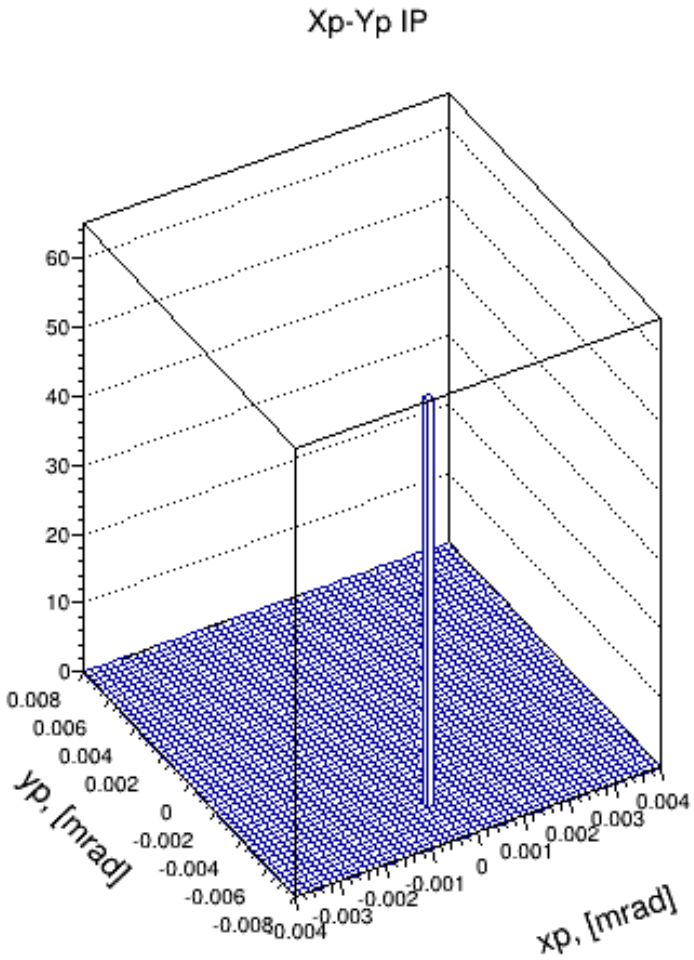

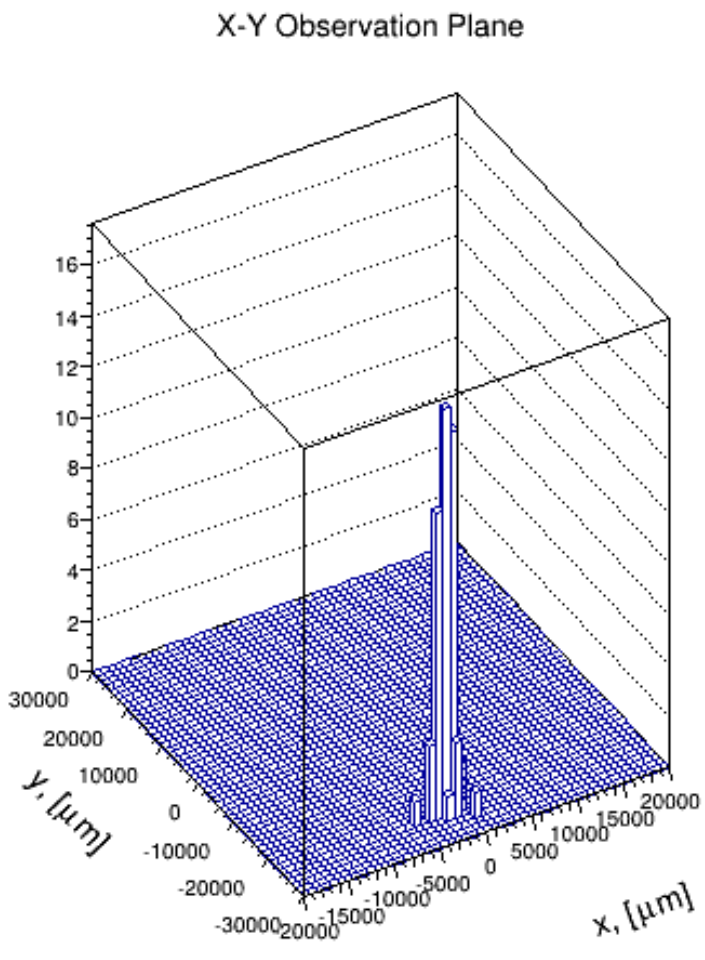

For edge Y coordinate there are too less events. Reason: most part of particles hit the pipe and magnet body and stopped in it.

Conclusions and Future Plans

- With such method we could better describe tails of real Halo distribution.
- Answer question about collimation halo electrons.