Positronium intensity measurement preparation (GBAR)

SNU

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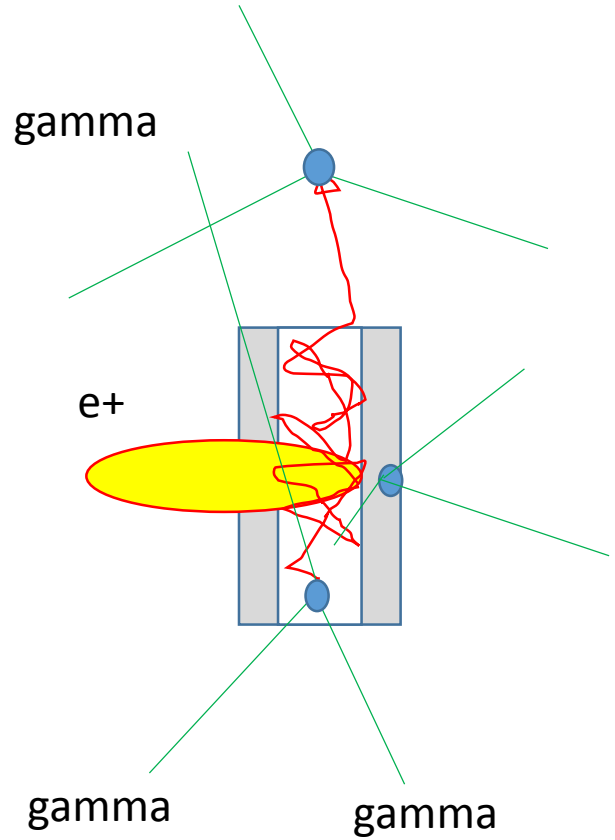
If we measure Ortho-PS now



- We can't distinguish positronium stayed in cavity, gone out cavity, stuck in cavity wall..
- Implanation time, beam width will ruin time resolution and we need to check from A to Z to estimate signal and find the way to figure out.
- Main purpose of simulation: measure positronium intensity inside cavity with small systematic error

Beam Parameters

- Positron Beam size : 1mm x 8mm →(σ_x = 0.25mm, σ_y = 2mm)
- Positron bunch size : 100ns →(σ_t = 50ns)
- Positron Beam energy : (although no dependency in simulation yet) 5~10keV
- Positron Beam direction : Z–axis

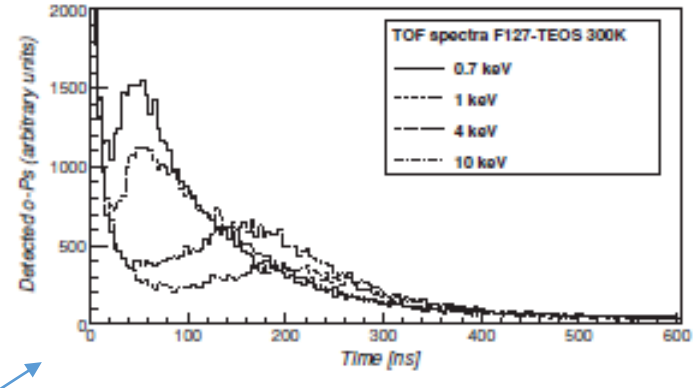
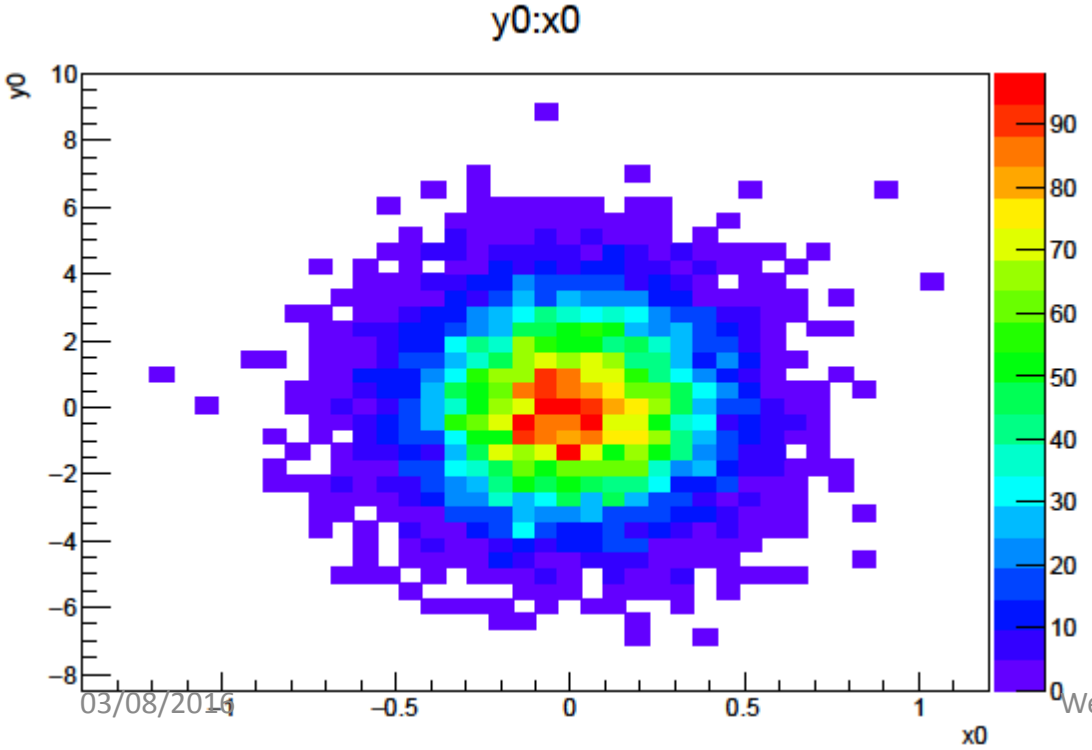
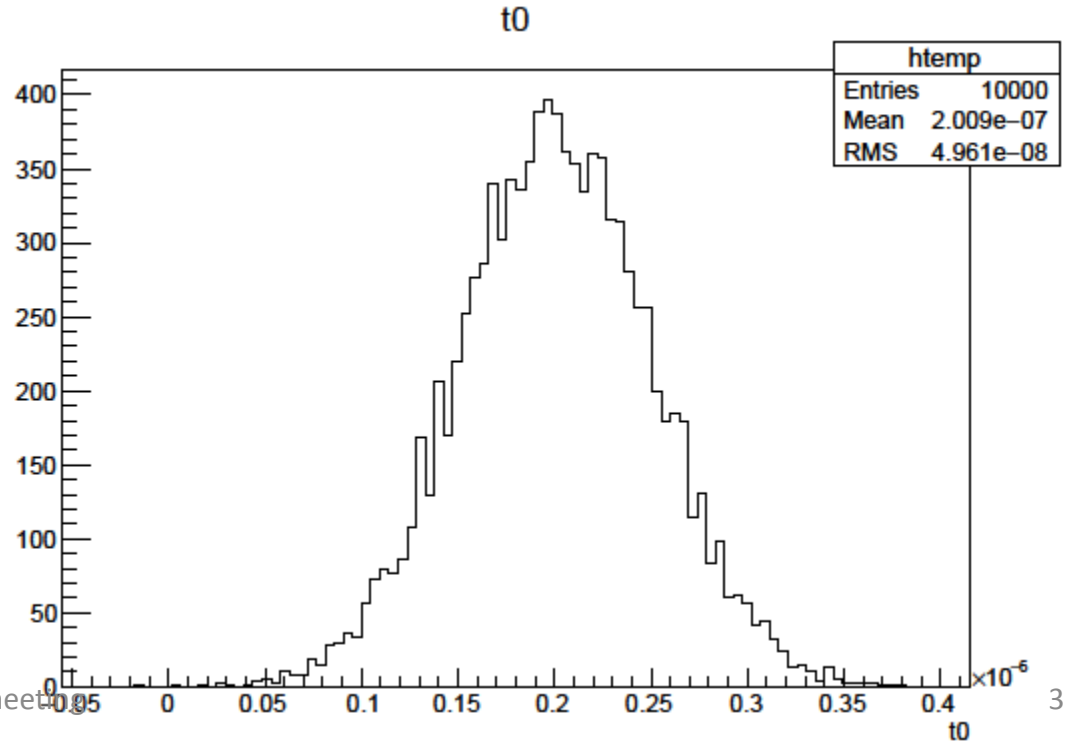


FIG. 3. TOF spectra of the F sample for positron implantation energies of 0.7, 1, 4, and 10 keV.





Ortho-Positronium simulation

- Parameters :

Life time : P-Ps (125ps), O-Ps (142.05ns)

Emitting energy : (independent of target Temp Phys.Rev.A, 81 052703) ~0.07eV

Emitting direction : isotropic or Lambert

Energy distribution : Maxwell-Bolzmann

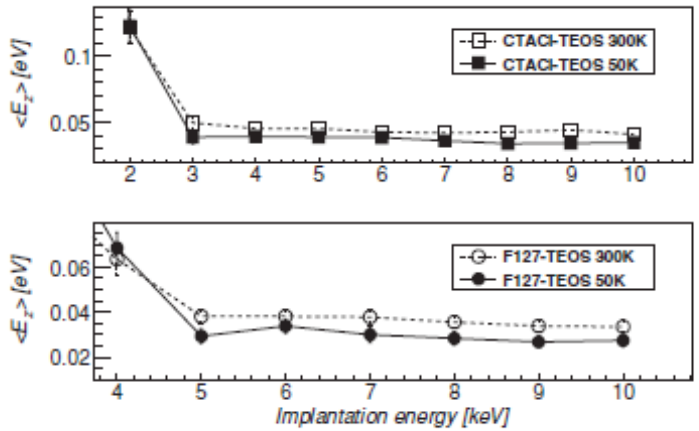


FIG. 7. (Top plot) Ps mean energy $\langle E_z \rangle$ for implantation energies higher than 2 keV at 50 and 300 K for the C sample. (Bottom plot) Ps mean energy as a function of the implantation energies higher than 4 keV at 50 and 300 K for the F sample.

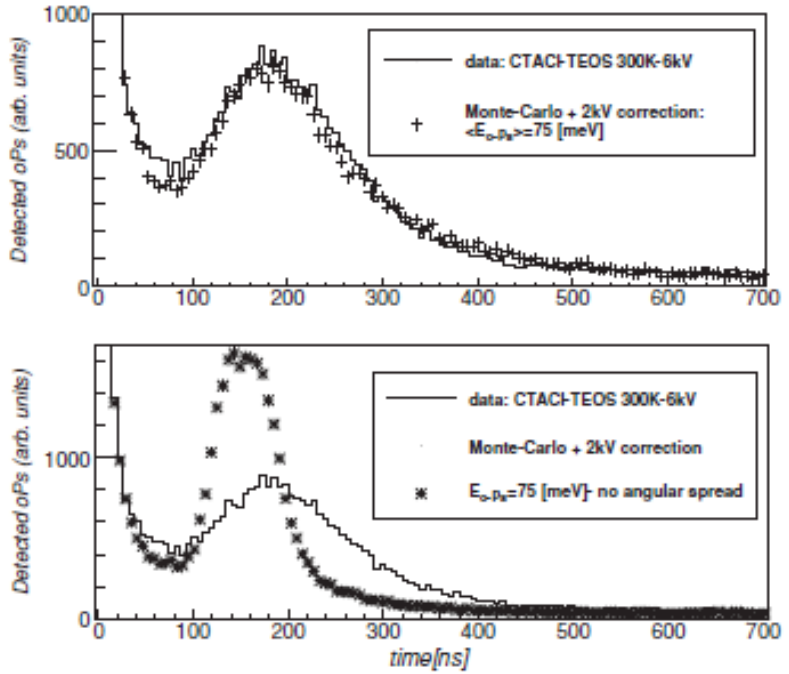


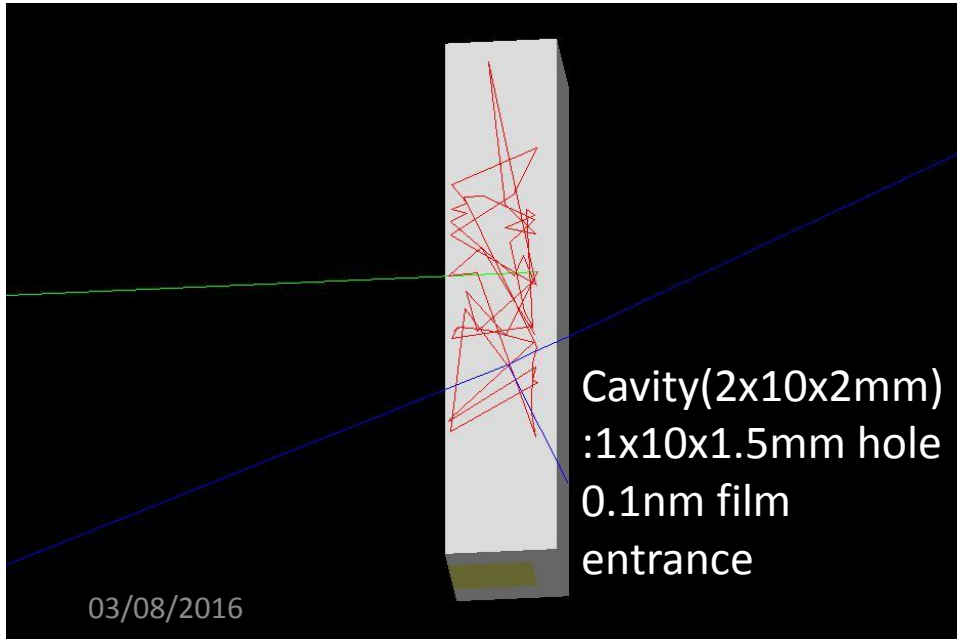
FIG. 8. (Top plot) Comparison between the data of the C sample at 6 keV and the MC simulating mono-energetic Ps emitted isotropically from the film surface. (Bottom plot) Comparison between the data of the C sample at 6 keV and the MC simulating mono-energetic Ps emitted perpendicular from the film surface. In both cases, the measured nonthermalized part (called 2-keV correction in the legend) was added to the MC.

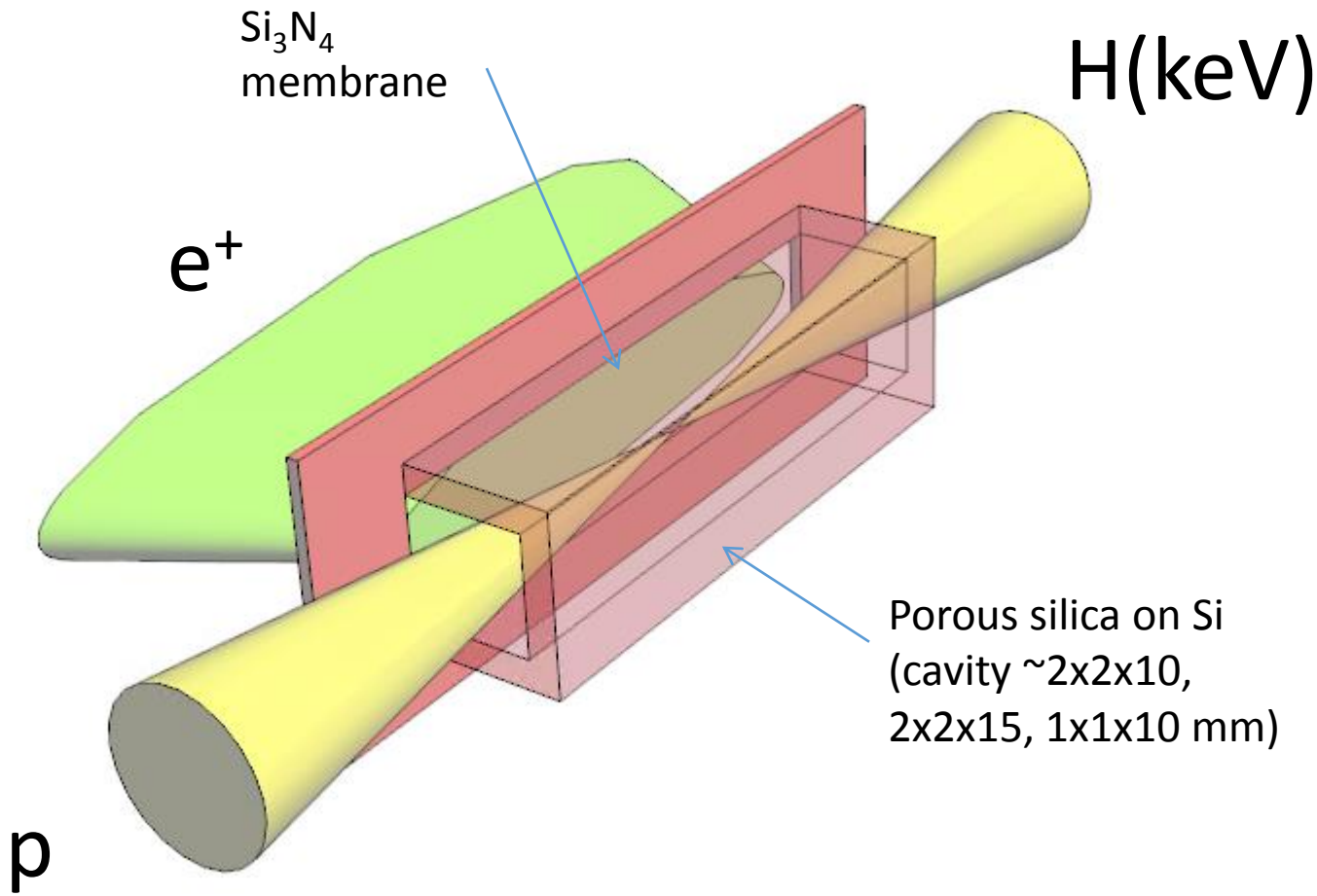
Positronium formation

- Ortho-positronium generation rate : 30%
- Annihilation : 35%
- Para-positronium generation rate : 25%
- Electrion back scattering : 10%

Positronium reflection

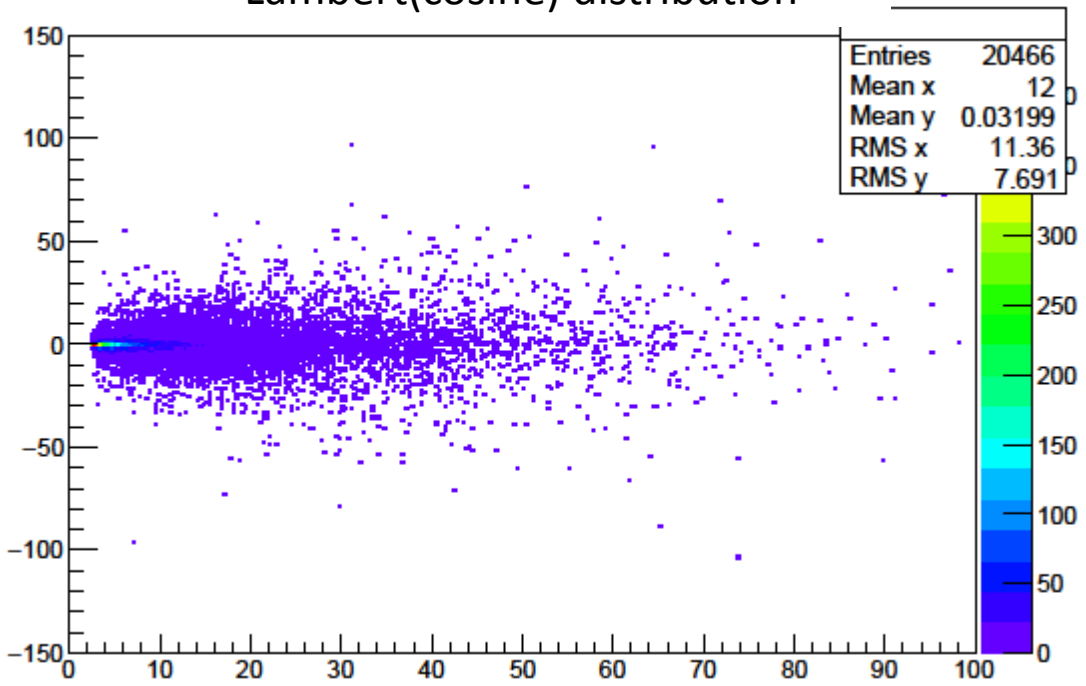
- Reflection angle : isotropic (?)
- Energy loss : neglegible (~0.01%)



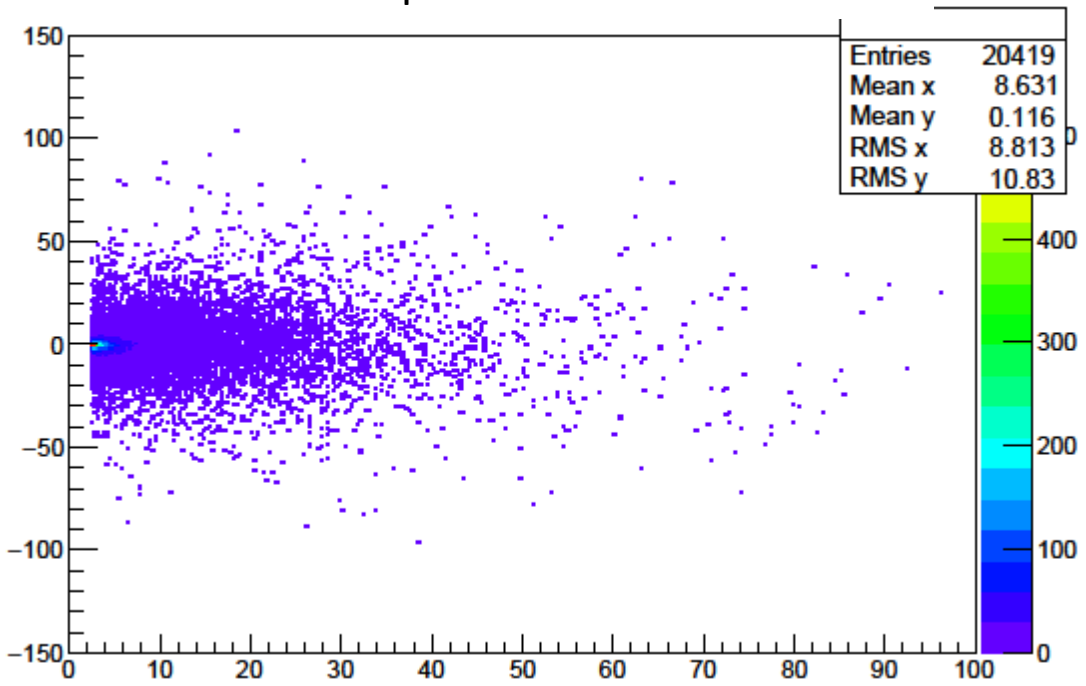


Positronium emission

Lambert(cosine) distribution



Isotropic distribution

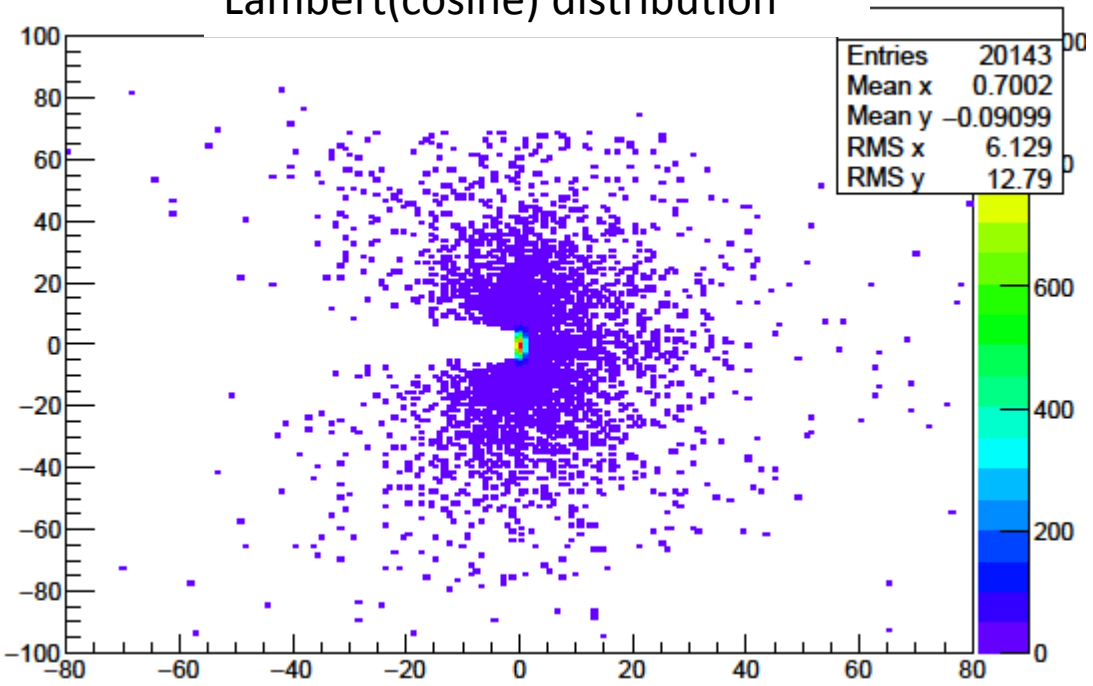


- Main point : we need to expect how many positronium go out from cavity before anti-proton beam coming.

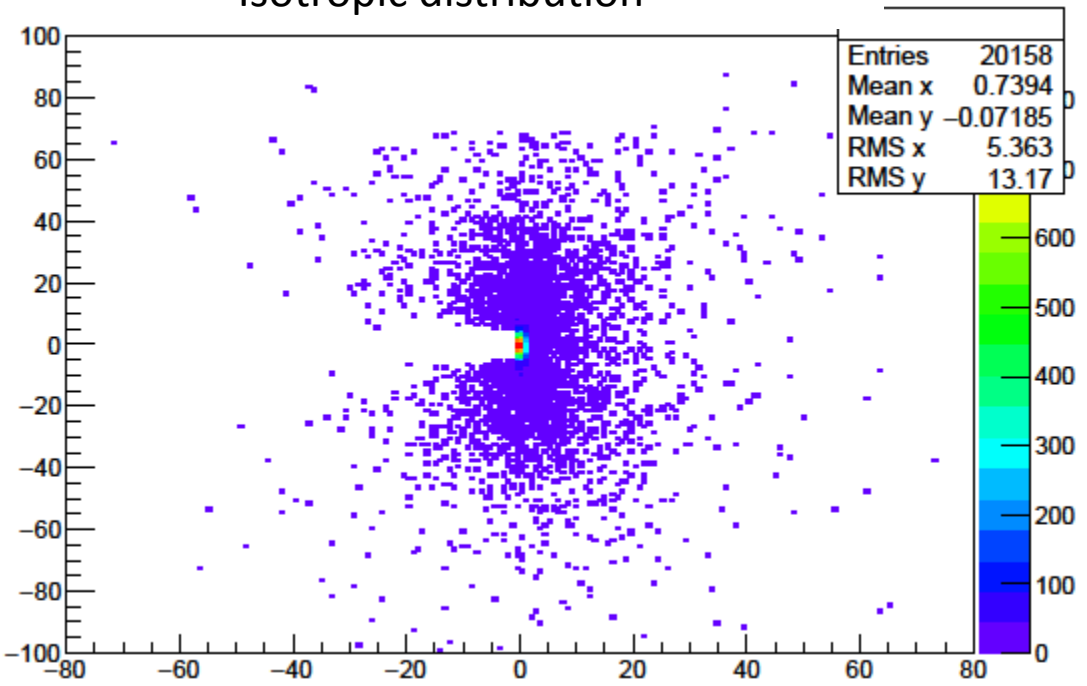
- One issue is positronium emission distribution and the other is positronium reflection distribution

Positronium diffusion

Lambert(cosine) distribution



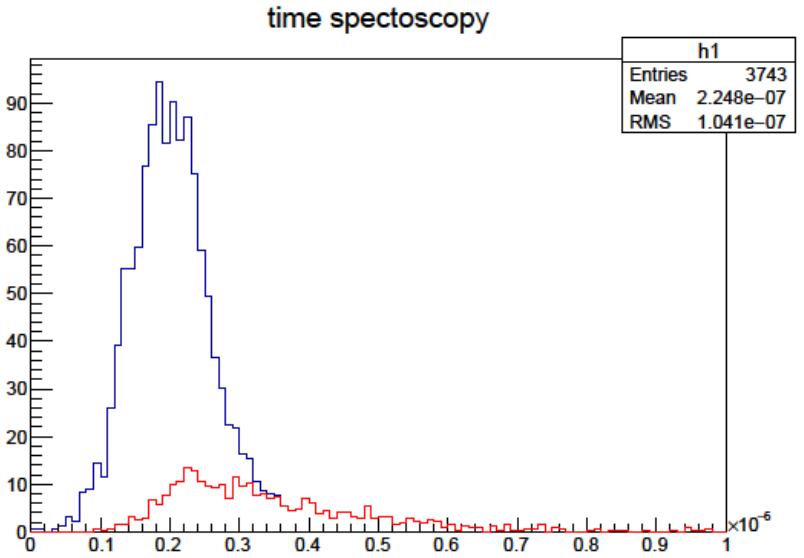
Isotropic distribution

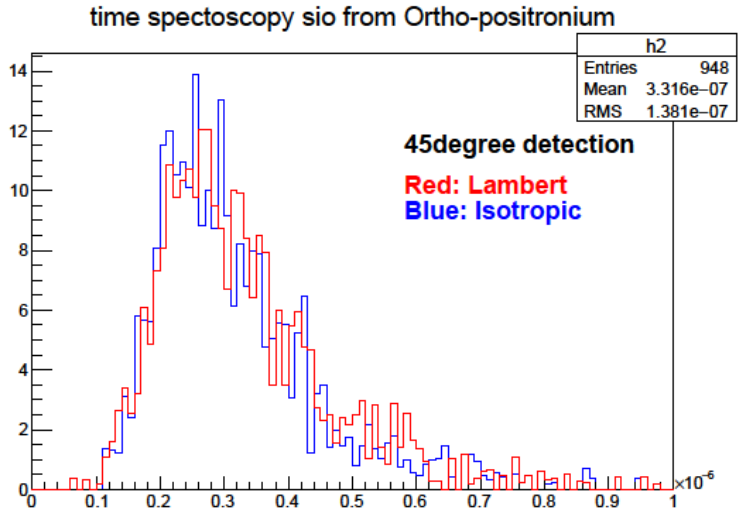


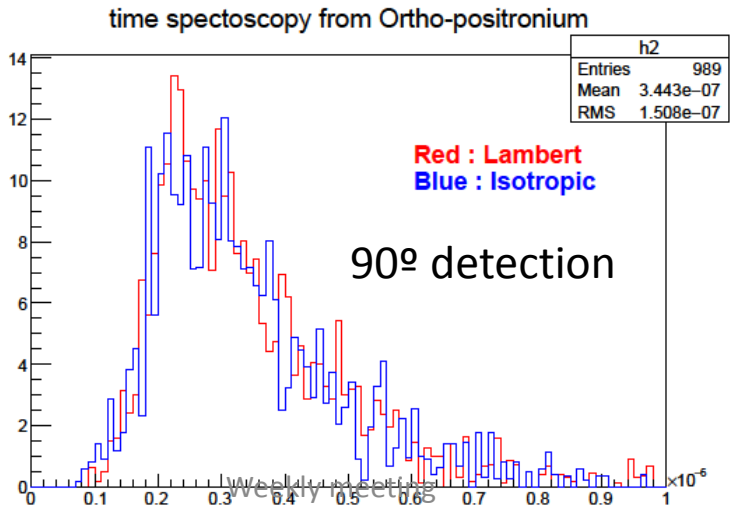
- Lambert case : 69.9% of positronium remain in cavity before decayed
- Isotropic case : 67.4% of positronium remain in cavity before decayed

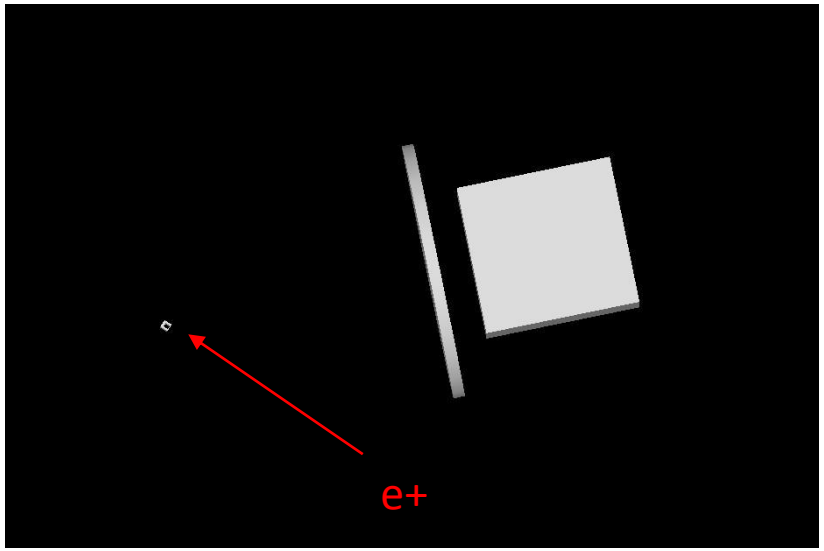
→Almost no difference.

Time spectroscopy

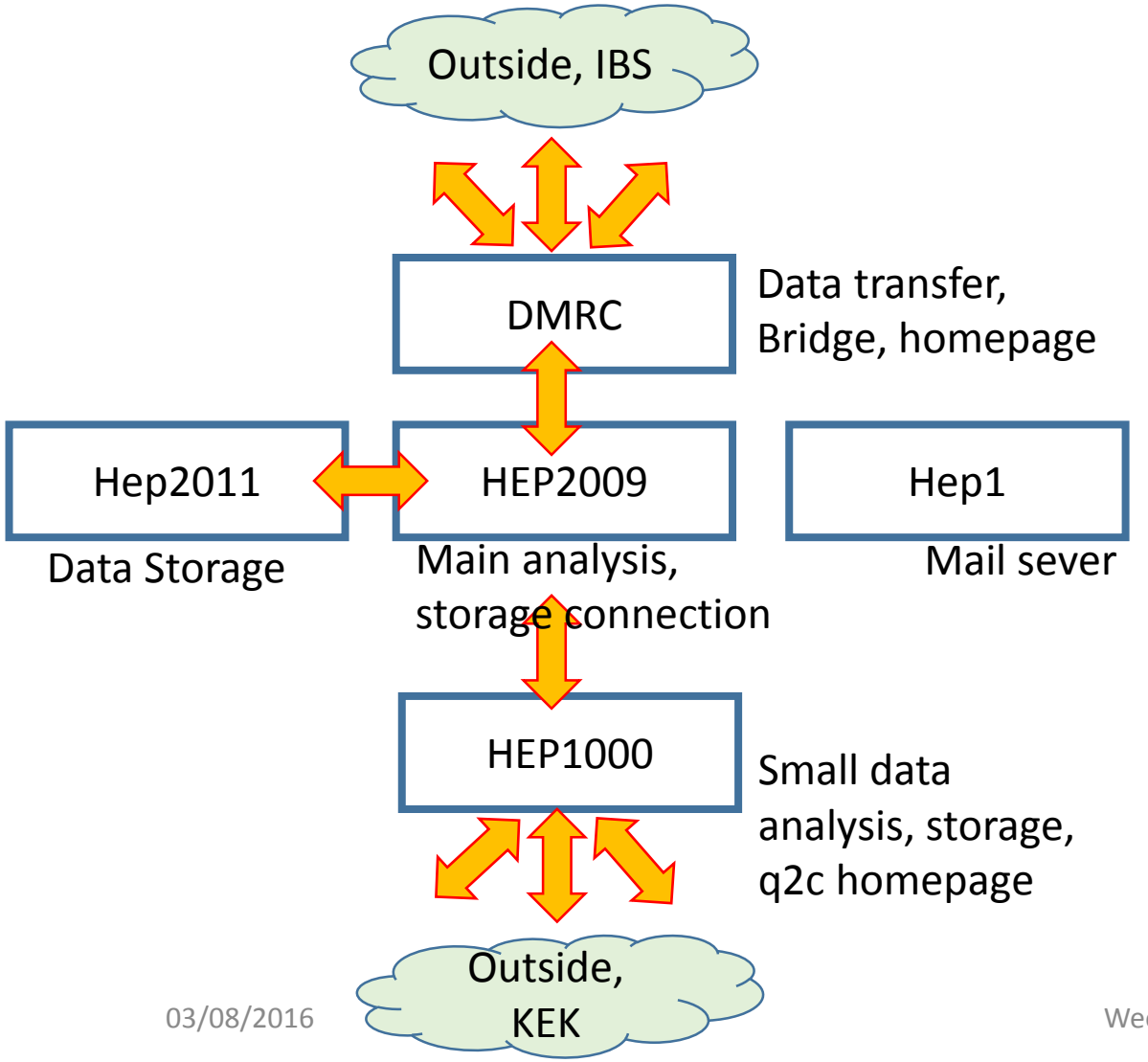








KIMS server status



- Connection log

DMRC : 25/month (from 2015.5)

- Main users : kwkim, jin lee

HEP2009 : 6/day (from 2016.7.25)

- Main users : arlee, jklee

HEP1000 : 25/month (from 2016.01)

- Main users : bhokim, jklee

HEP1 : 보통 pop3 나 imap 으로 접속하므로 로그체크외의 방법이 요구됨

CEA Saclay status

- Positron beam almost dead

→They are investigating the main problem

→Electron gun cathode need to be changed

→Vacuum leak has found

→Time required to fix (Few month?)

Next plan

- For a while, I will focus on simulation part.
- Need to change reflection, etc and check positronium diffusion more.