Progress on Simulation Software

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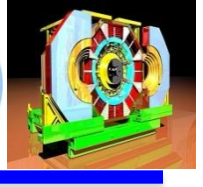
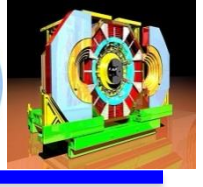
Xiao-Rong Zhou(USTC) Yu Hu(IHEP)

Outline



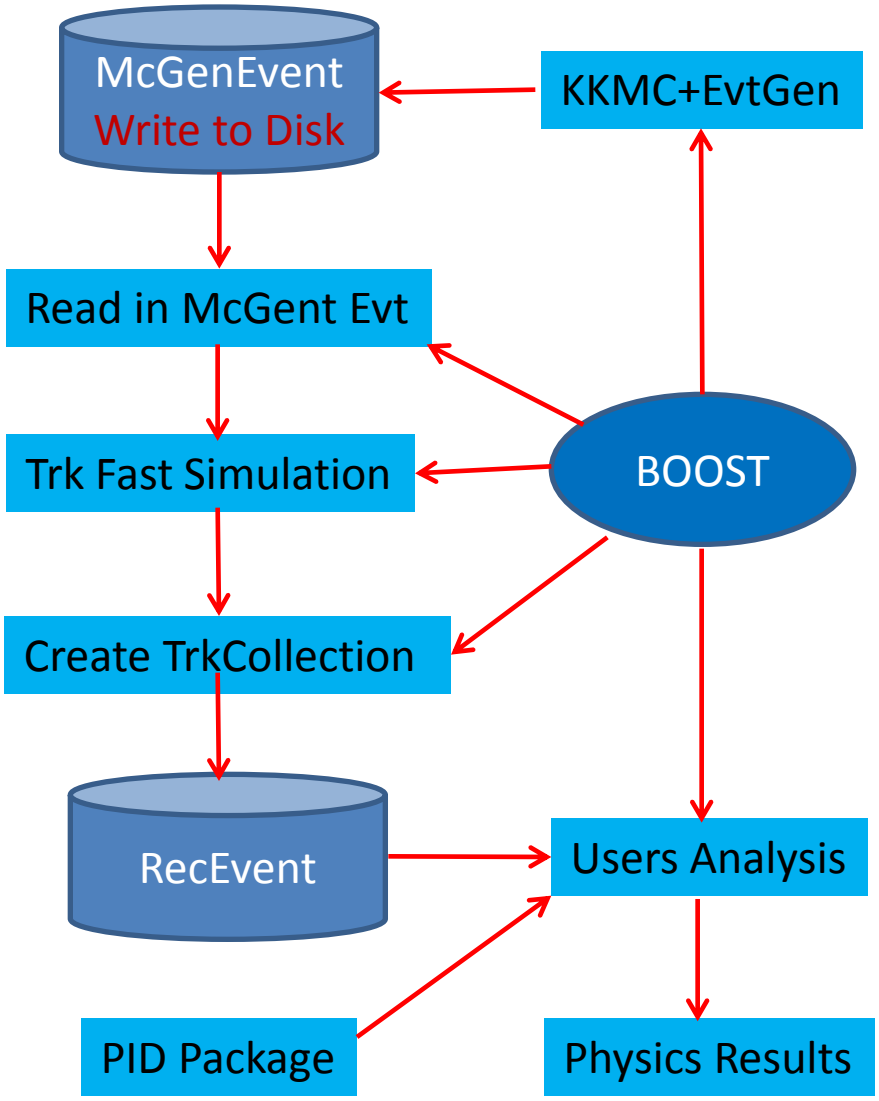
- Fast simulation software
- Full simulation software
- Package for PID
- Some information

Base Ideas for Fast Simulation



- Fast and Small storage capacity
- Convenient and friend for users
- Flexible for detector parameters
- ……

Scheme for Fast Simulation

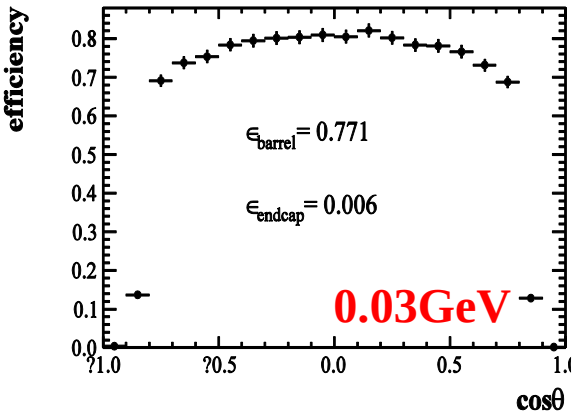


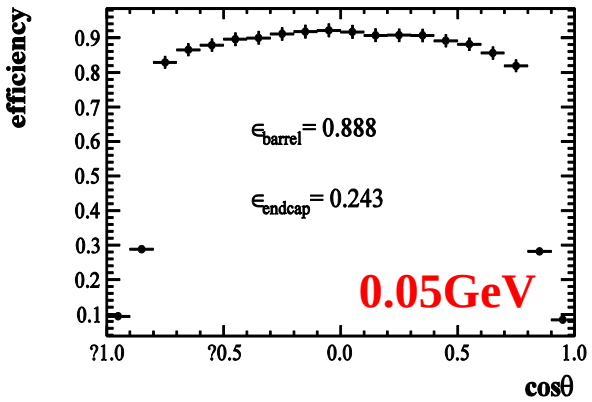
- Same as BESIII for the McGenEvt, and keep events in storage.
- Fast simulation for charge and neutral tracks (resolution, efficiency , error matrix etc),
- do not keep RecEvt information. Fix random seed for repeating analysis.
- User analysis same as BESIII Jobs
- with additional PID Package.

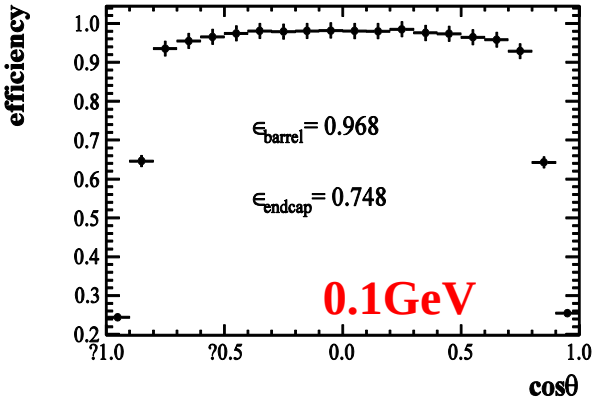
Parameterization for Gamma

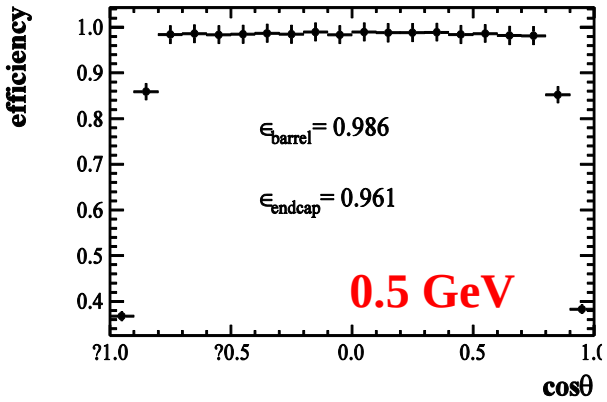
All the performance are studied by the BESIII FULL simulation

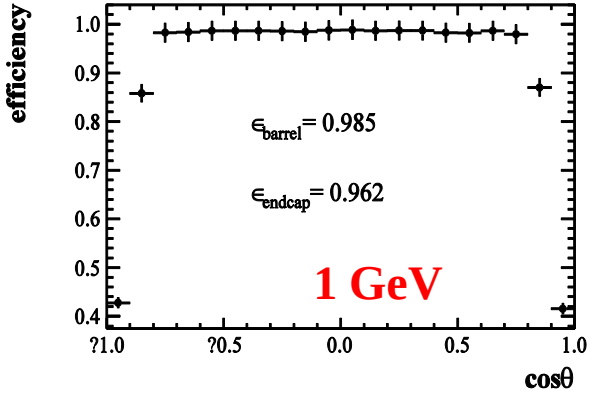
Efficiencies

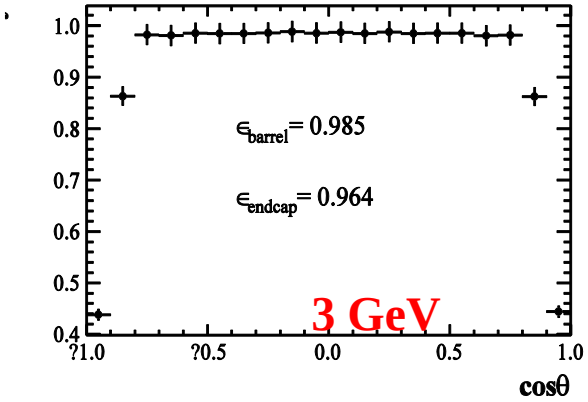






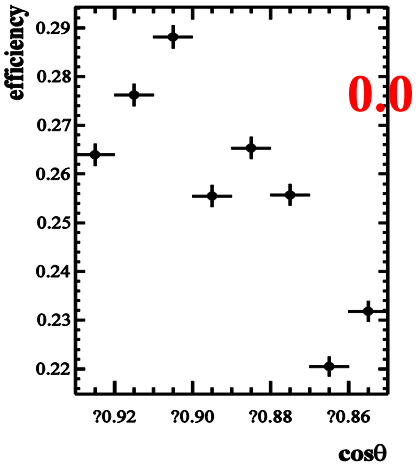




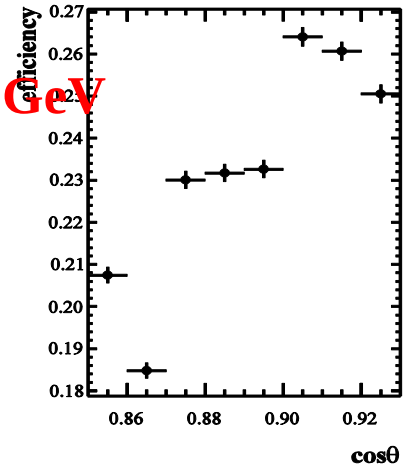


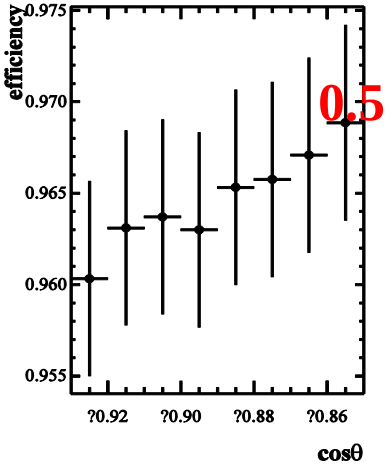
Parameterization for Gamma

Efficiencies (Endcap)

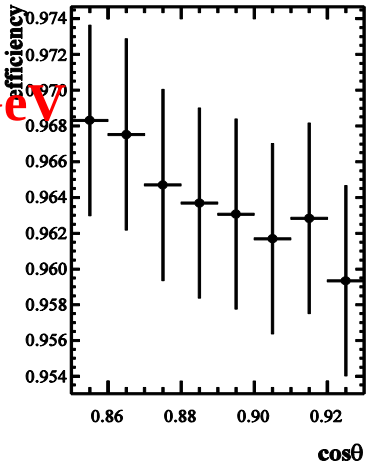


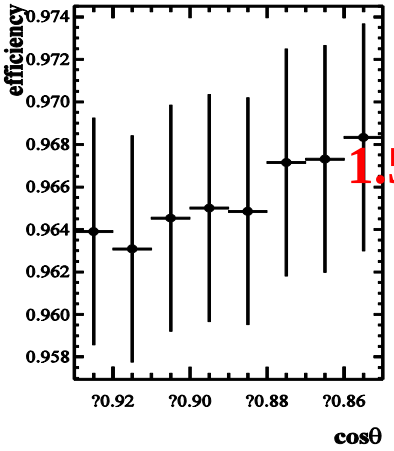
0.05GeV



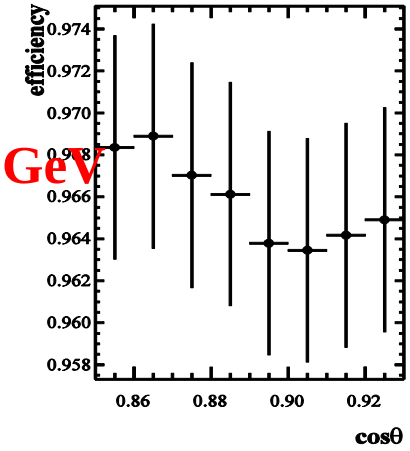


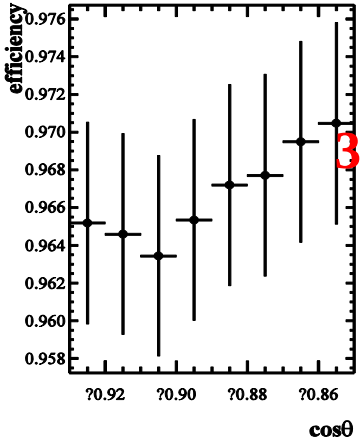
0.5GeV



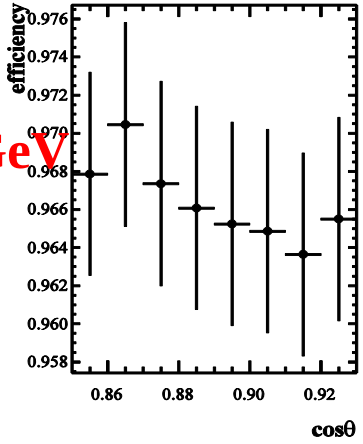


1.5 GeV



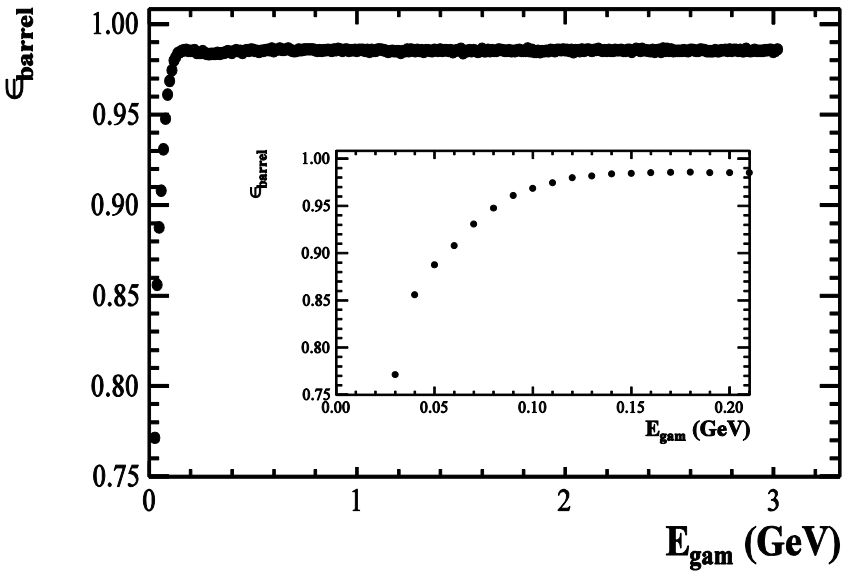


3 GeV

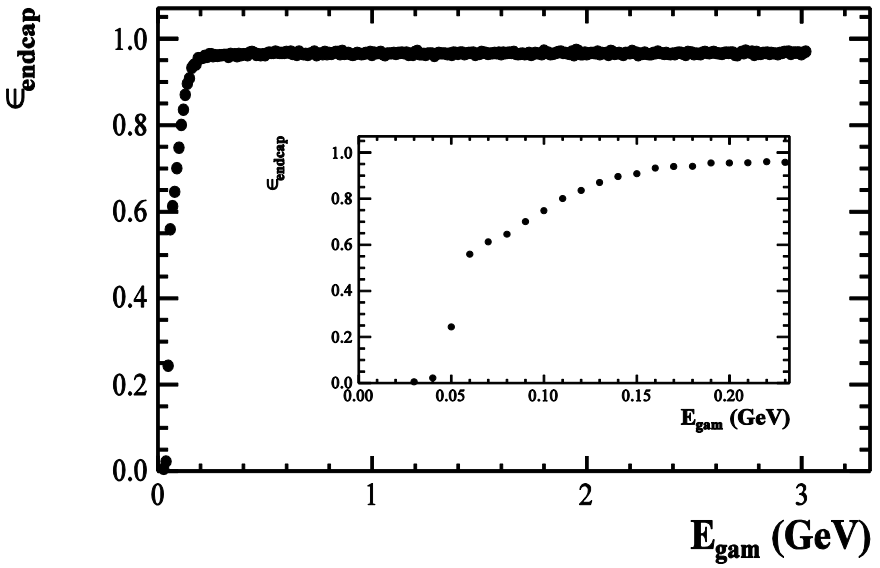


Parameterization for Gamma

The efficiency at both barrel and endcap vary within 10% at low energy. And within 1% at high energy(>0.2GeV).



Barrel : |cosθ|<0.8



Endcap : 0.86<|cosθ|<0.92

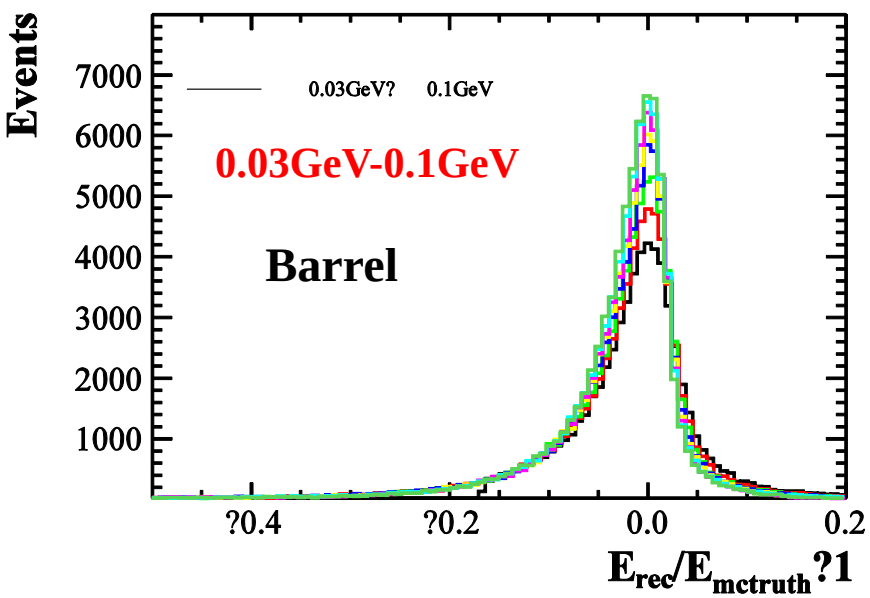
The efficiency is parameterize with two function

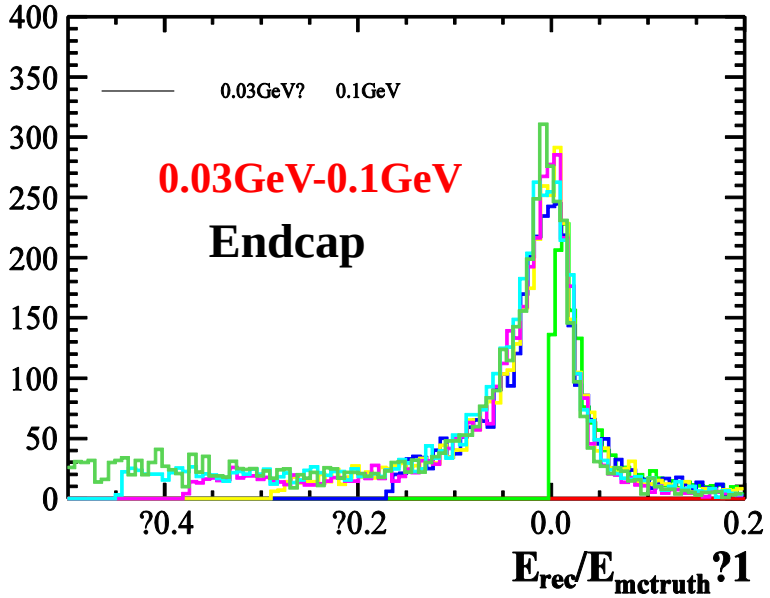
(vary with energy) for Barrel and Endcap, respectively

Parameterization for Gamma

Energy Distribution : Res = $(E_{rec}-E_{true})/E_{true}$

----versus different energy



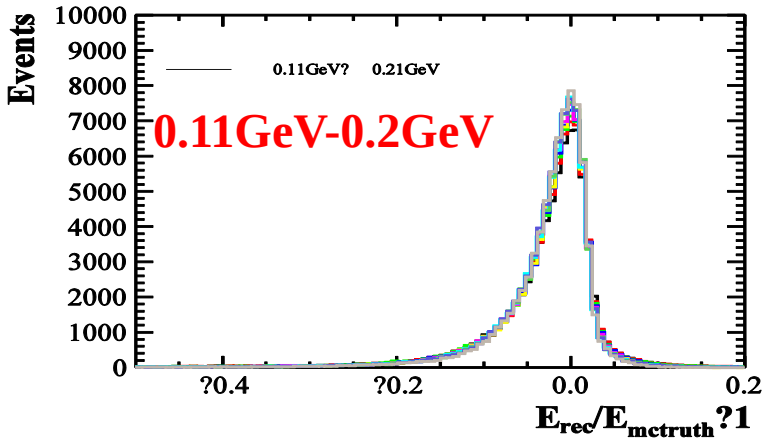


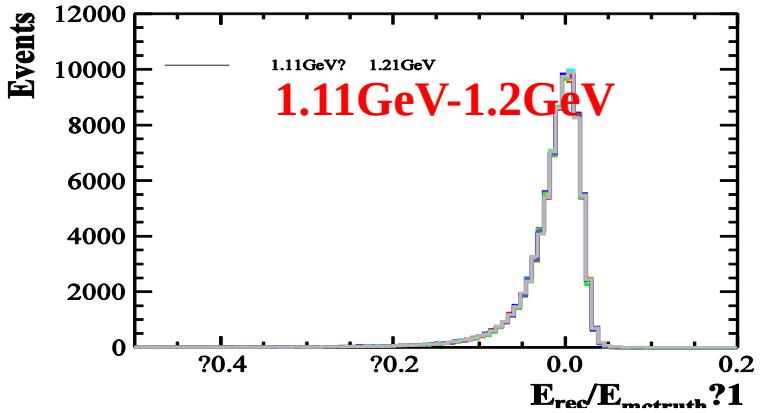
In low energy range (30MeV-100MeV), the resolution change significantly within 100MeV

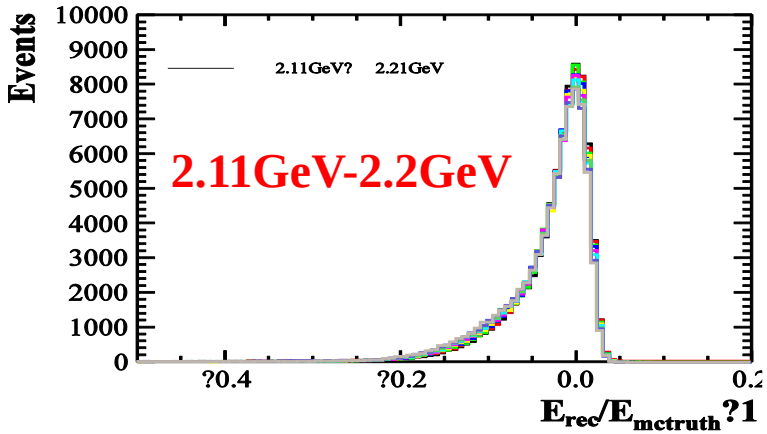
Parameterization for Gamma

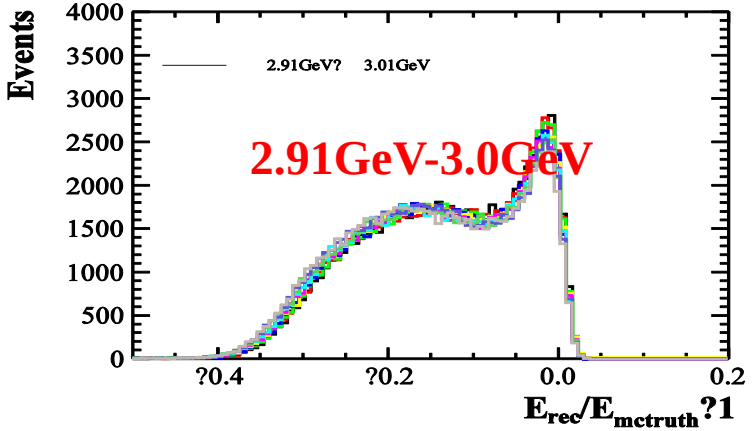
Energy Distribution : Res = $(E_{rec}-E_{true})/E_{true}$ (Barrel)

----versus different energy







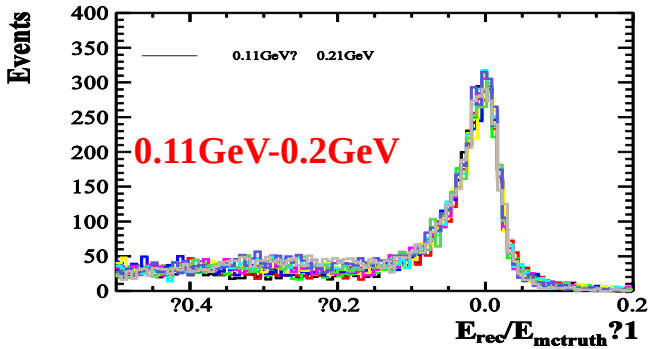


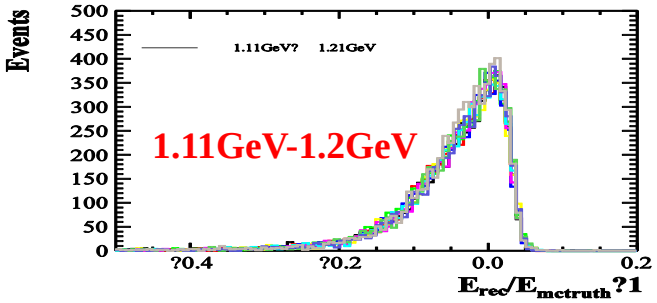
In high energy range, the resolution is stable within 100MeV

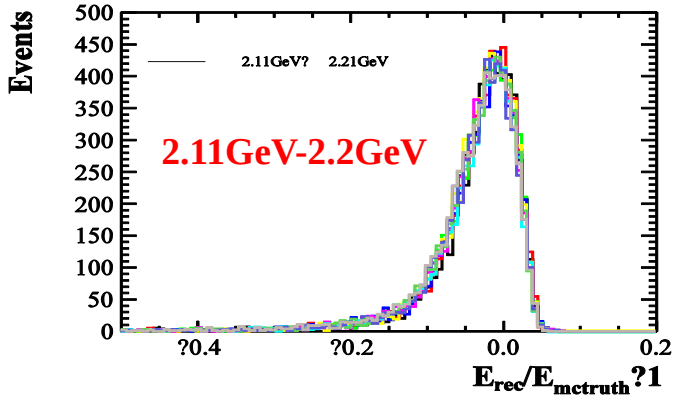
Parameterization for Gamma

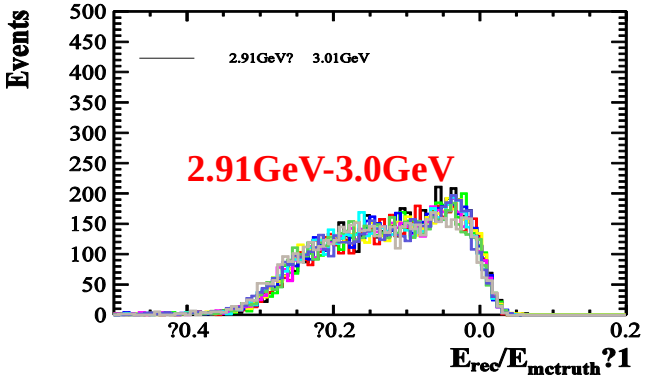
Energy Distribution : Res = $(E_{rec}-E_{true})/E_{true}$ (Barrel)

----versus different energy







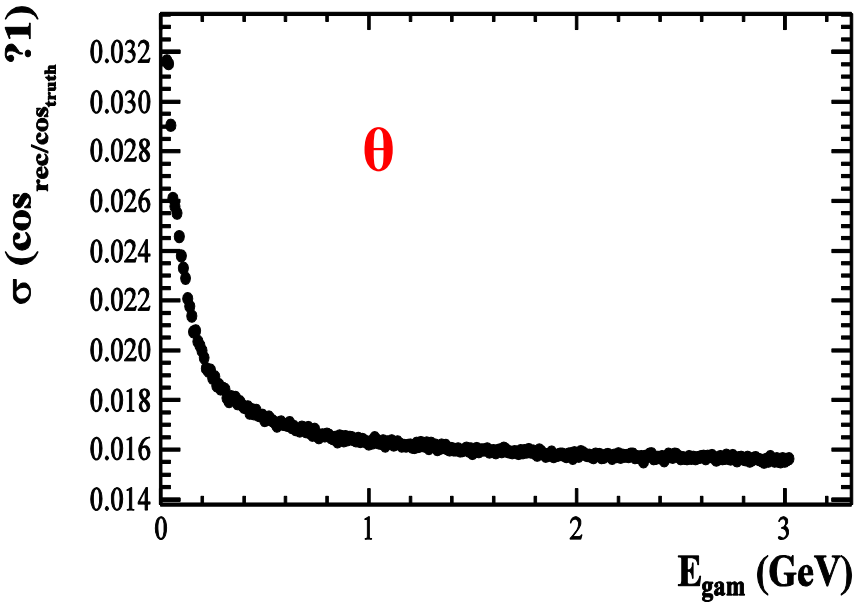


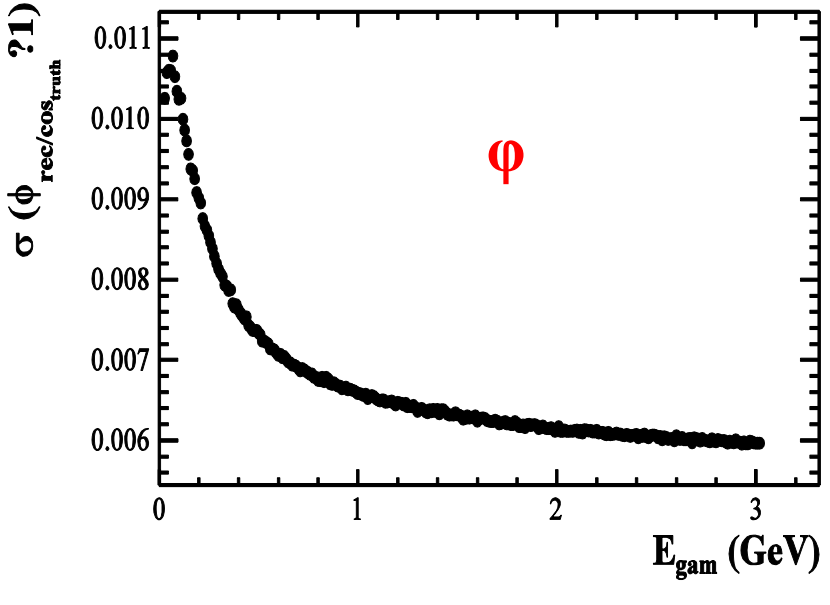
The energy resolution is sampling with histograms for Barrel and Endcap respectively, 10 MeV each MC samples.

Parameterization for Gamma

$\Delta\theta=\theta_{rec}-\theta_{true}$ / $\Delta\phi = \phi_{rec} - \phi_{true}$

----versus different energy



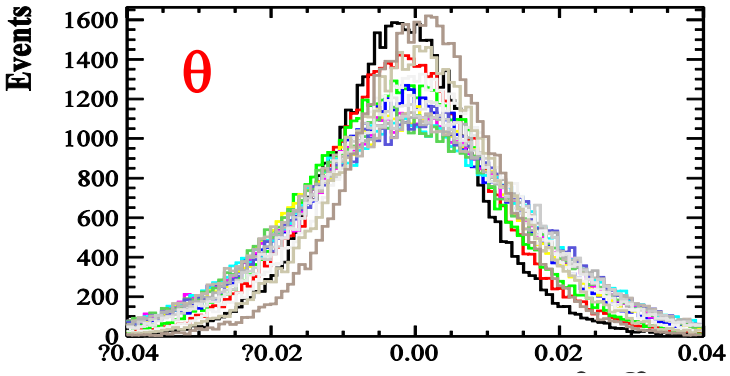


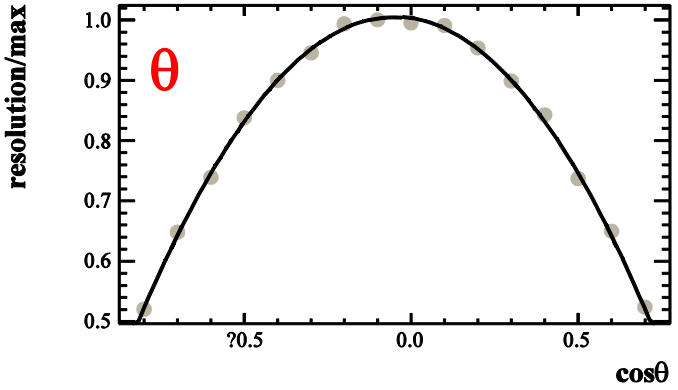
The θ/ϕ resolutions are parameterized as function of energy

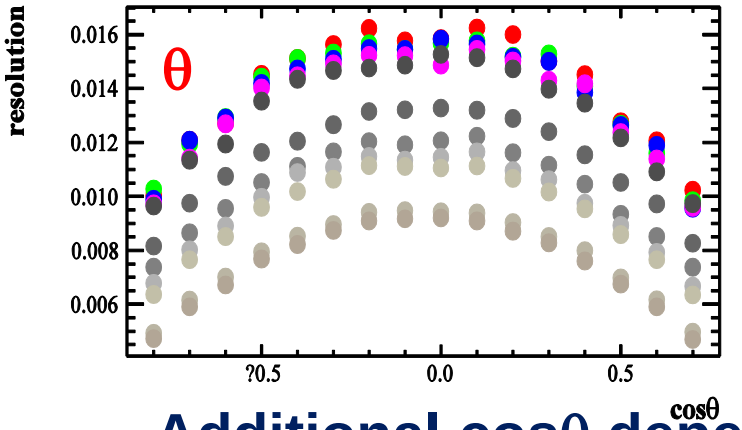
Parameterization for Gamma

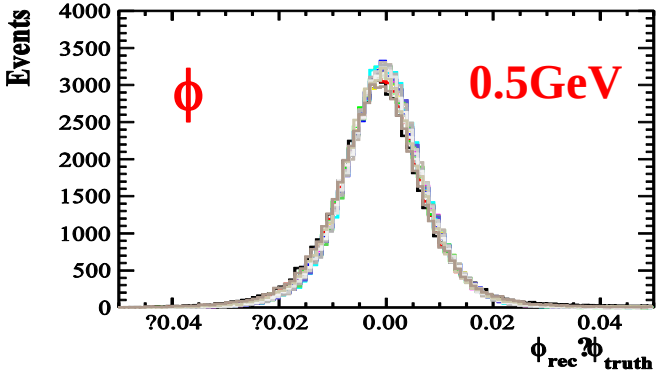
$\Delta\theta=\theta_{rec}-\theta_{true}$ / $\Delta\phi = \phi_{rec} - \phi_{true}$

----versus cosθ (16 bin from -0.8 to 0.8)





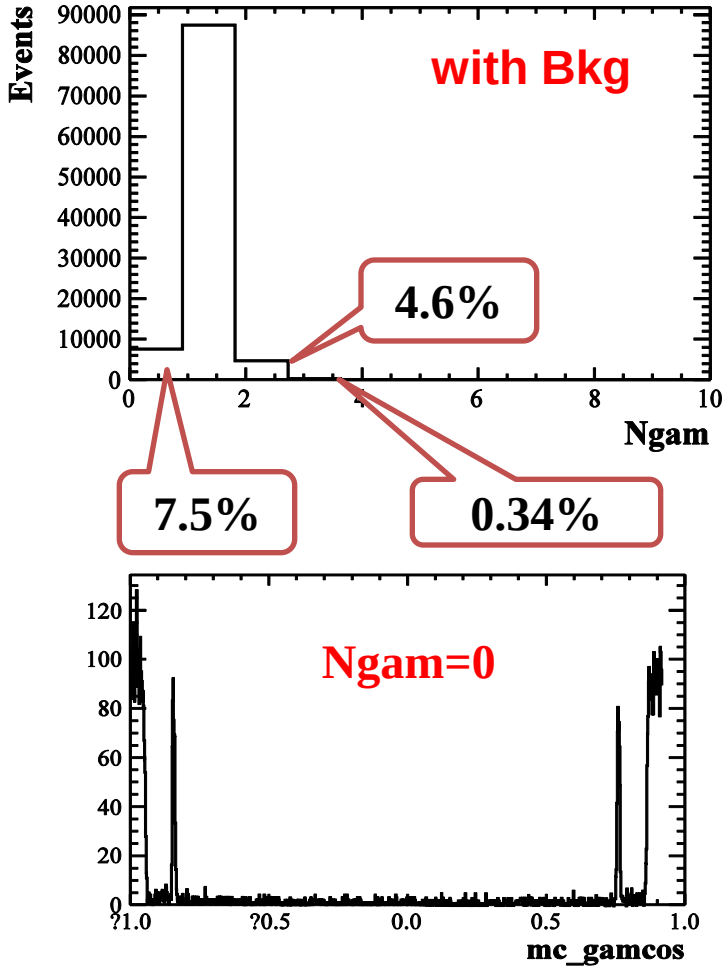


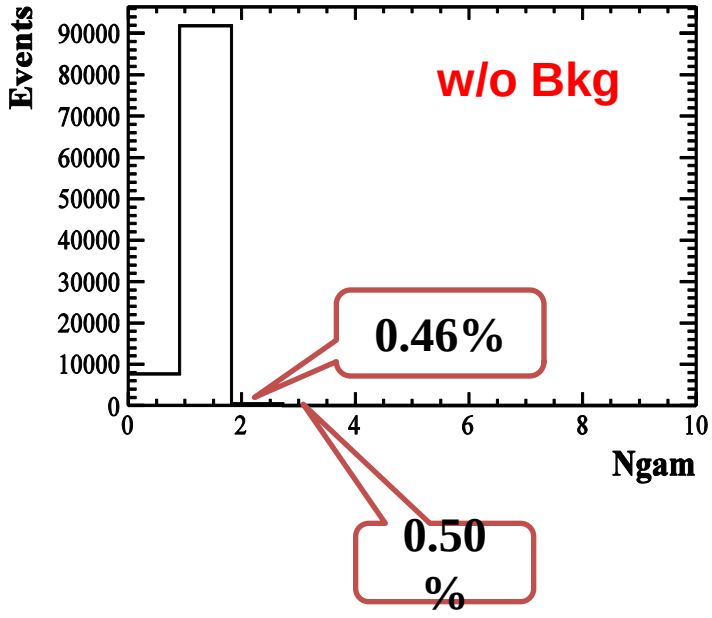


Additional cosθ dependence for θ resolution is applied in the FastSim package

Parameterization for Gamma

Multiplicity



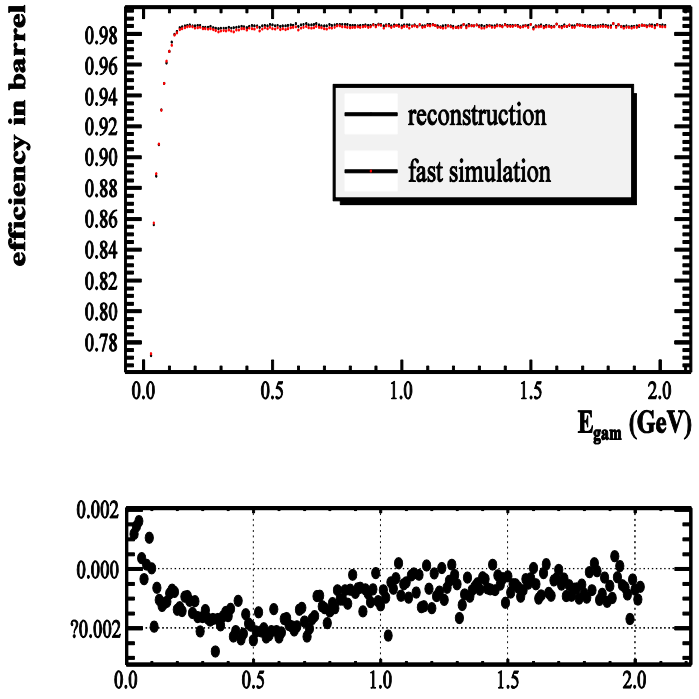


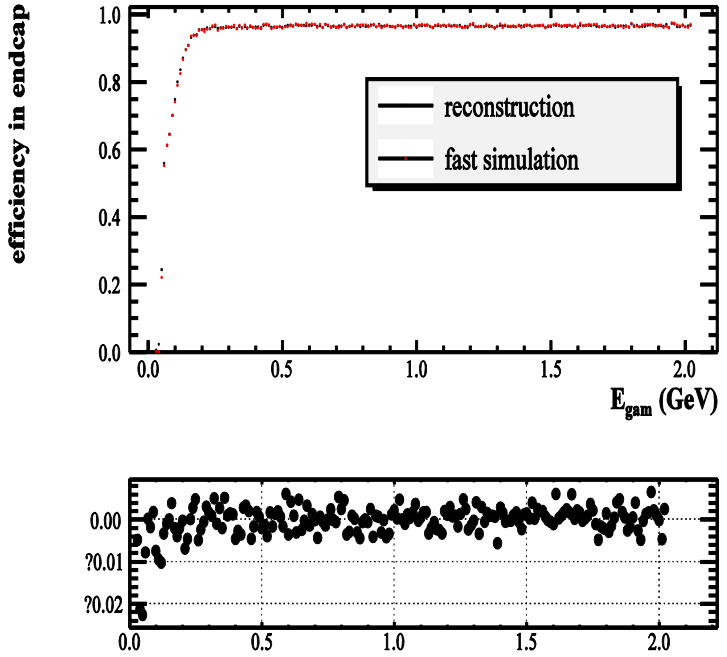
- The 7.5% 0-gam is due to acceptance.
- The 4.6% additional gamma come from the Bkg

Test Analysis of $\psi' \rightarrow \gamma\pi^0\pi^0$

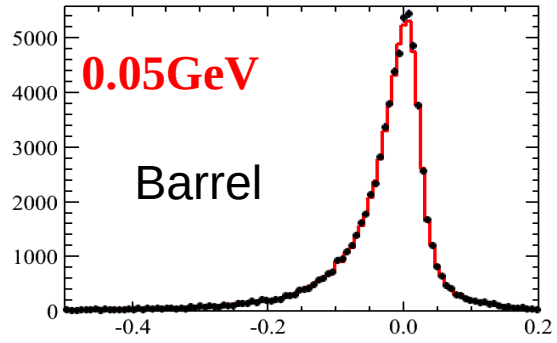
- Test Analysis with 100K sample
- Very fast for fast simulation and analysis, <5Mins, Comparable to analysis only for full simulation.
- Storage usage 10G

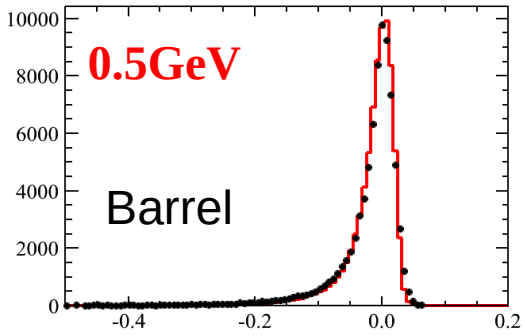
Single gamma efficiency difference smaller than 0.5% between full and fast simulation

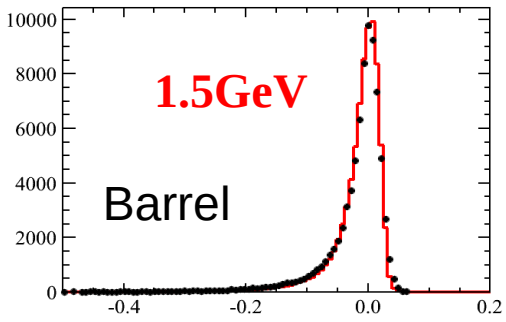


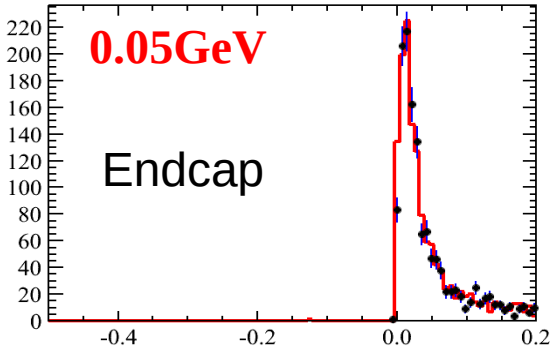


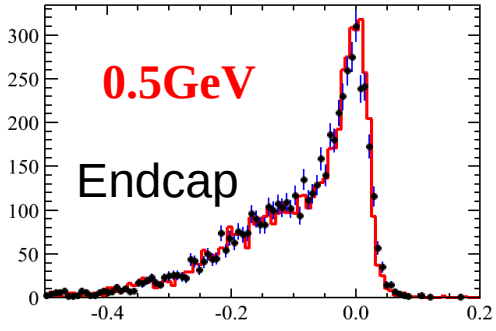
Test Analysis of $\psi' \rightarrow \gamma\pi^0\pi^0$

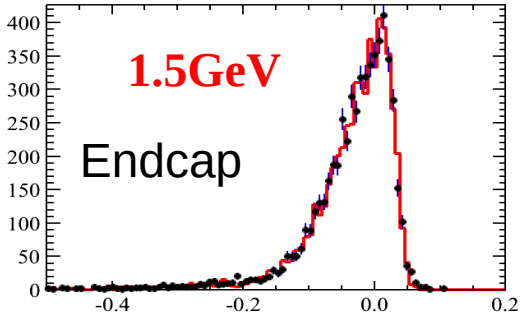










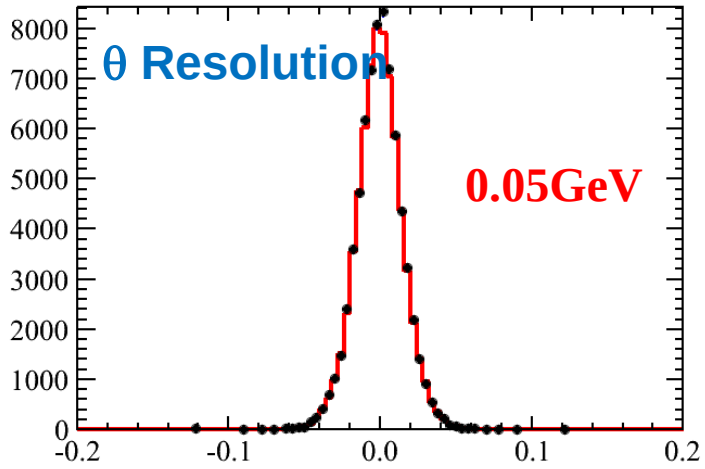


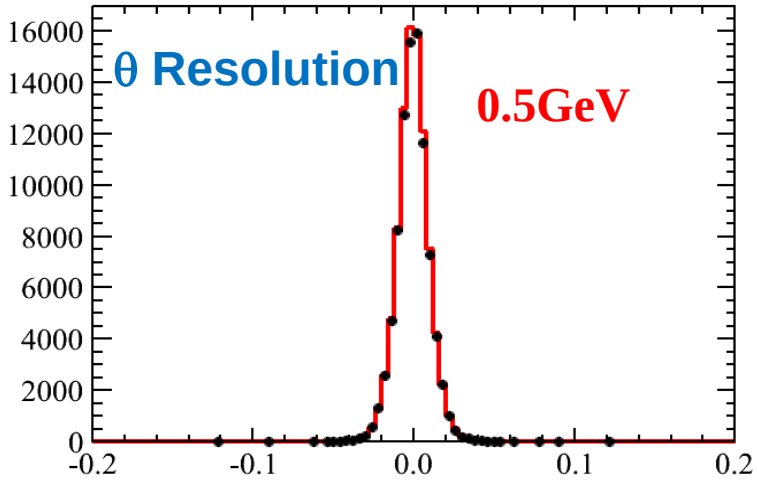
——Full Simulation

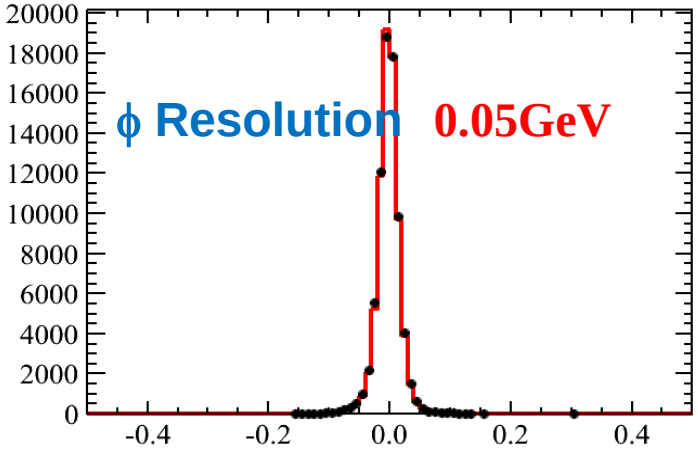
- Fast simulation

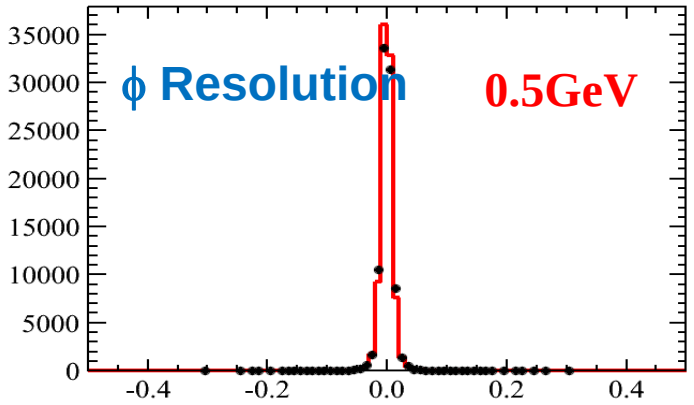
Good agreement between Fast and Full simulation for gamma Energy resolution

Test Analysis of $\psi' \rightarrow \gamma\pi^0\pi^0$

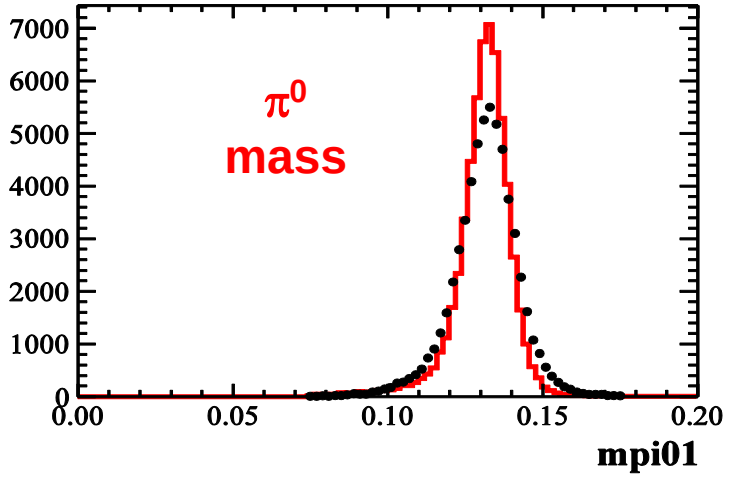


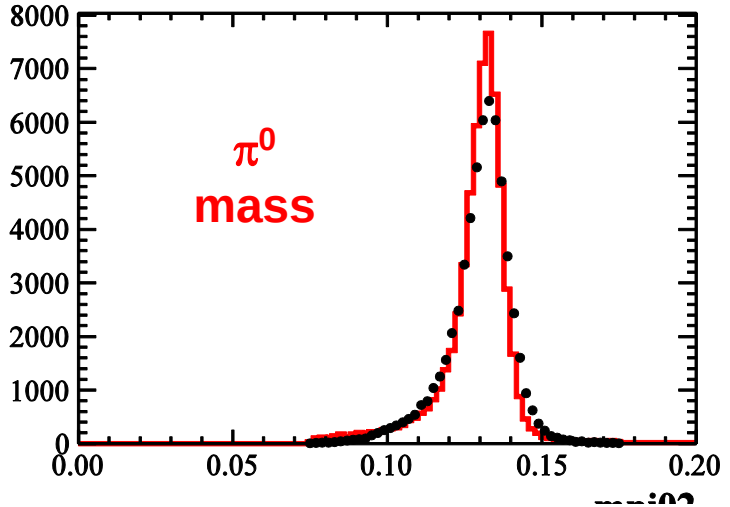






Test Analysis of $\psi' \to \gamma\pi^0\pi^0$

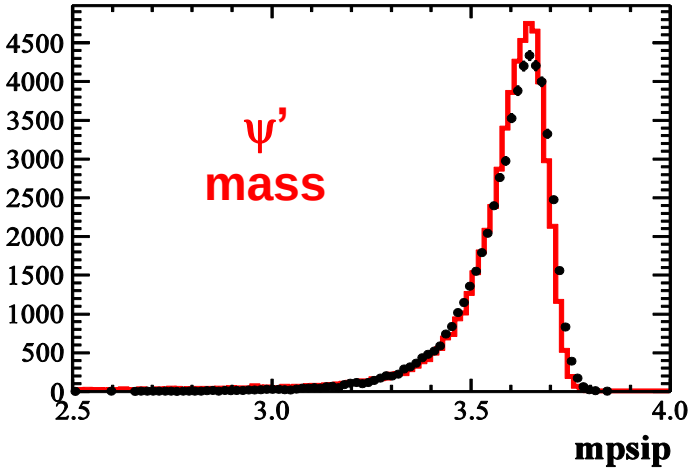




Event Selection efficiency :

Full Simulation : 58.5%

Fast Simulation : 56.6%

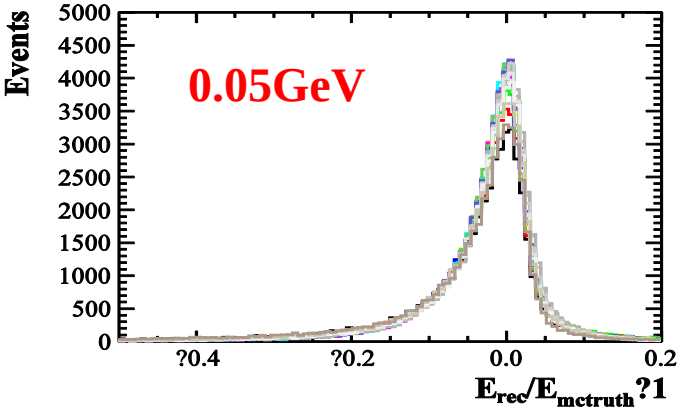


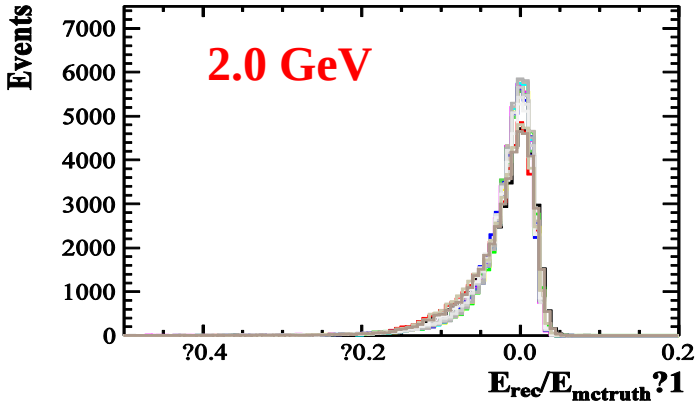
Small difference in mass resolution

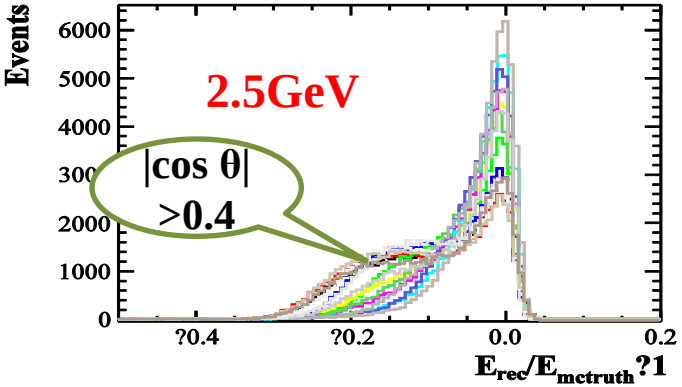
Gamma Energy resolution

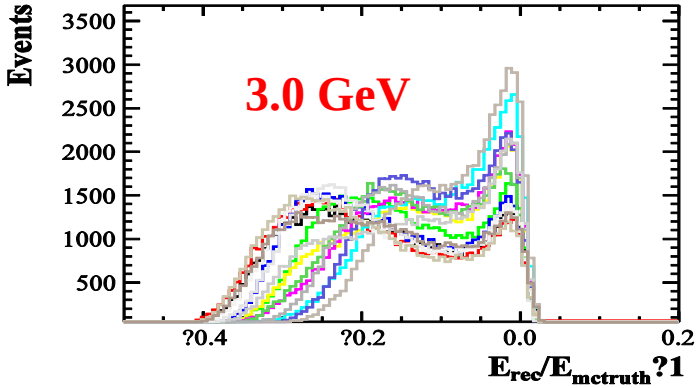
Energy Distribution : Res = $(E_{rec}-E_{true})/E_{true}$ (Barrel)

----versus cosθ (16 bins from -0.8 to 0.8)

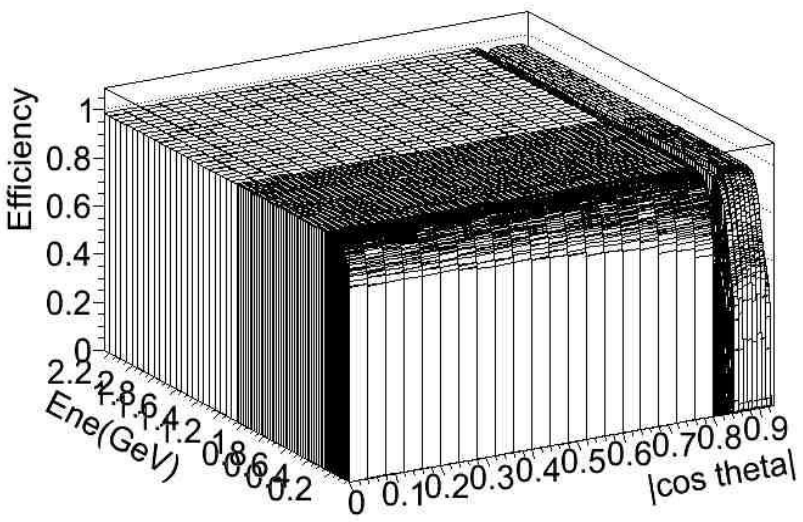


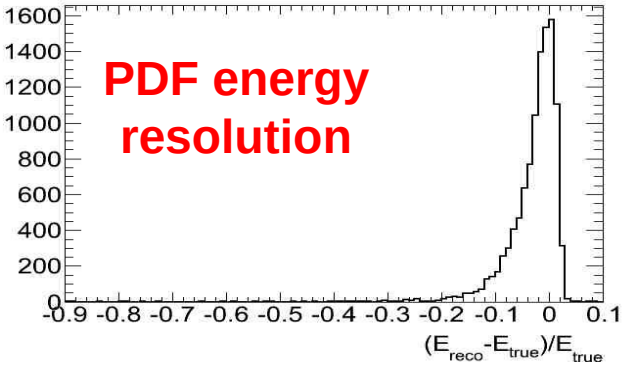


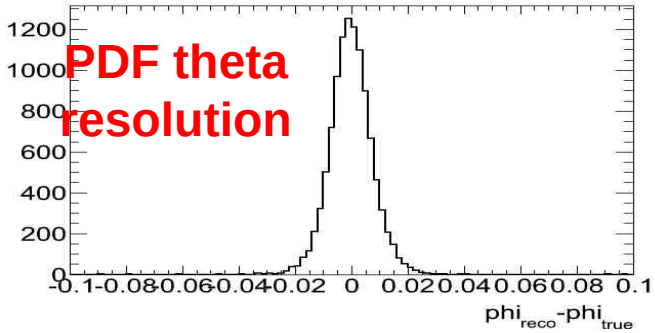


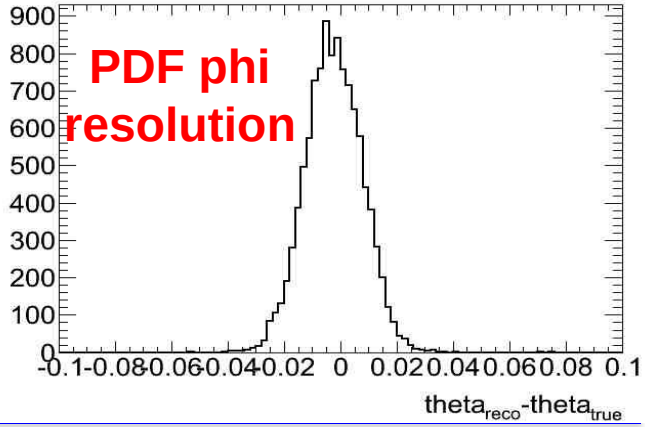


New scheme for gamma Parameterization



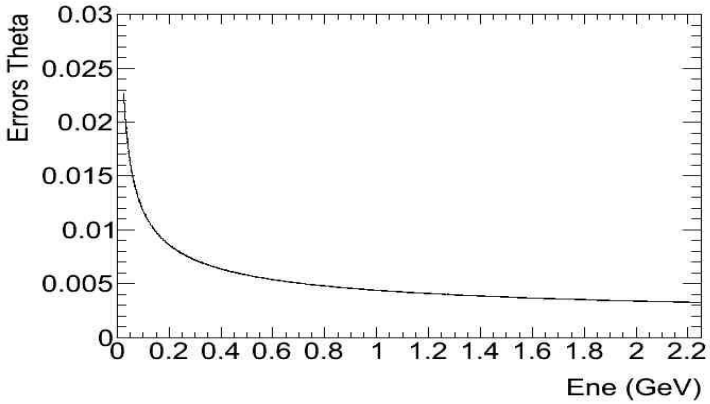


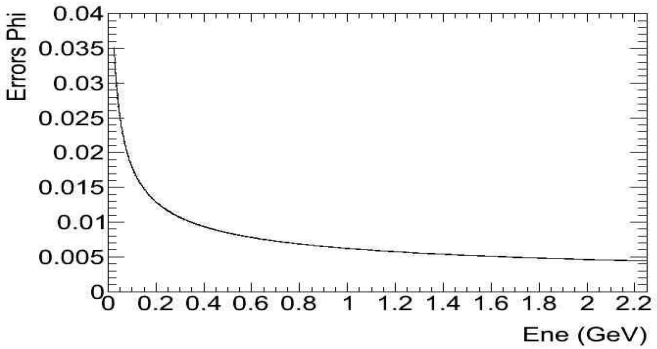


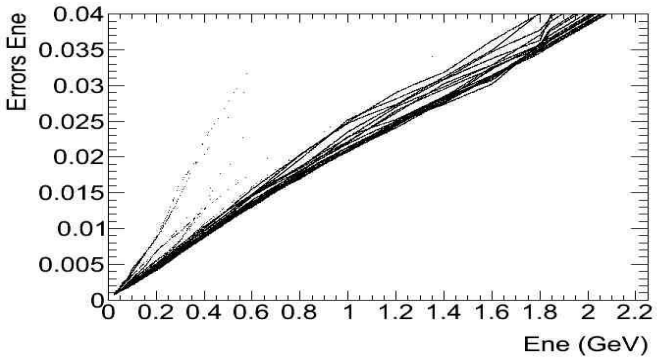


- Binning as function of energy and cosθ to get the efficiency, energy, θ/ϕ resolution in local.
- Bin size (total 5600 bins) is studied carefully to make sure the efficiency and PDF not change dramatically in two neighbor bins, also to make sure small memory consuming
- Interpolation is applied between neighbor bins

New scheme for gamma Parameterization







- **Add error parameters of energy, theta, phi for Kinematics fit in analysis.**
- **Add scale variables in jobs option for user to change the expected detector resolution easily**

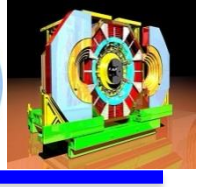
****

STCFastSim.gamEneScale = 0.9;
STCFastSim.gamTheScale = 1.1;
STCFastSim.gamPhiScale = 0.8;

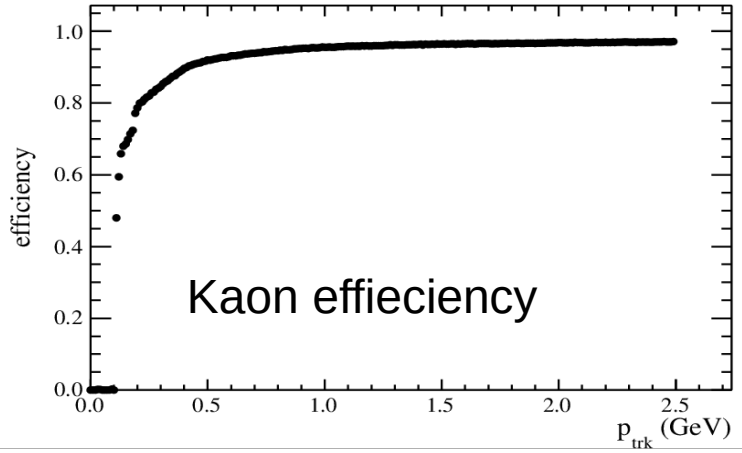
****

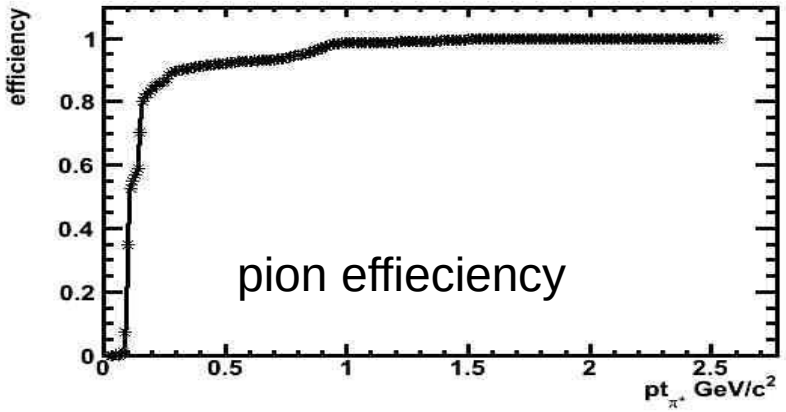
Expected to have better agreement between full and fast simulation, and not too much slow on speed, But need more test…..

Parameterization for charged tracking

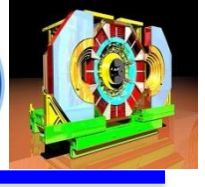


- The simulation flow is ready, can be used to do physics analysis.
- A bit more complication on the parameterization, especially for the efficiency due to low momentum tracks decay
- Different parameterization for the π/K/proton particles (efficiency, 1/pt, theta, phi resolution)
- expected to less than 8% difference on efficiency between full and fast simulation at low momentum.



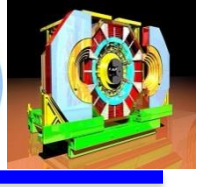


Full simulation package



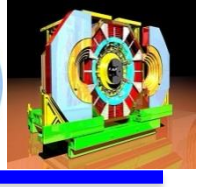
- To simulate signals and to validate the fast simulation package.
- Base on the BESIII Package.
- But can try to adjust some parameters (e.g. momentum resolution etc)

PID package



- Maybe Completely different to the BESIII detector, and BESIII simulation scheme can not be used.
- Is developing a new PID package simply according to the assumed separation power as function of momentum between π/k/proton.
- to be employed easily for user
- The code will be ready in three weeks….

Some information



Computing environment on USTC:

- Upgrade the cluster system last month
- Totally 840TB bare storage, and 630TB can be available
- 48 blade machine (384 cores, 768 jobs at same time) as computing node.
- A lot of machine for interactive jobs, (login node, submit batch job, debugging ….)
- BESIII software, root, geant4 etc Installed, and Fast (full) physics simulation , analysis , and detector simulation jobs can be run easily

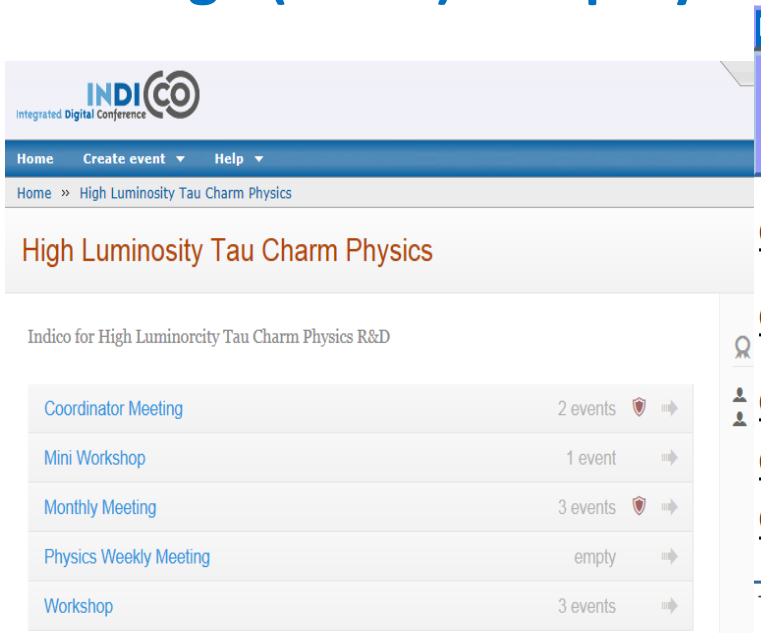
Welcome more experts/students join us to run simulation/analysis job

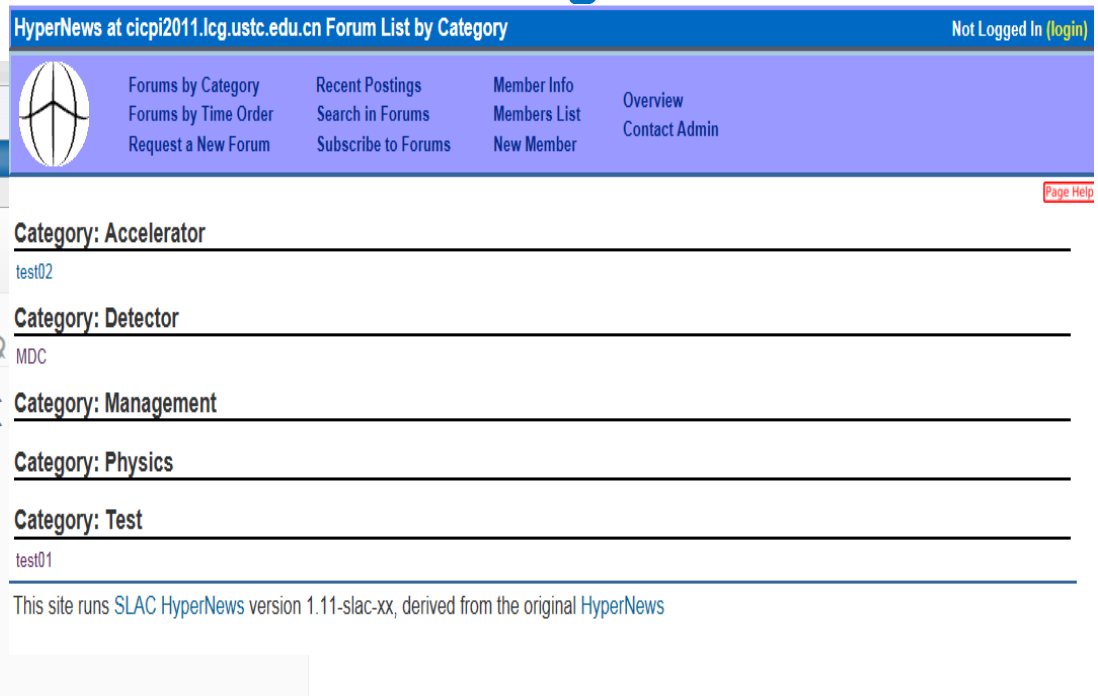
Some information

Indico: http://cicpi2011.lcg.ustc.edu.cn/indico/categoryDisplay.py?categId=2

Hypernews: http://cicpi2011.lcg.ustc.edu.cn/HyperNews/cindex/

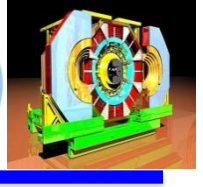
Seevogh (BESIII) and polycom for remote meeting



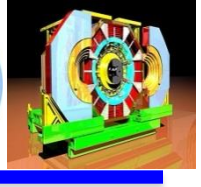


Welcome to join our meeting!

Summary



- Fast simulation package and computing environment at USTC are ready for STCF physics/detector study.
- Gamma parameterization is good enough, and need more detail to study the charged tracking performance.
- PID package will be ready soon
- Need more package (neutron, long life particle etc..)
- Physics simulation progress is a bit delay, encourage our theorist provide more ideas, topics for explore.
- Welcome more experts/students join us for physics simulation, detector simulation and software/tool developing



- Weekly meeting is set up from next week…..
- Some mini-workshop for some dedicate topics ….

Welcome to join …..

Thank you!