Summary of Kinematical cuts

G.Y.Lim

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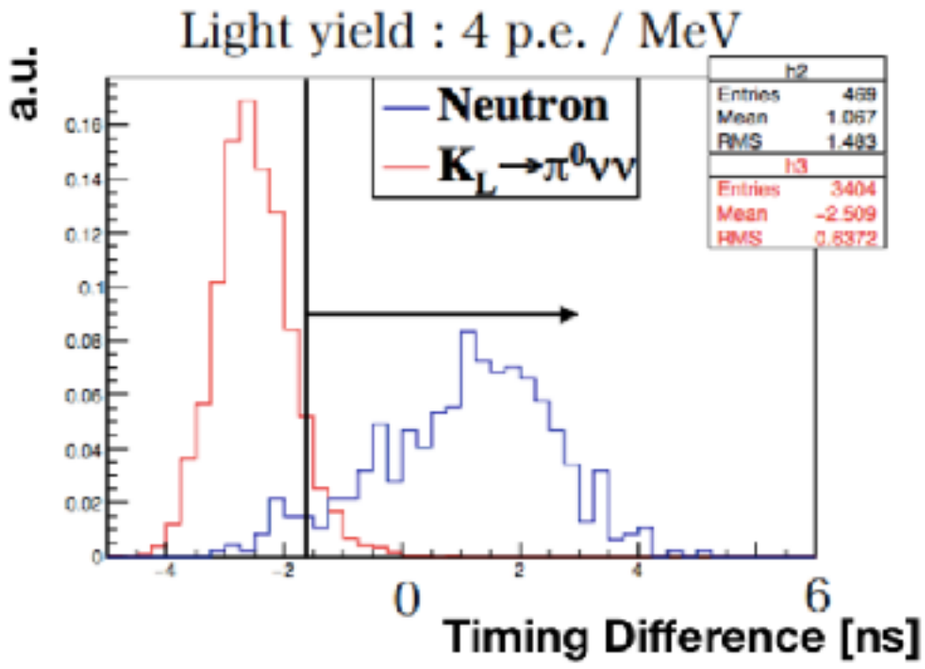
Selection Cuts

- Obtained data contains lots of background
    - Background: Unwanted events such as different modes of the K-decay, pi0 generation etc.
- In order to select signal only by rejecting background, we use observables which have different distribution between signal and background
    - Keep signal as large as possible
      and to reject background as many as possible



Current default cut condition

- Default cut from Proposal

	min	max
γ energy energy	>100MeV	<2000MeV
CsI fiducial	min(x,y)>150mm	R<850mm
vertex z	>3000mm	<5000mm
Pt	>130MeV	<250MeV
projection angle		<150deg
cluster distance	>3000mm	
γ total energy energy	>500MeV	
Eθ	>25000MeVdeg	
Energy ratio	>0.2	
Pi0 Kinematic Cut		
Shape χ^2	<4.6	

two gamma from pi0

- New cut from run49 analysis

	min	max
γ total energy energy	>650MeV	
COE	>200mm	
Cluster RMS	>10	
Cluster Size	>4	
Vertex time difference		<2ns
min. distance from dead ch.	>53mm	

- New cut from run62 analysis

	min	max
Cluster Discrimination	>0.8	
Pulse shape Likelihood ratio	>0.1	
Max Theta χ^2	>4.5	

n/gamma separation

- Veto set

	Energy	Timing
FB,NCC	1MeV	±20ns
MB	1MeV	±30ns
BCV	0.5MeV	±30ns
OEV	1MeV	±10ns
CV	0.2MeV	±40ns
LCV	0.6MeV	±15ns
Hinemos	1MeV	±15ns

	Energy	Timing
CC03-06(CsI)	3MeV	±15ns
CC04-06(Scinti)	1MeV	±15ns
BHCV	0.3MeV	±7.5ns
Extra cluster		±10ns

CsI single crystal: <10MeV(200mm)-3MeV(600mm)

 BHPV: <3Module coincidence (±7.5ns)

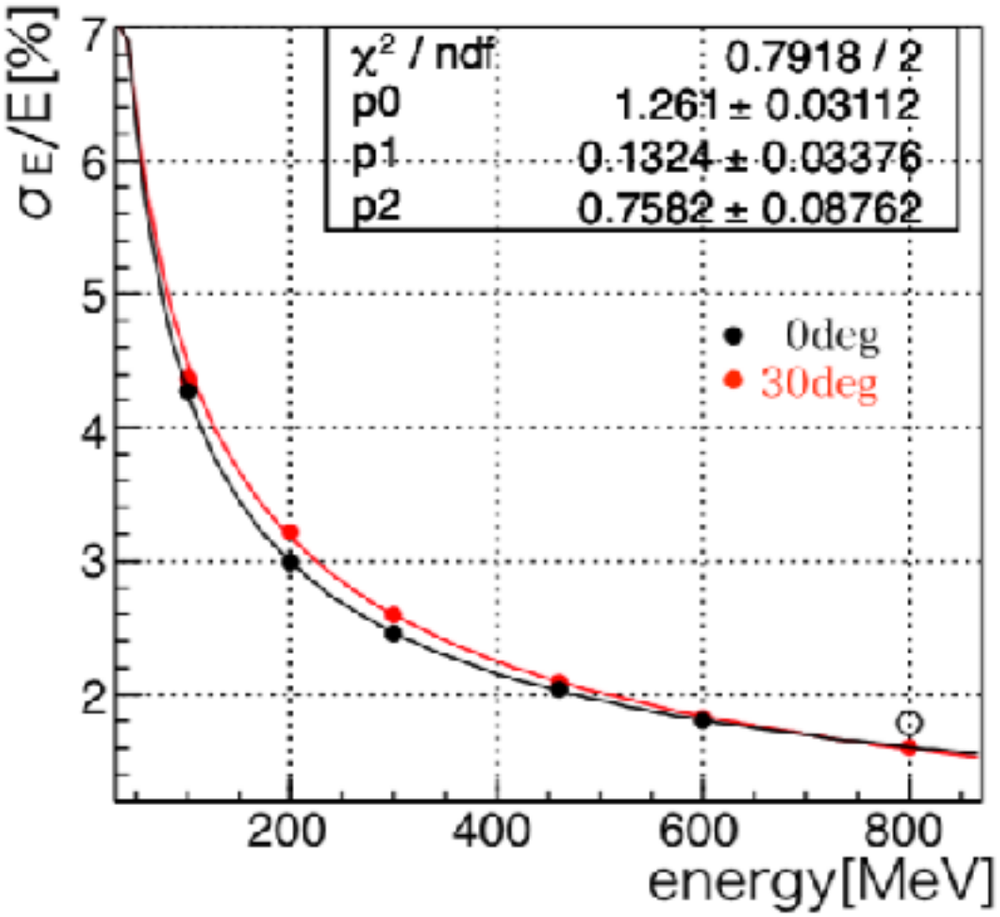
Use well reconstructed gamma

Energy

Gamma energy distribution

125MHz, 14 bit ($2^{14} = 16384$)

Resolution



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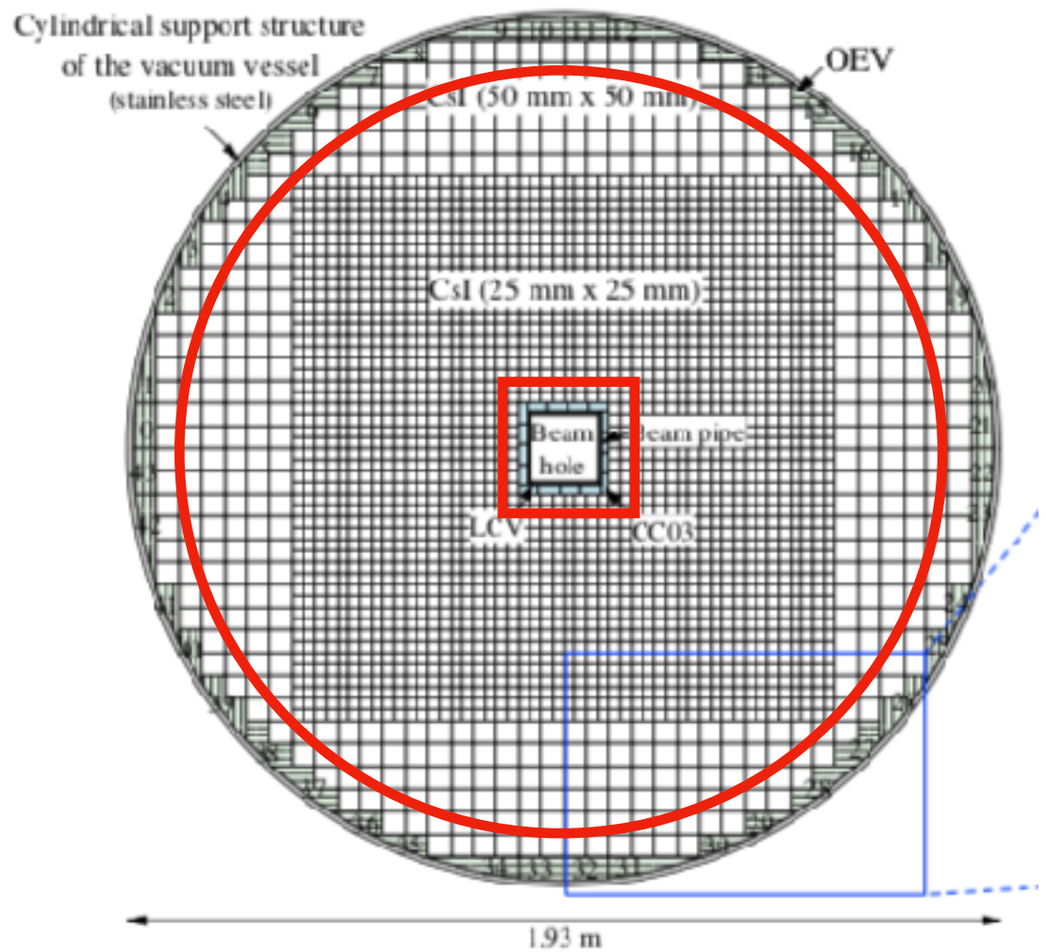
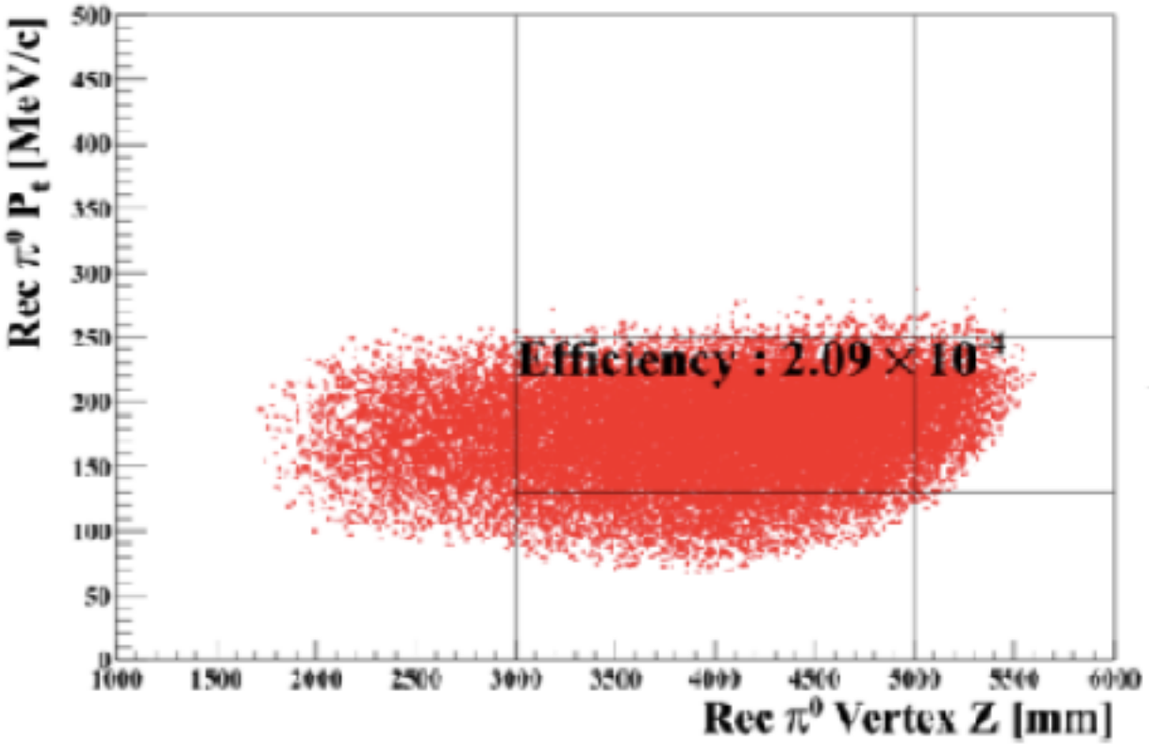
Fiducial

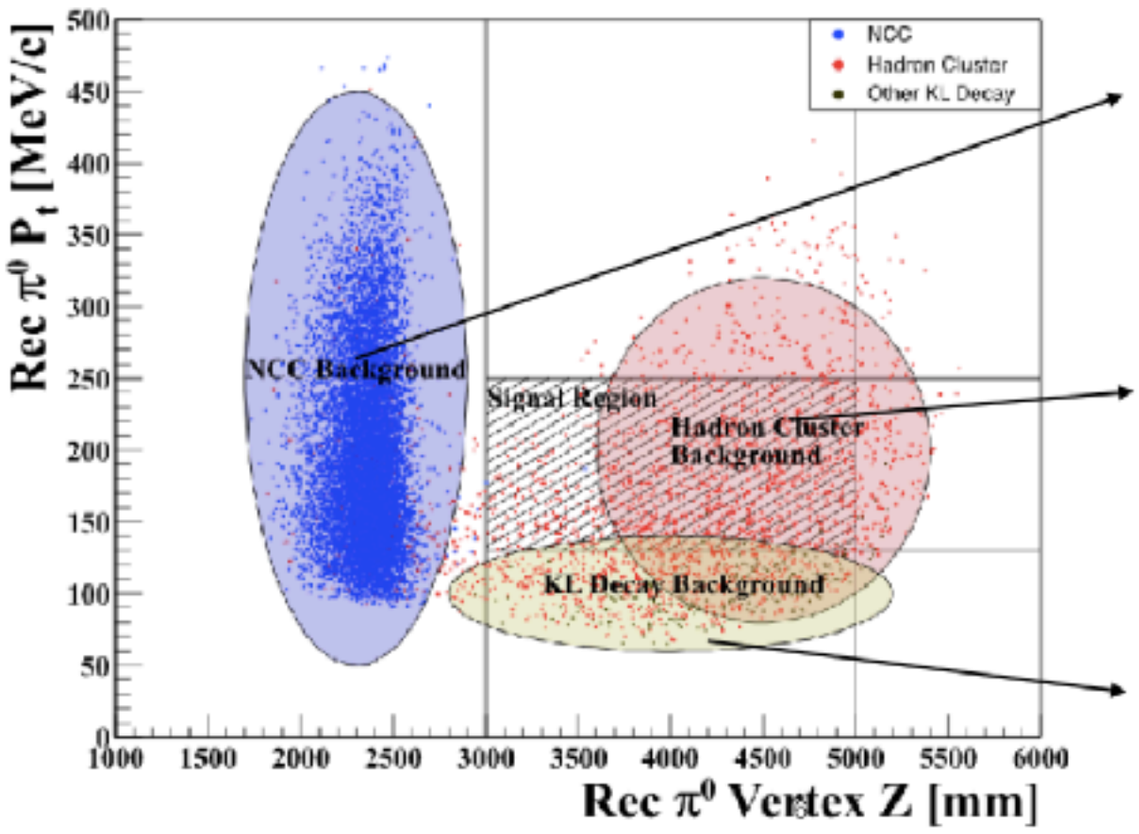
Shower leakage

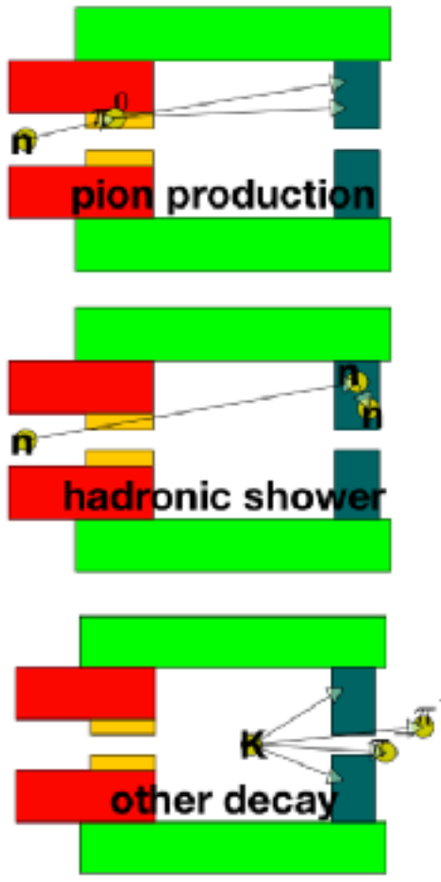




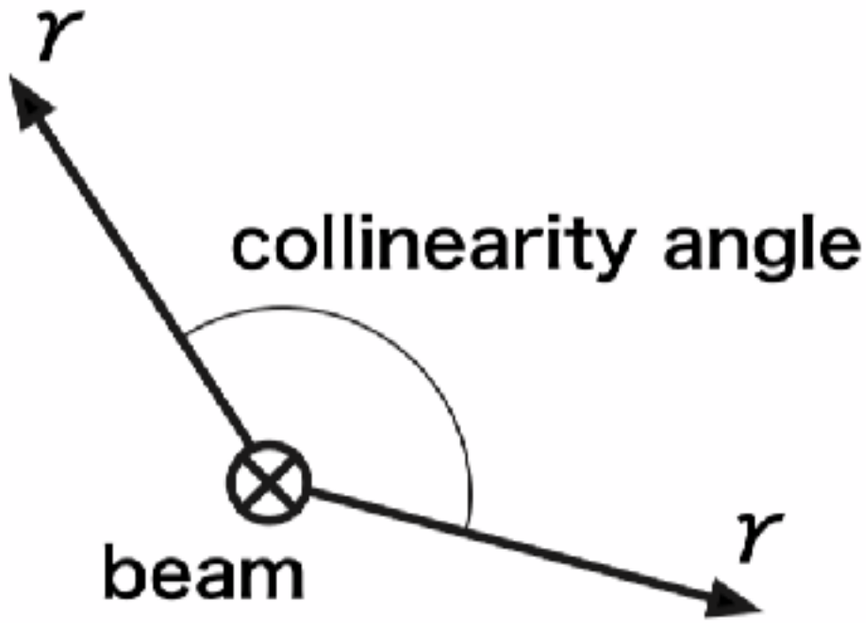
P_T-Z plot

- Background estimation for understanding remaining events around signal box.





Projection angle
- Two body kinematics
- To reject KL->gamma gamma



$$\cos^{-1}\frac{\vec{r_1}\cdot\vec{r_2}}{|\vec{r_1}||\vec{r_2}|},$$

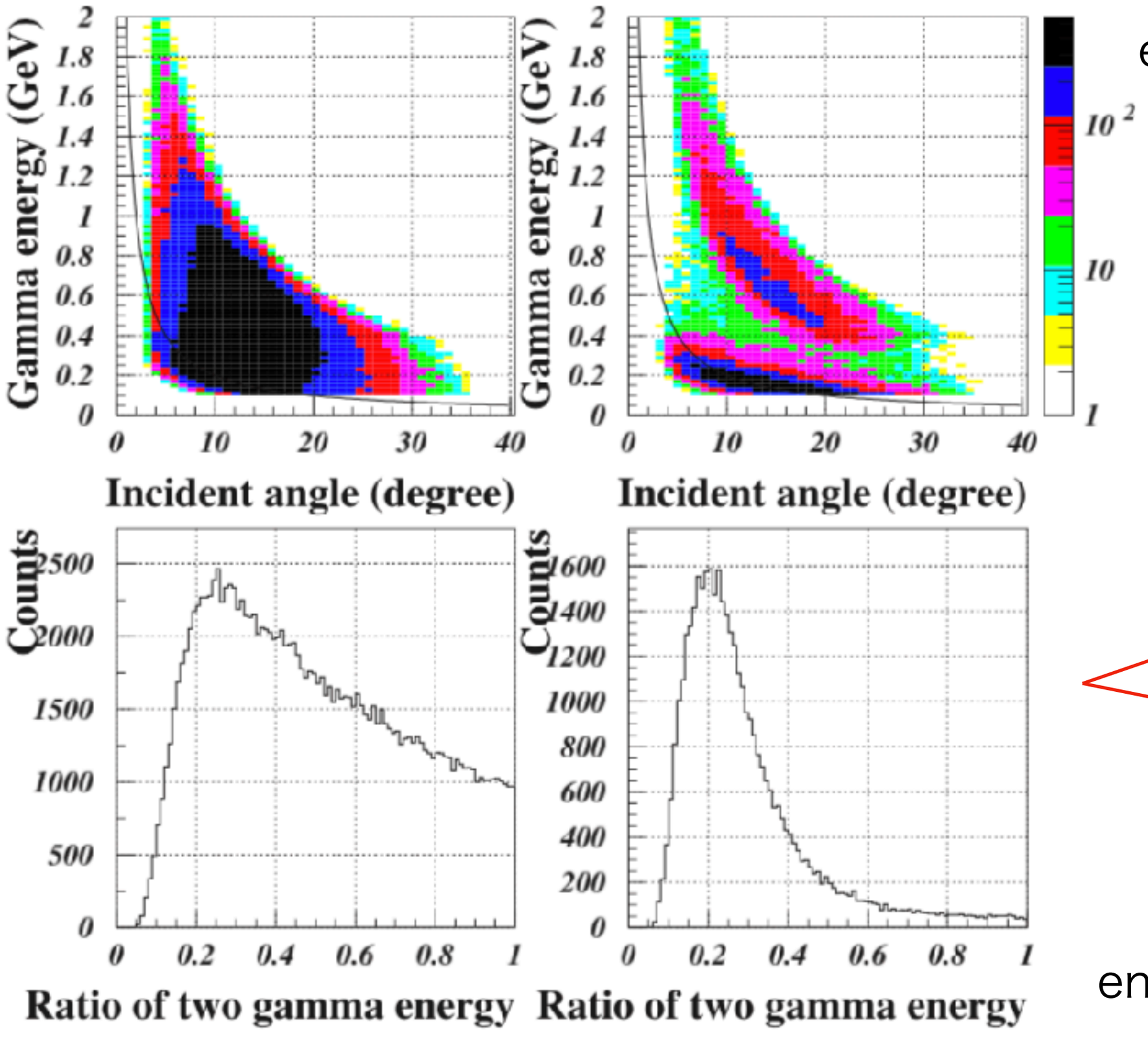
Cluster distance
- separation ability
- kinematics of pi0 decay

Gamma total energy
- pi0 from KL (500 MeV/c^2)
- Trigger by using Esum

COE : center of energy
- weighted mean in CsI surface
- All particles enter CsI, COE=0

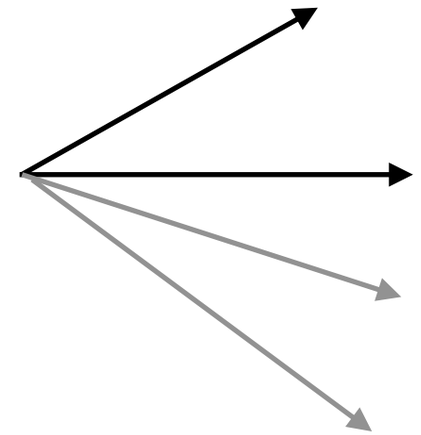
Distance from dead channel
- Incorrect gamma information

Vertex time difference
- To reject accidental coincidence

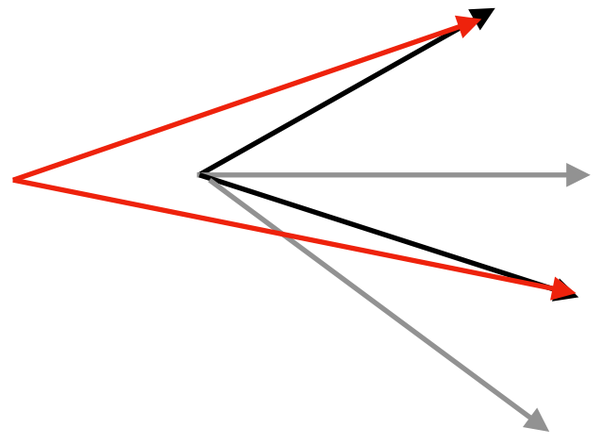


e-theta

even pairing



odd pairing



energy ratio

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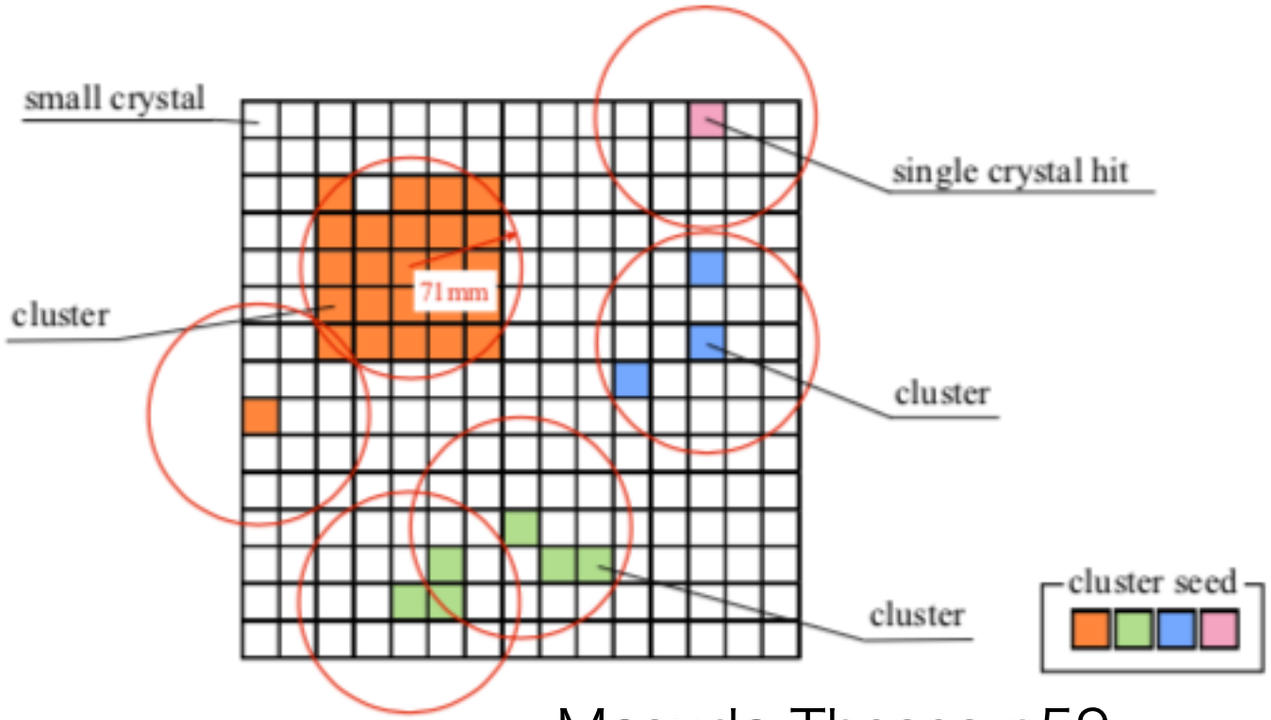
Cluster, shower shape cut



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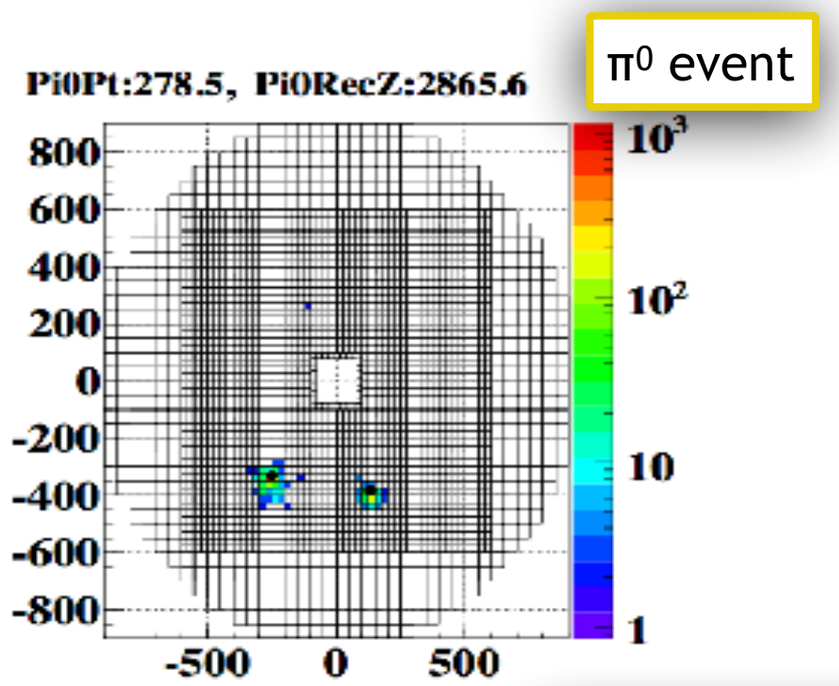
Shape Chi-2

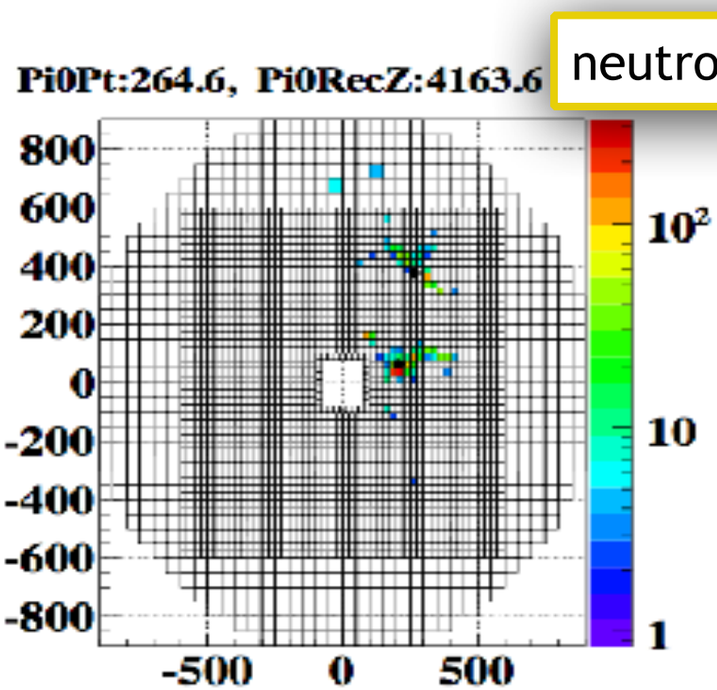
- discrepancy to the template

  (Given energy, given angle)

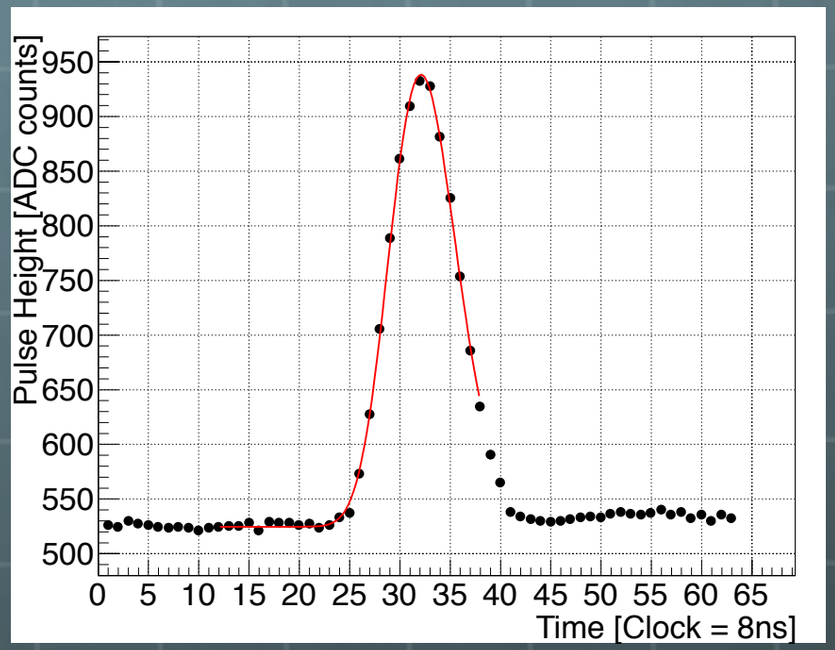
Size : How many crystals make cluster

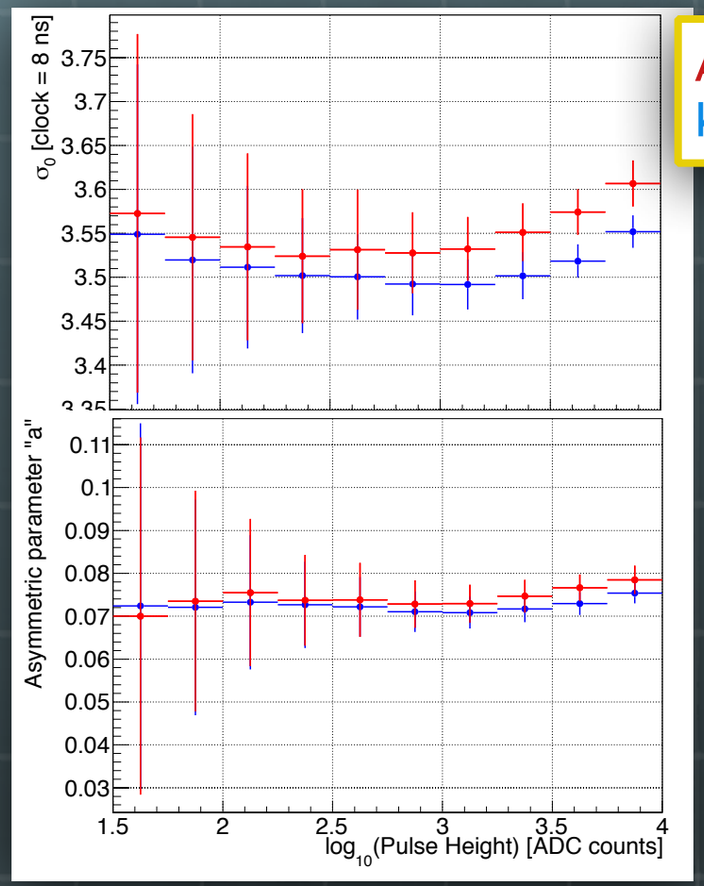
RMS : $\sqrt{\sum_i \frac{\epsilon_i r_i^2}{\sum_j \epsilon_j}}$





Pulse shape analysis

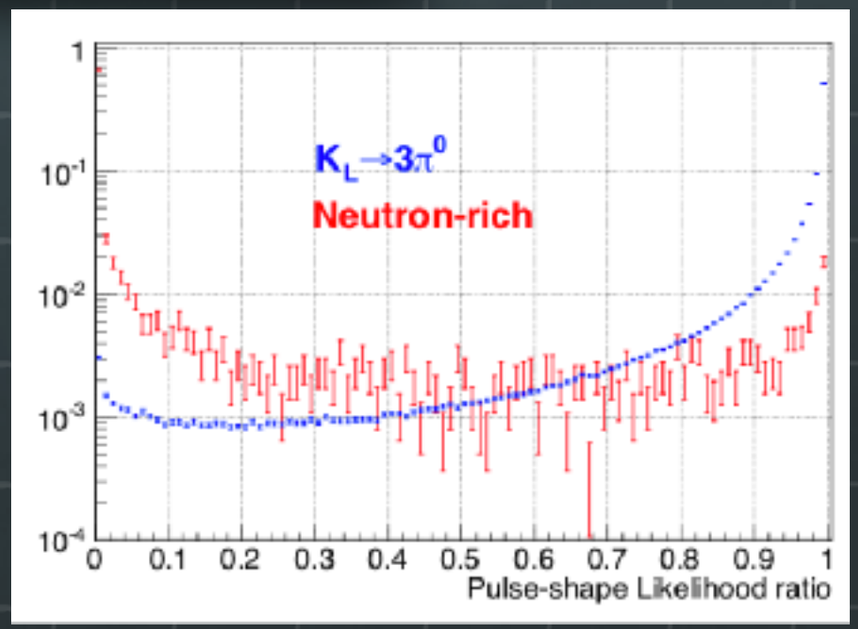




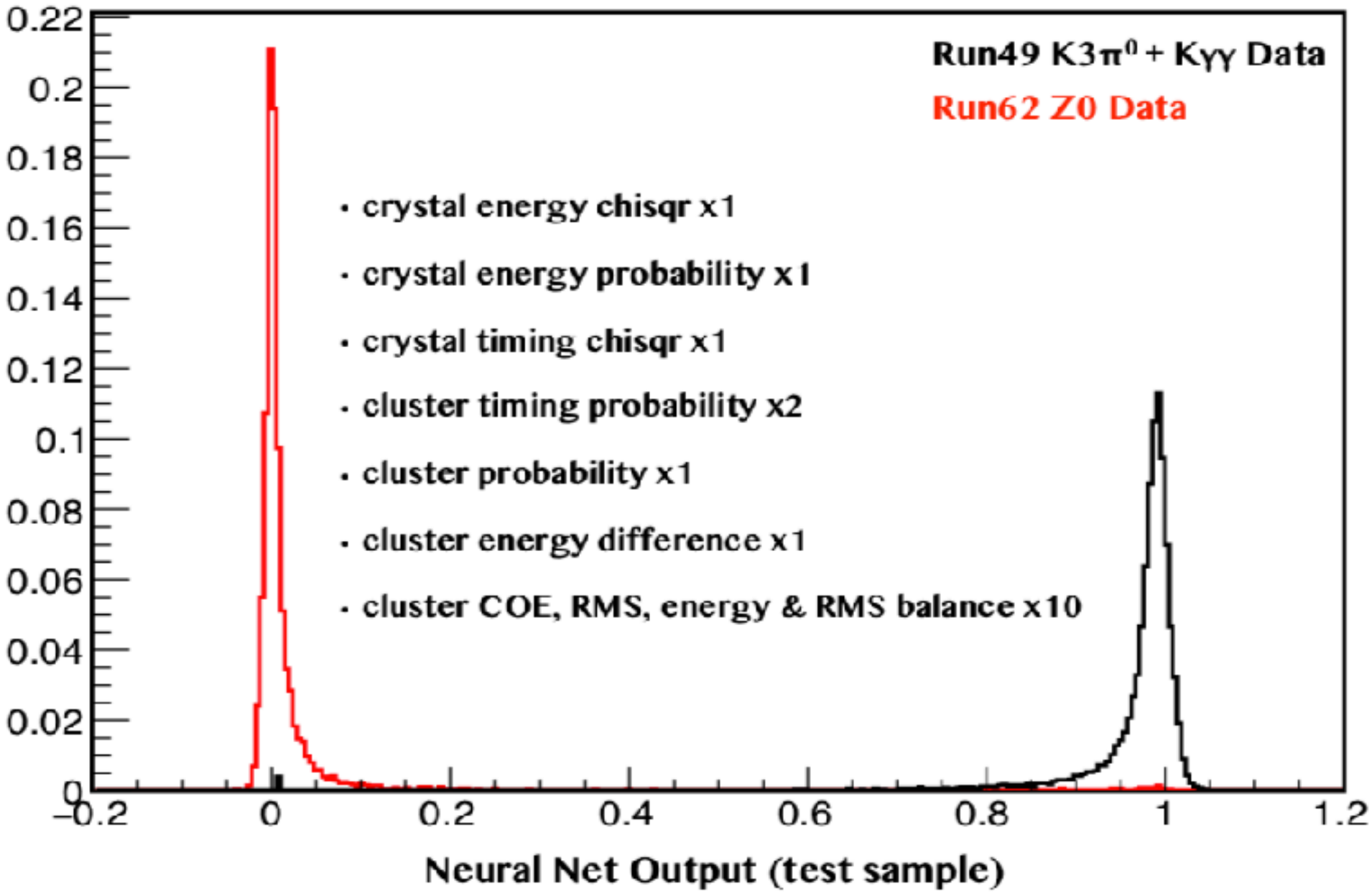
Al Target(Neutron)
K3π^0(Photon)

$$A(t; A, t_0, \sigma_0, a) \quad = \quad |A| \exp\left(-\frac{(t-t_0)^2}{2(a(t-t_0)+\sigma_0)^2}\right)$$

Y. Sugiyama Ph.D. thesis Osaka Univ.



Cluster Shape Discrimination



Yu-Chen Tung 2016-07-15