



# BEAM TEST RESULTS OF THE DIRICH BASED READOUT SYSTEM FOR HI2700 MAPMT

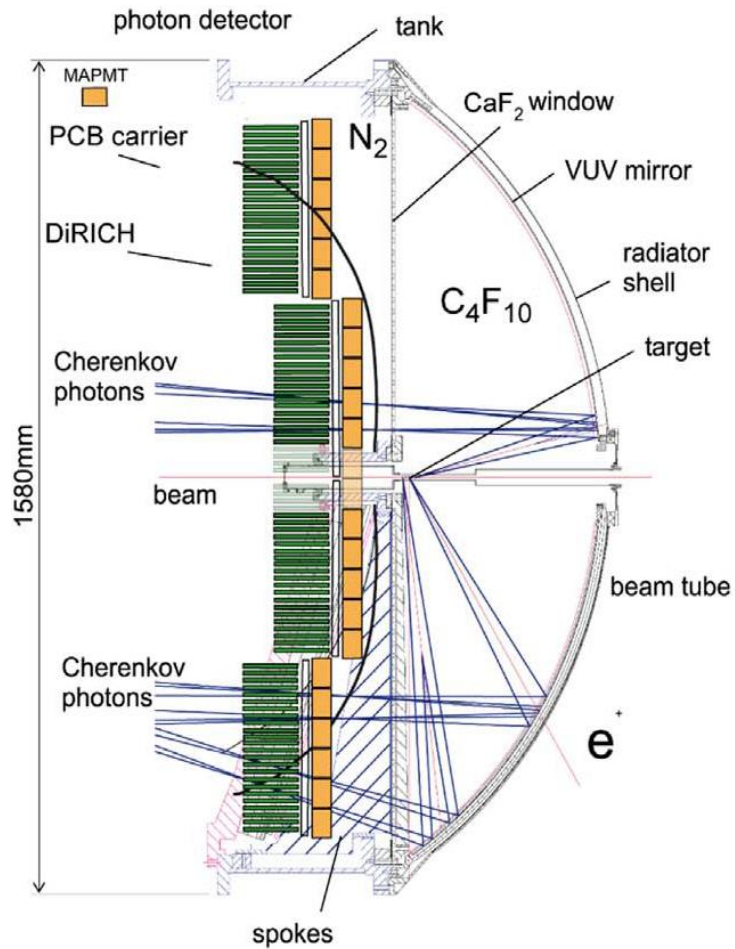
- VIVEK PATEL



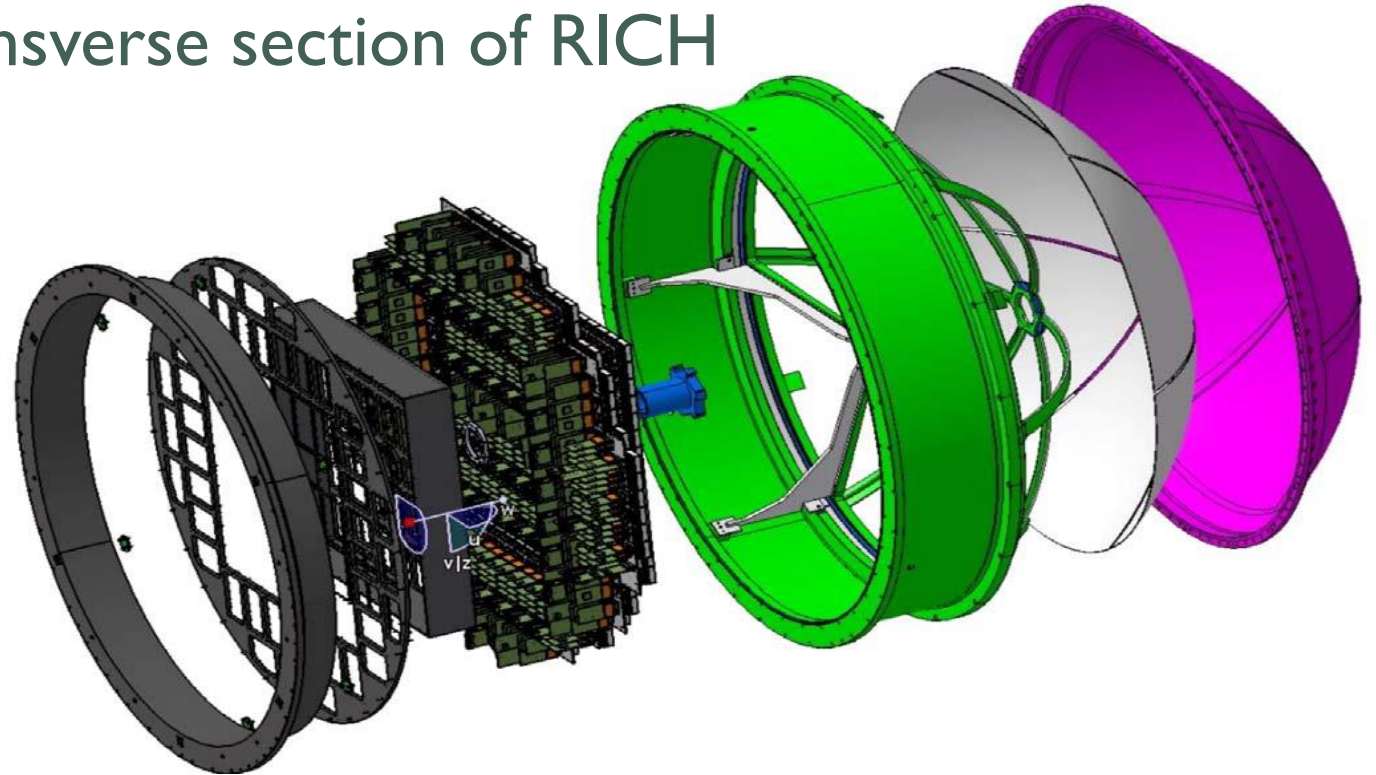
BERGISCHE  
UNIVERSITÄT  
WUPPERTAL

*Deutsche Physikalische Gesellschaft  
(DPG), March 2019*

# HADES – RICH UPGRADE



## ■ Transverse section of RICH

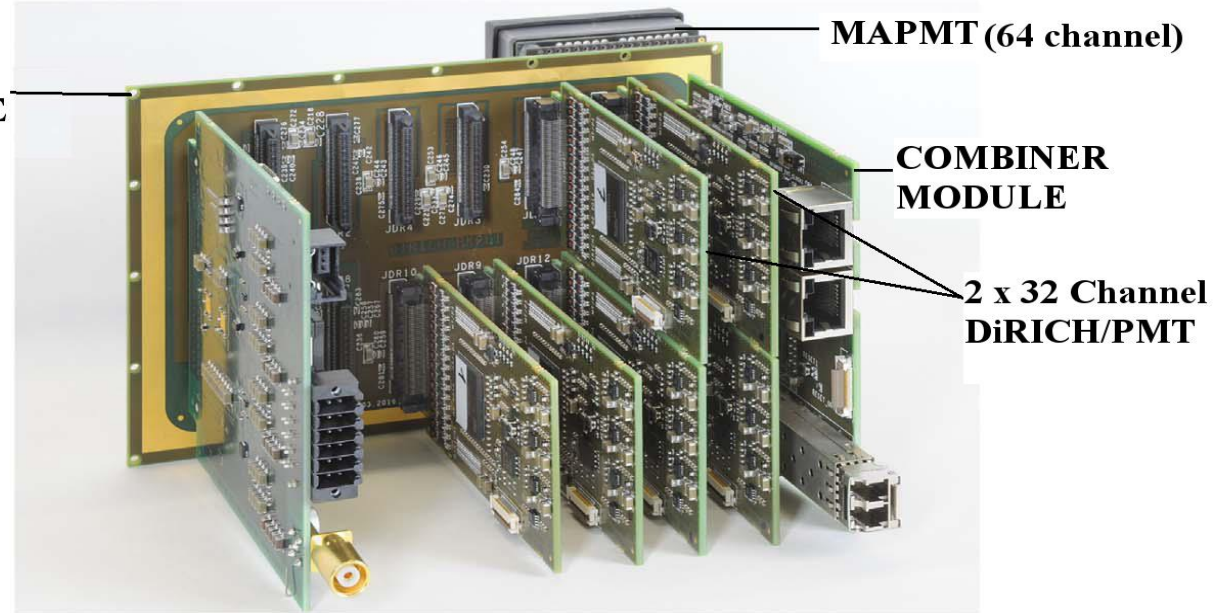


## ■ Exploded sketch of upgraded HADES-RICH

# READOUT ELECTRONICS FOR RICH MAPMTs

- **Back plane** – holds (3 x2) combination of MAPMTs , 12 DiRICHs (2 per MAPMT), Combiner module, Power Module.
- **DiRICH FE Module** – FPGA based readout module. Analog amplifier followed by FPGA TDC.
- **Power module** – Supplies HV to MAPMTs & LV to DiRICHs.
- **Combiner module** – Combines output of all the DiRICHs and sends it to DAQ via optical fibre link.

BACK  
PLANE



DiRICH frontend  
module



Combiner module



Power module



## SETUP FOR COSY RICH TEST BOX

- Cherenkov prototype detector for COSY beam test in Nov 2017
- Two fully equipped 3x2 module, 12 MAPMTs, glass/ quartz radiator.}
- Few MAPMTs were coated with wavelength shifting coating for testing UV efficiency.



# IMPORTANCE OF TIME OVERTHRESHOLD

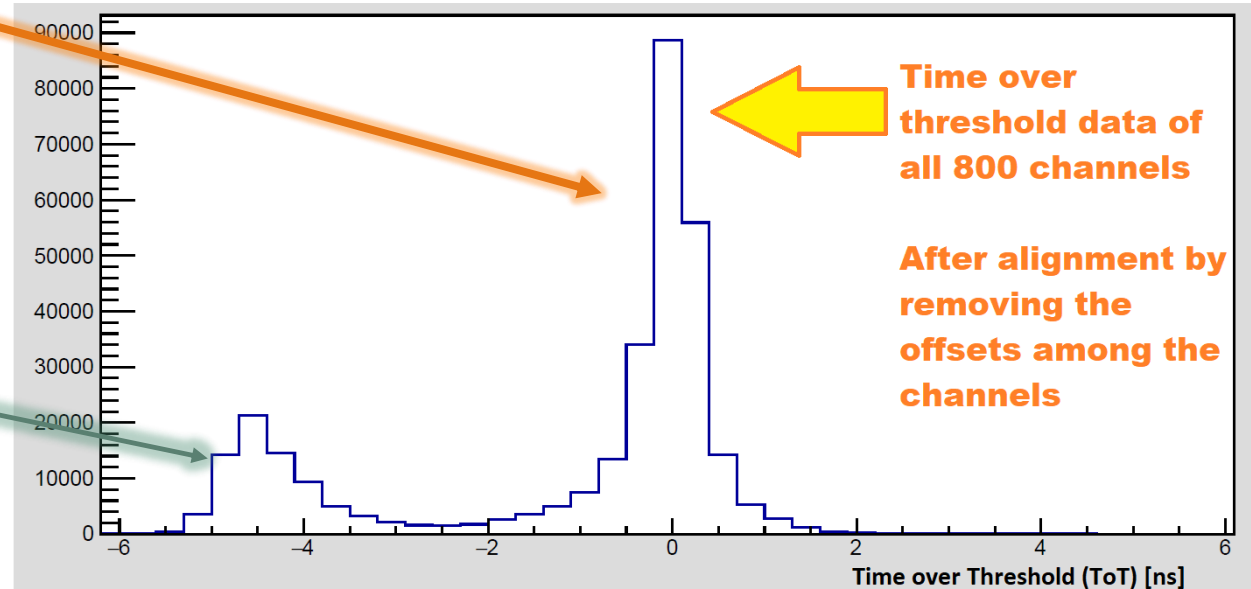
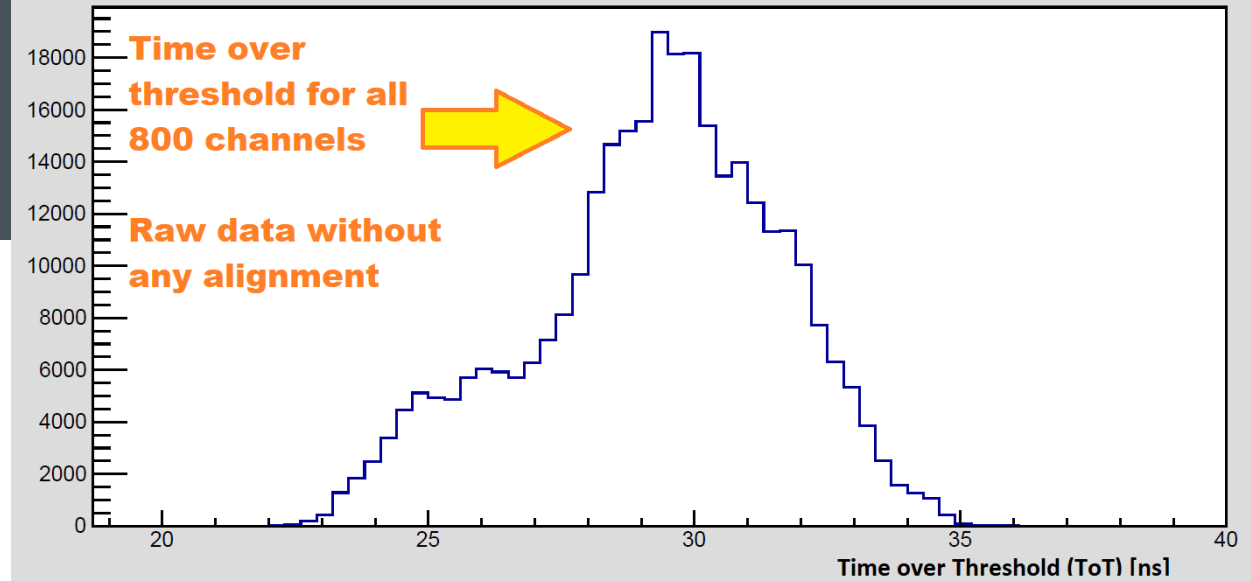
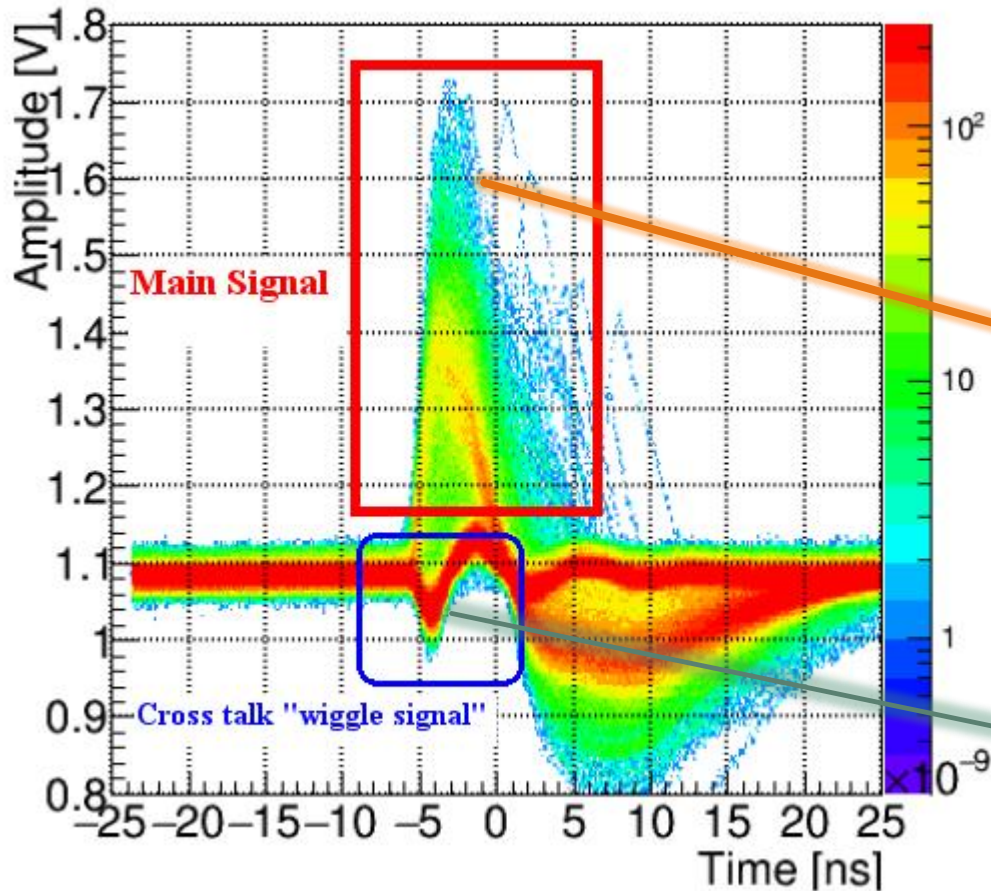
DiRICH is designed to measure precise timing using a FPGA TDC. There is no ADC measurement implemented on DiRICH.

To derive pulse information it relies on Time over Threshold (ToT) measurement by measuring precise leading and trailing edge time.

ToT can also be used to suppress the capacitive cross talk. (Details presented in previous DPG talks).

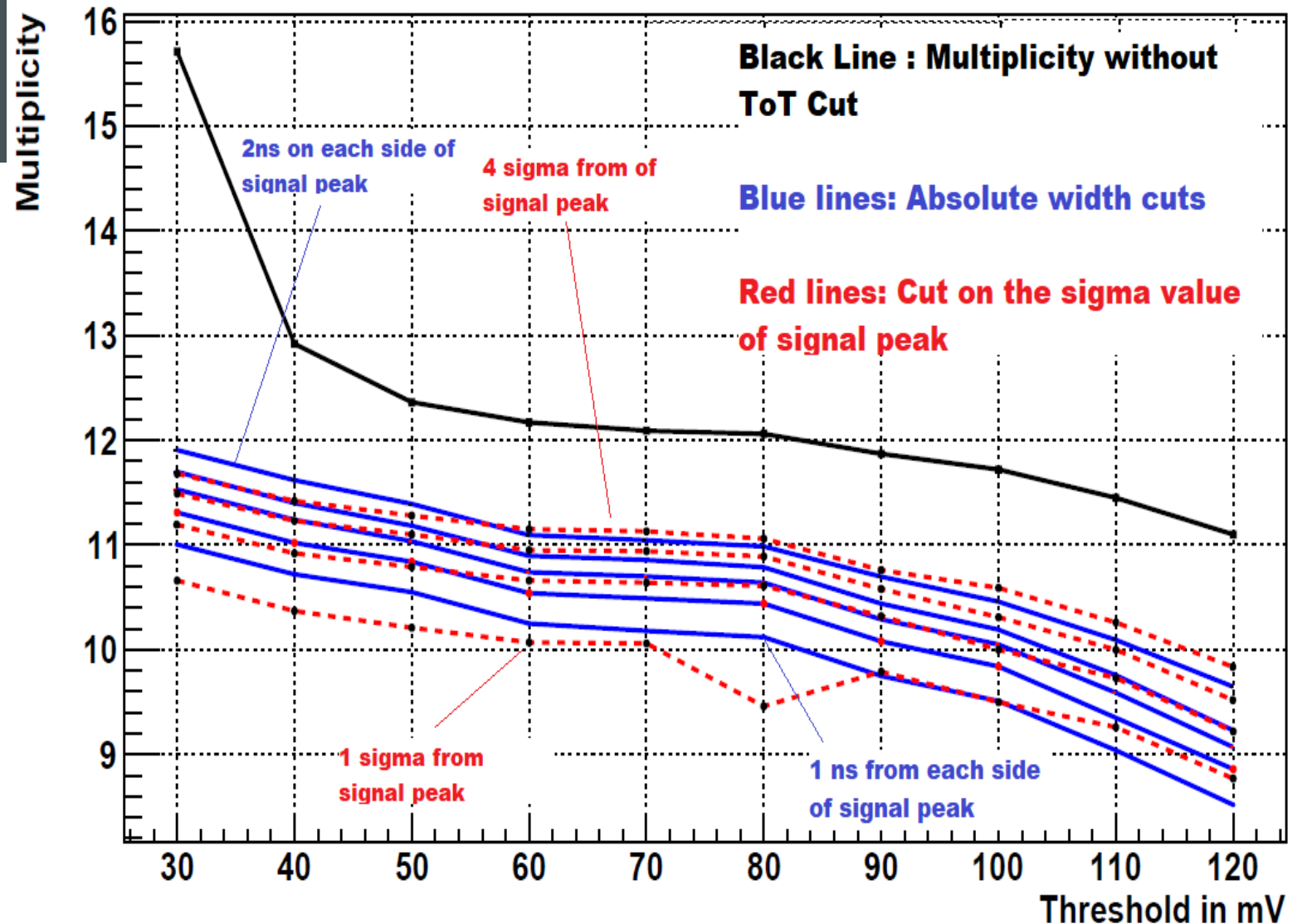
This talk will discuss the usage of ToT cuts on the raw data taken during the beam time for improving the final results.

# TOT ALIGNMENT



# EFFECT OF TOT CUTS ON HIT MULTIPLICITY

- **Multiplicity** – Number of simultaneously detected hits on whole MAPMT plane / trigger.
- Two approaches were tested:
  - **Fix width cuts in ns** around ToT signal peak (Blue lines in graph)
  - **Sigma values of signal peak** from ToT spectrum (Red dotted lines)

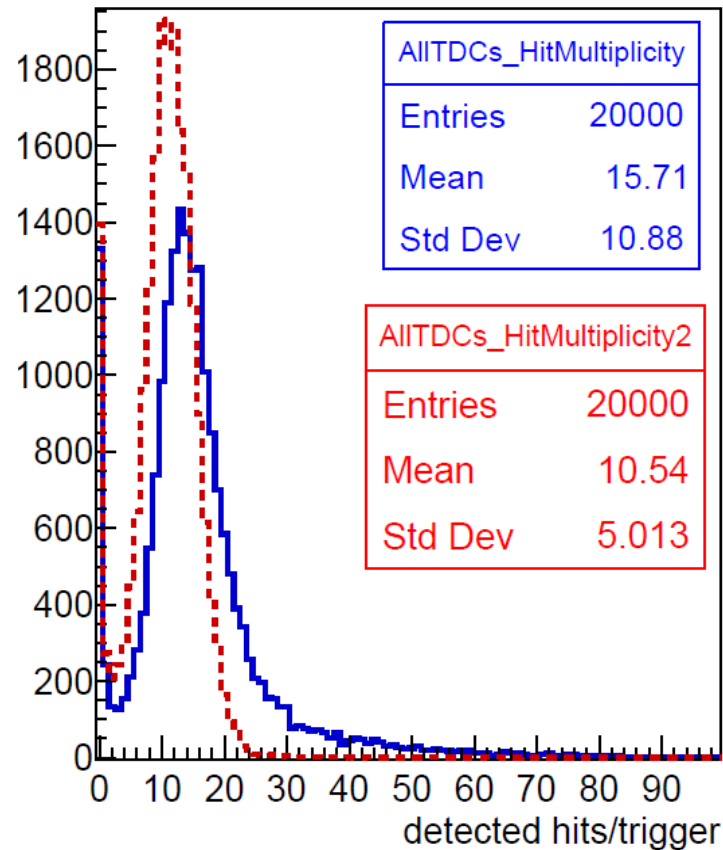




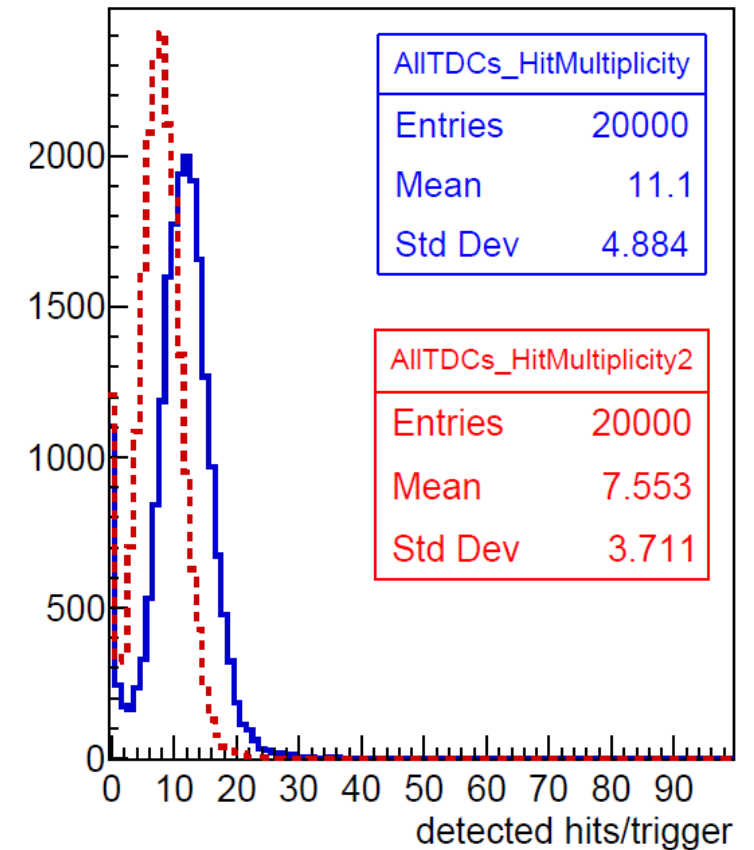
# EFFECT OF TOT CUTS ON HIT MULTIPLICITY

Hit Multiplicity for  
different  
discriminated  
threshold settings

Multiplicity @ Th-30mV



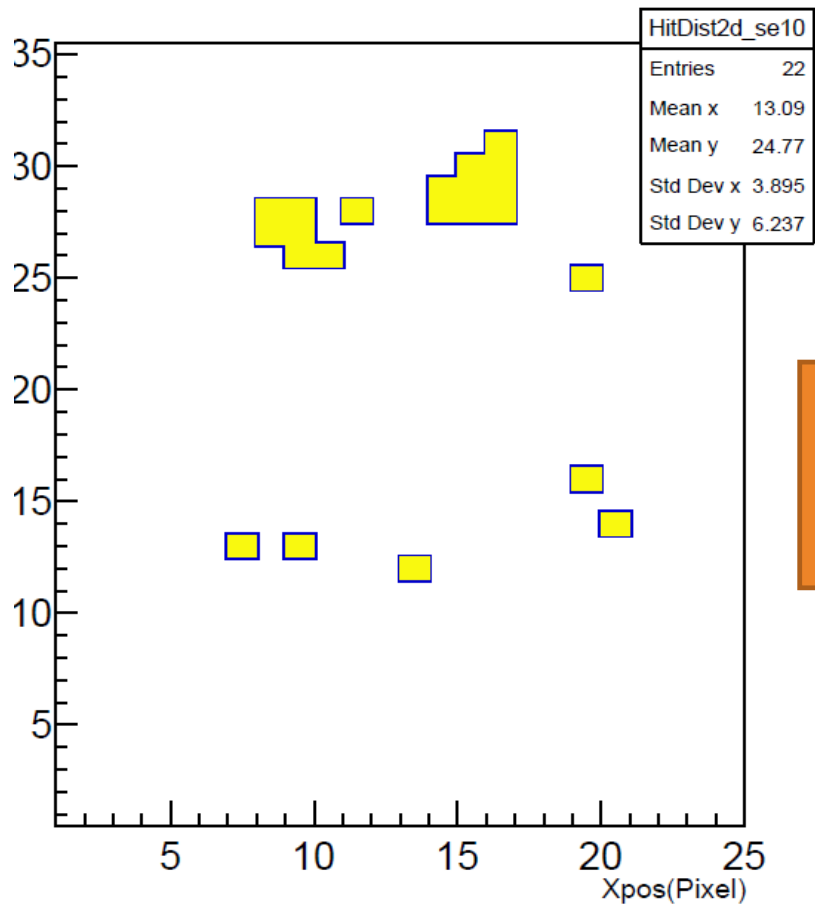
Multiplicity @ Th-120mV





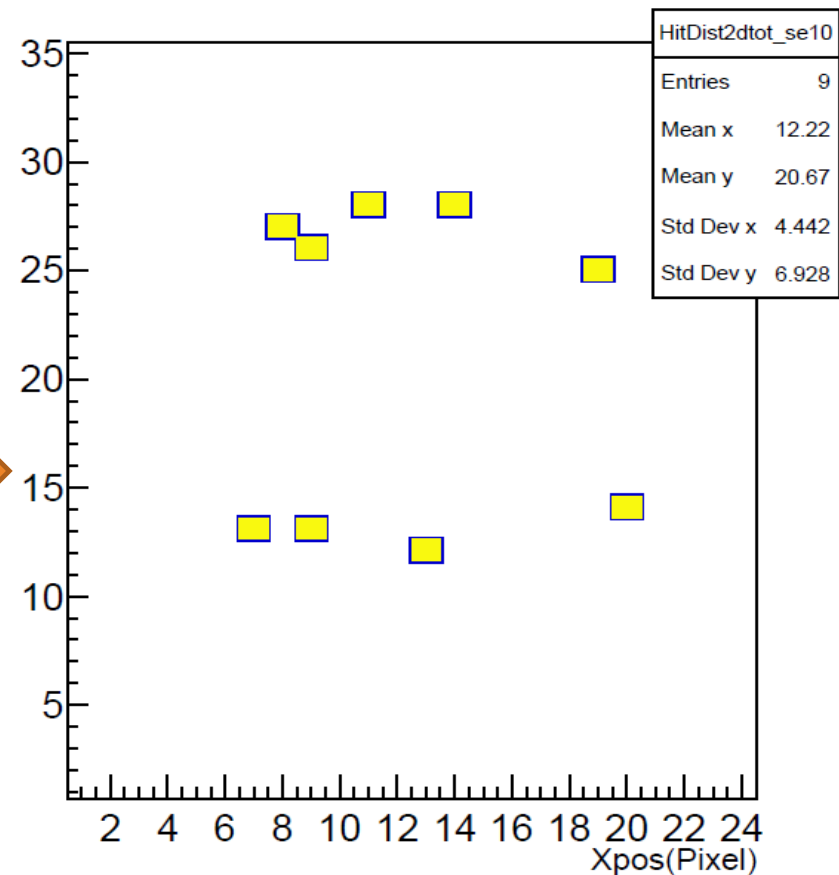
# SINGLE EVENT PLOTS (THRESHOLD 30 mV)

Single event No-ToTcut



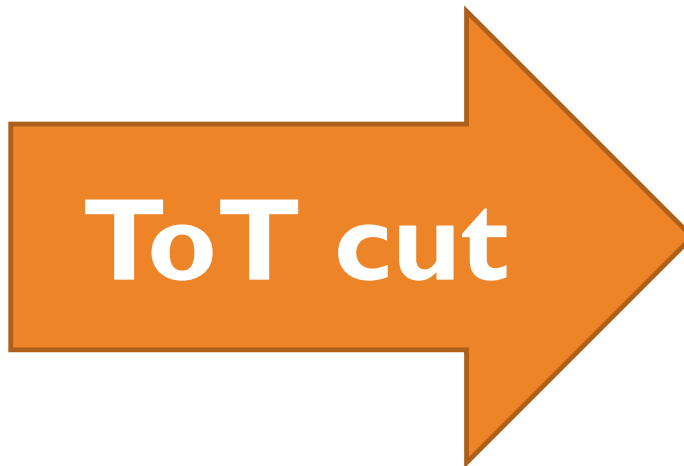
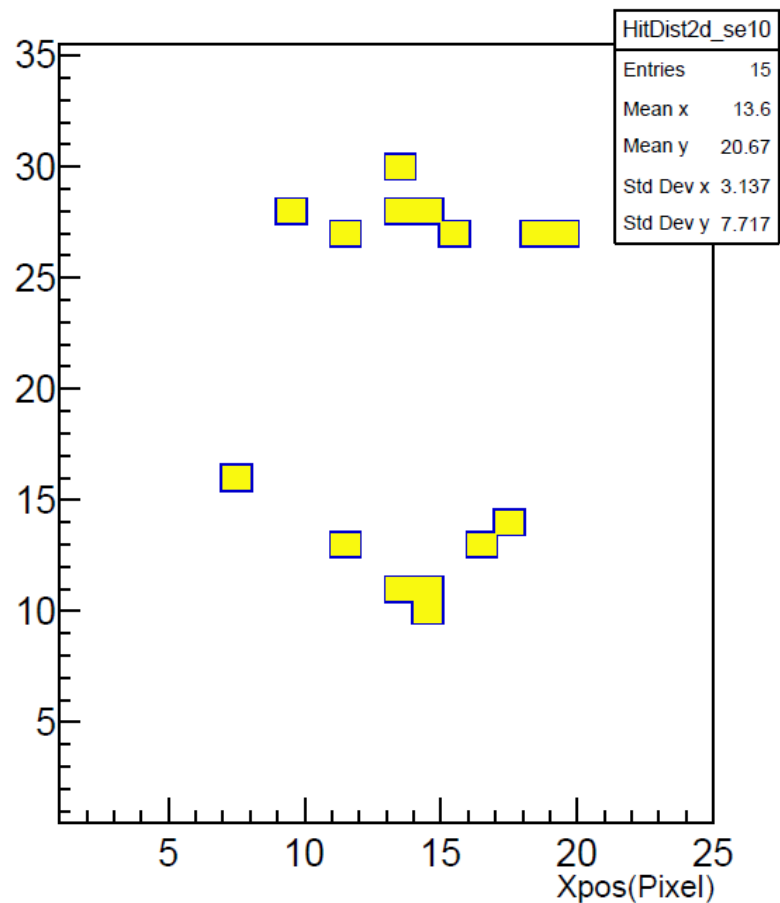
ToT cut

Single event After ToT cut

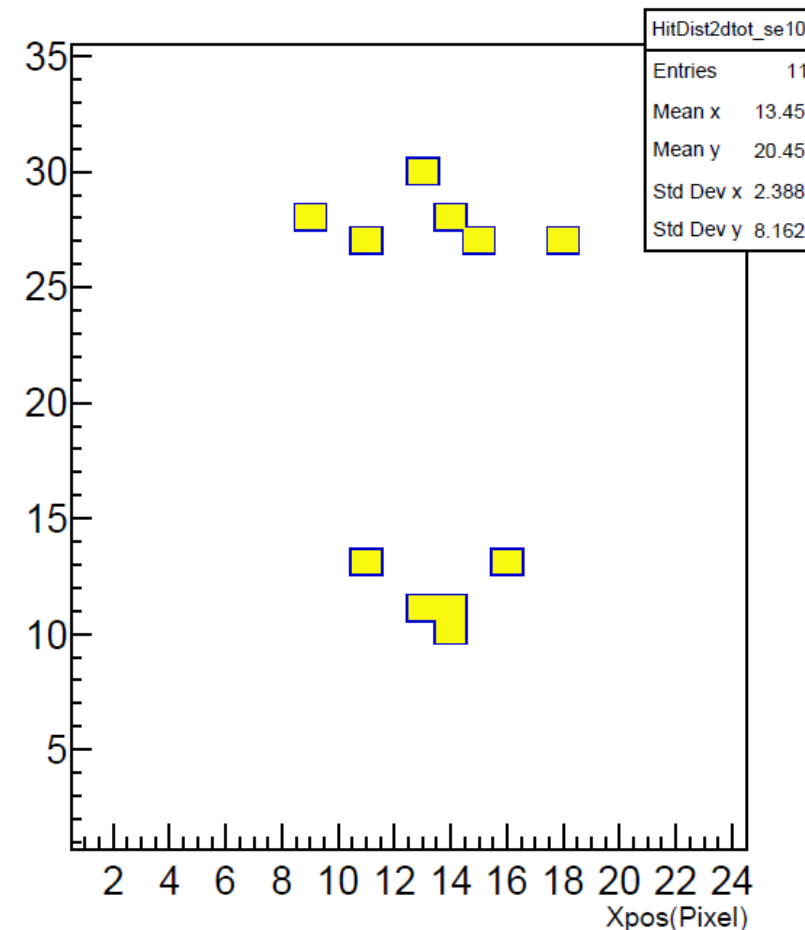


# SINGLE EVENT PLOTS (THRESHOLD 120 mV)

Single event No-ToTcut



Single event After ToT cut

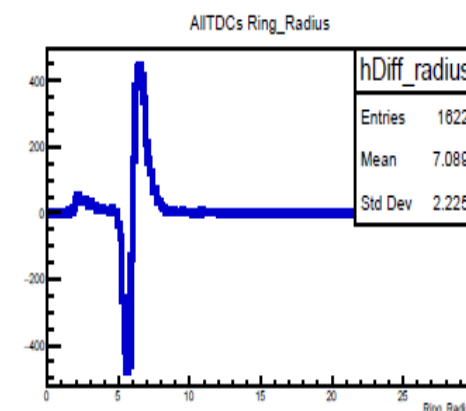
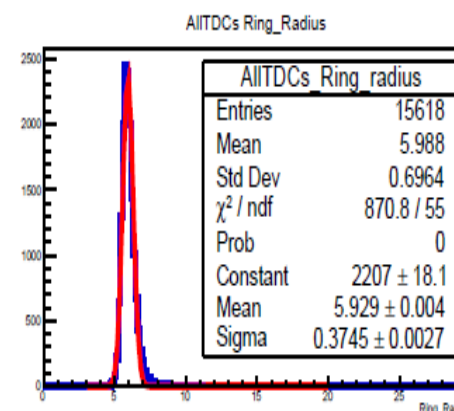
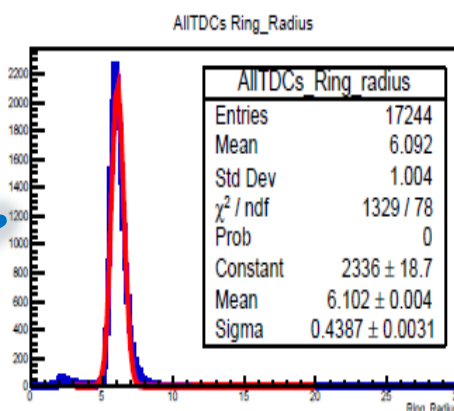
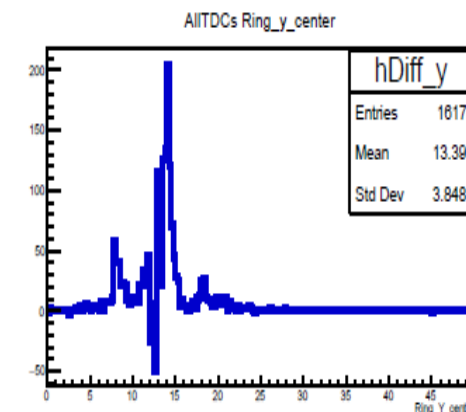
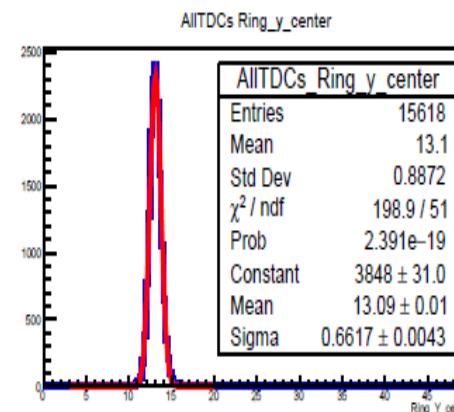
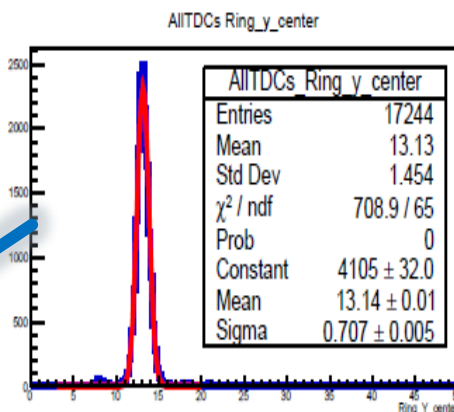
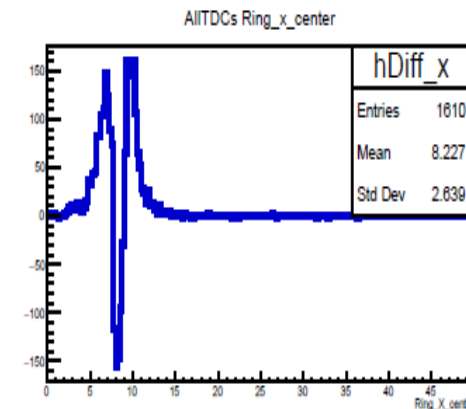
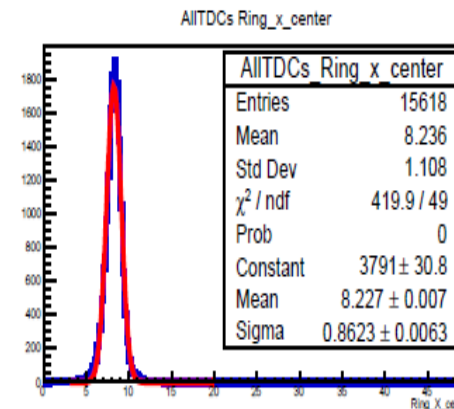
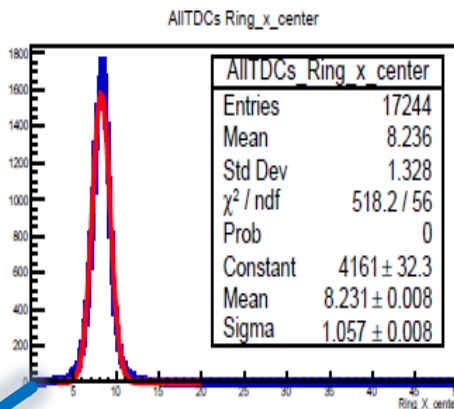


# RING PARAMETERS

X center of Ring

Y center of Ring

Radius of Ring



**(i) NO ToT cut      (ii) After ToT cut      Difference of (i) - (ii)**

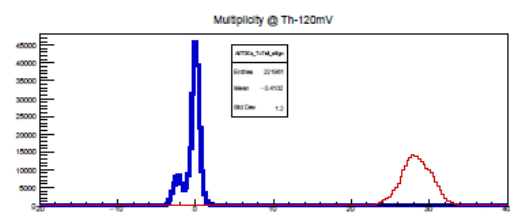
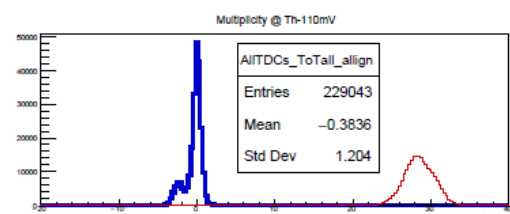
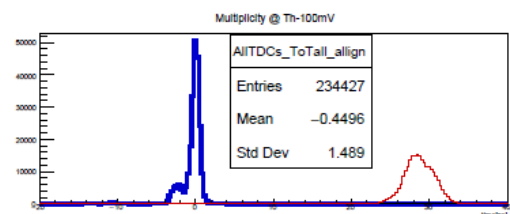
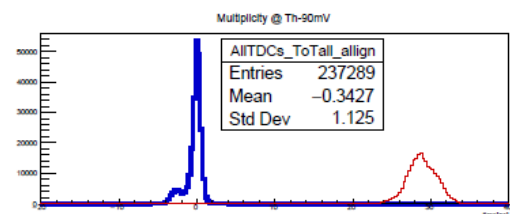
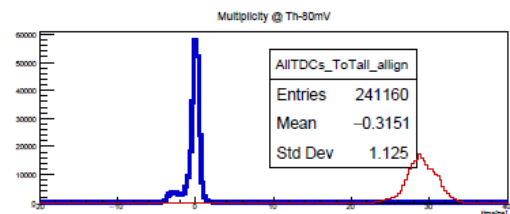
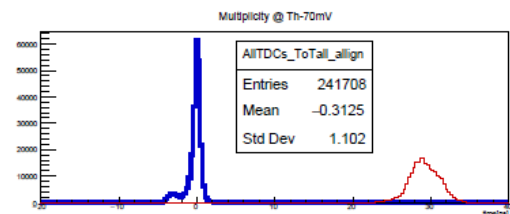
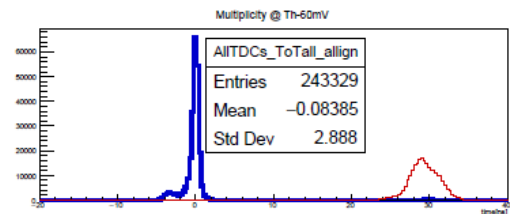
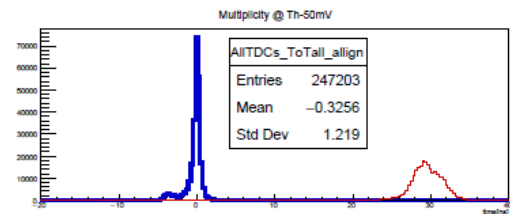
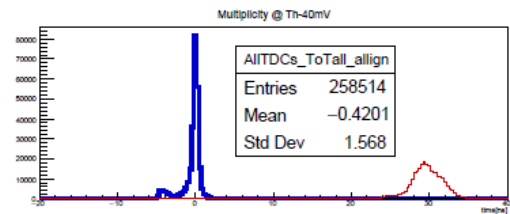
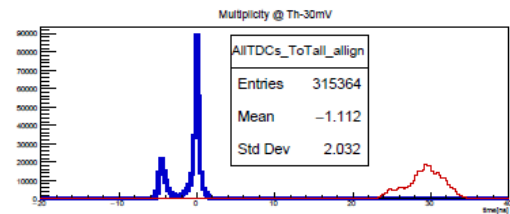
# SUMMARY

- Beam test at COSY was successful.
- HADES is upgraded with HI2700 MAPMTs and DiRICHs and is now seeing its first physics beam at this point of time.
- ToT cuts are also implemented in new data from HADES physics run.
- The main idea of using this method (applying ToT cuts) is to operate the detector at as low threshold as possible while still successfully get rid noise and crosstalk hits.
- We learned that even after applying these ToT cuts there is no significant loss of photon detection efficiency.



Thank  
you





# ProjectionY of binx=602 [x=601.5..602.5]

