Verification of Multivariate analysis with color information for signal distinction

10/25/2018

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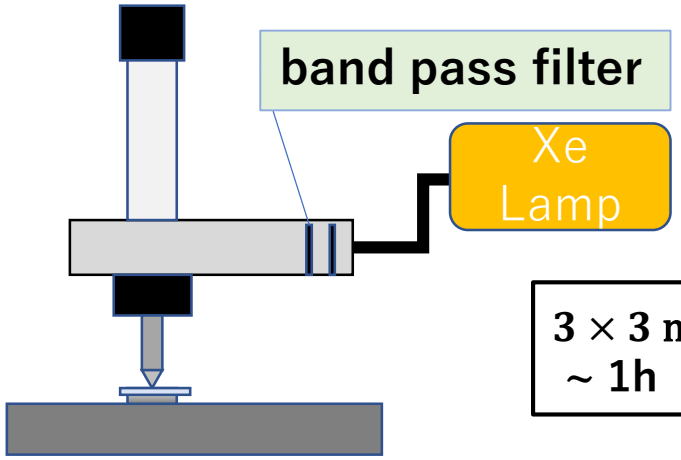
Multivariate analysis for signal identification

Multivariate Analysis(1)

scanning system



1st scan (volume scan)

Selects candidate event

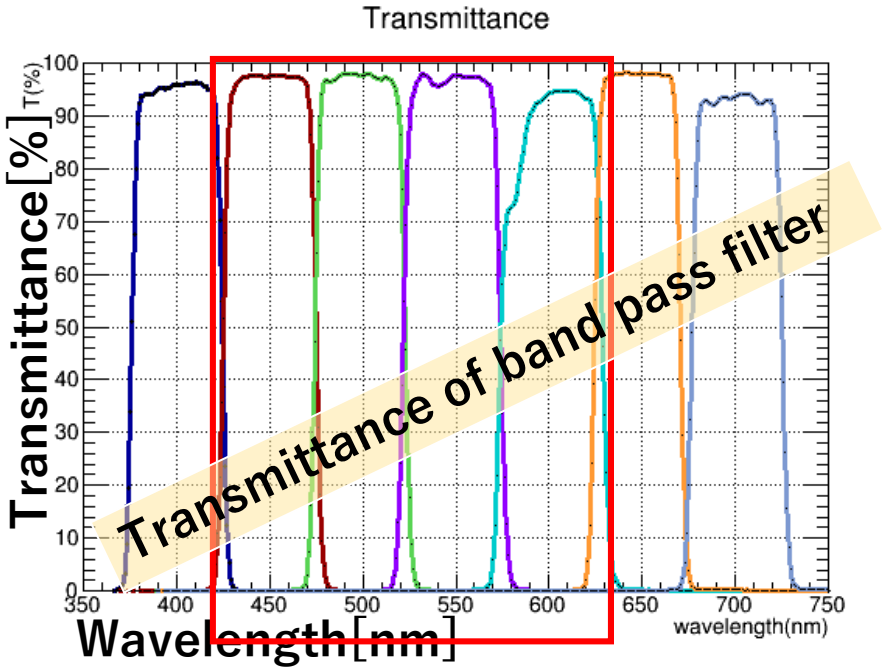
1st selection
ellipticity>2, 4<minor<6
Best focus event

$3 \times 3\ mm^2$ scan -> 992/view
~ 1h

2nd scan(scan the candidate event with multi-wavelength)

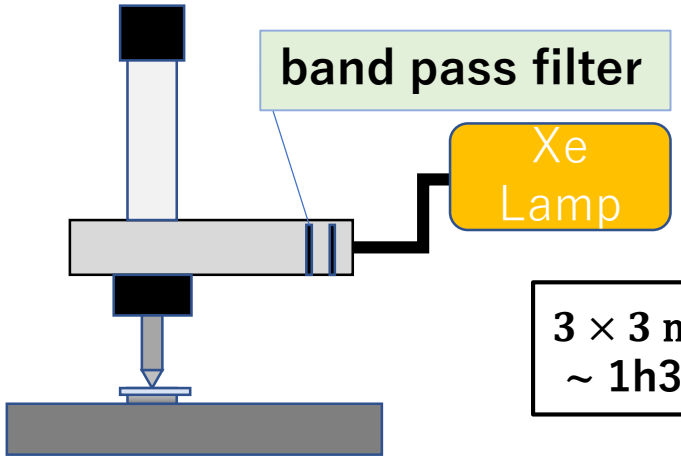
event matching at all wavelength

event matching
~30 s/event



Multivariate Analysis(1)

scanning system



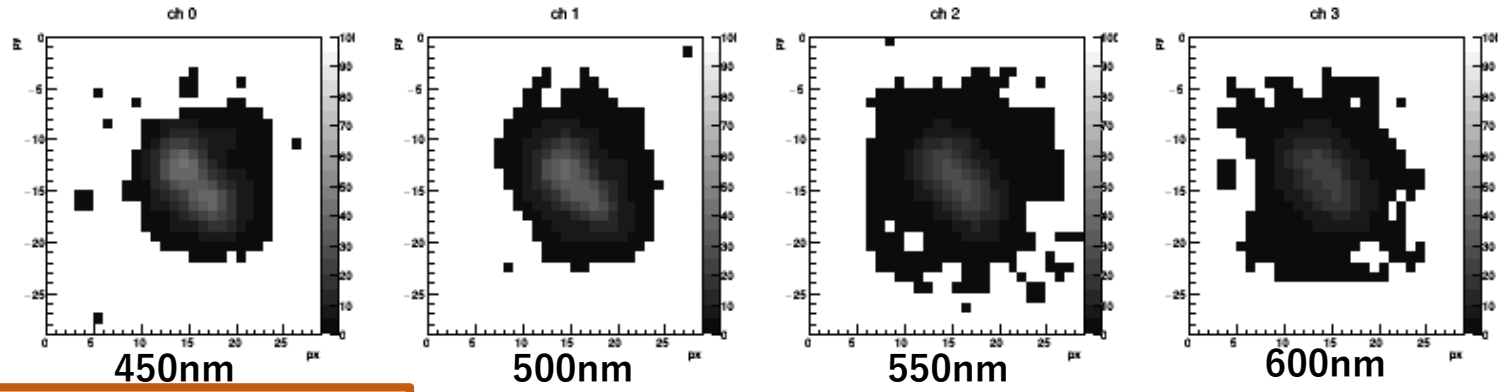
1st scan (volume scan)

Selects candidate event

1st selection
ellipticity≥2, 4≤minor≤6
Best focus event

$3 \times 3\ mm^2$ scan -> 992/view
~ 1h35m -> 5.75 s/view

2nd scan(scan the candidate event with multi-wavelength)



Acquirable optical information

- max brightness
- mean brightness
- event area

etc.
at each wavelength

Multivariable analysis

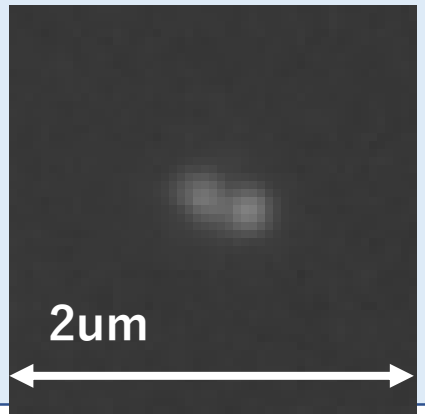
BDT, neural network, etc…

Distinction Carbon track and Contamination with this analysis method

Multivariate Analysis(2)

signal

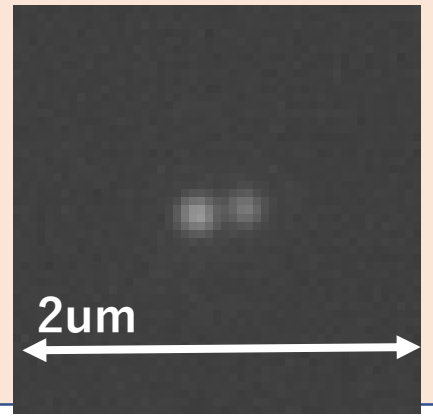
- Carbon ion track with ion implantation system
- Energy of Carbon ion when incidence on detector
  ~ 200keV → expected length ~500nm
- FAN102gf



1455 event

BG

- Contamination event present in reference developed sample
- Unknown composition
- FAN102gf



937 event

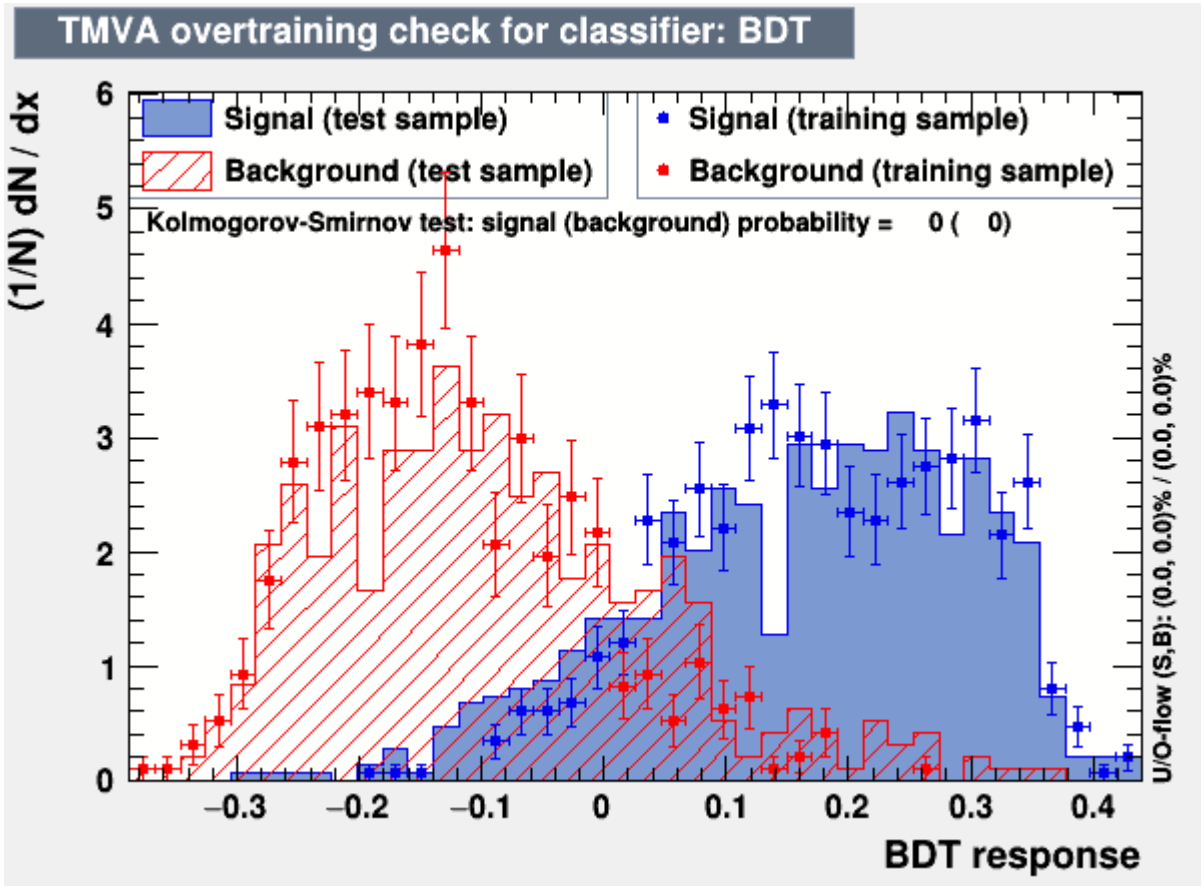
Each independent sample

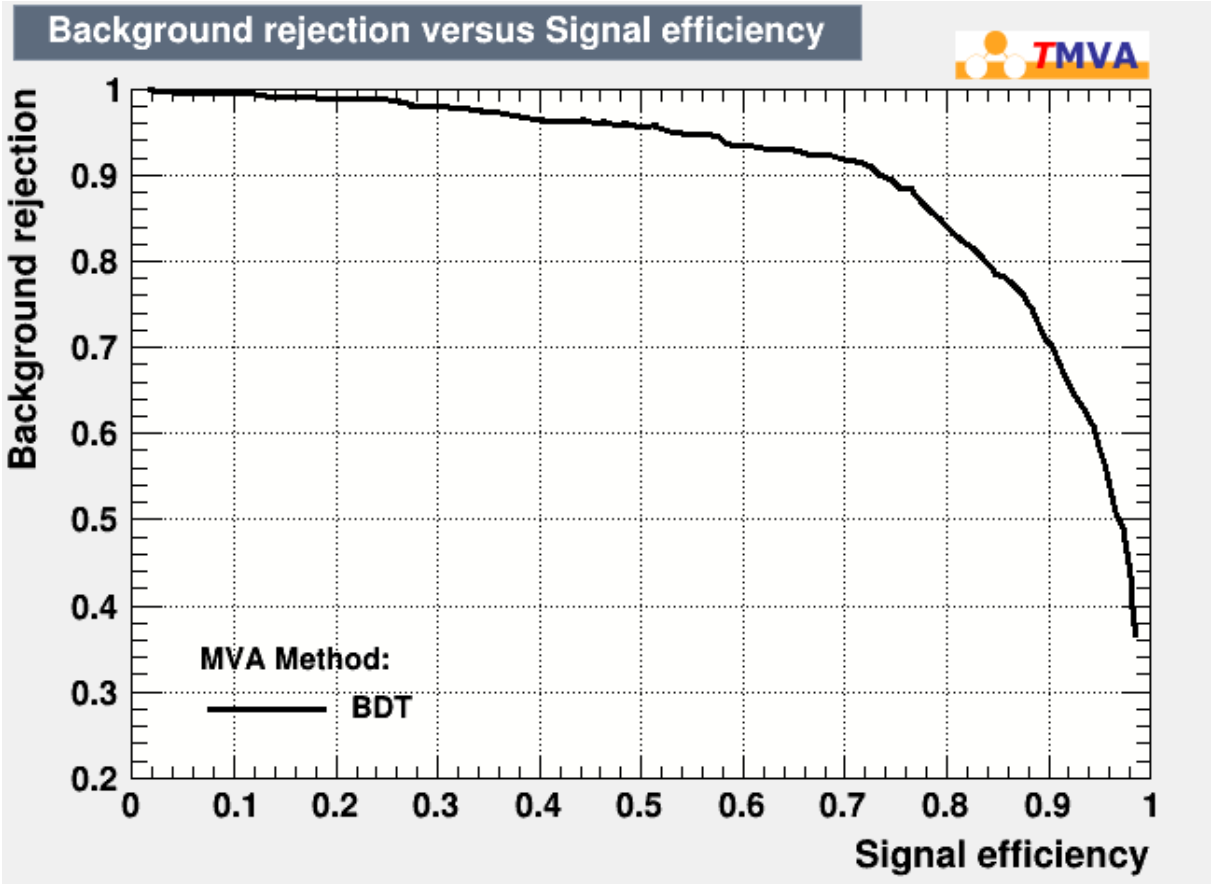
result of Boosted Decision Tree

TMVA ver4.2

Parameters used: relative max brightness (max_i / max_{450nm}), relative mean brightness ($mean_i / mean_{450nm}$)
relative event area($area_i / area_{450nm}$), relative areaHM($areaHM_i / areaHM_{450nm}$)

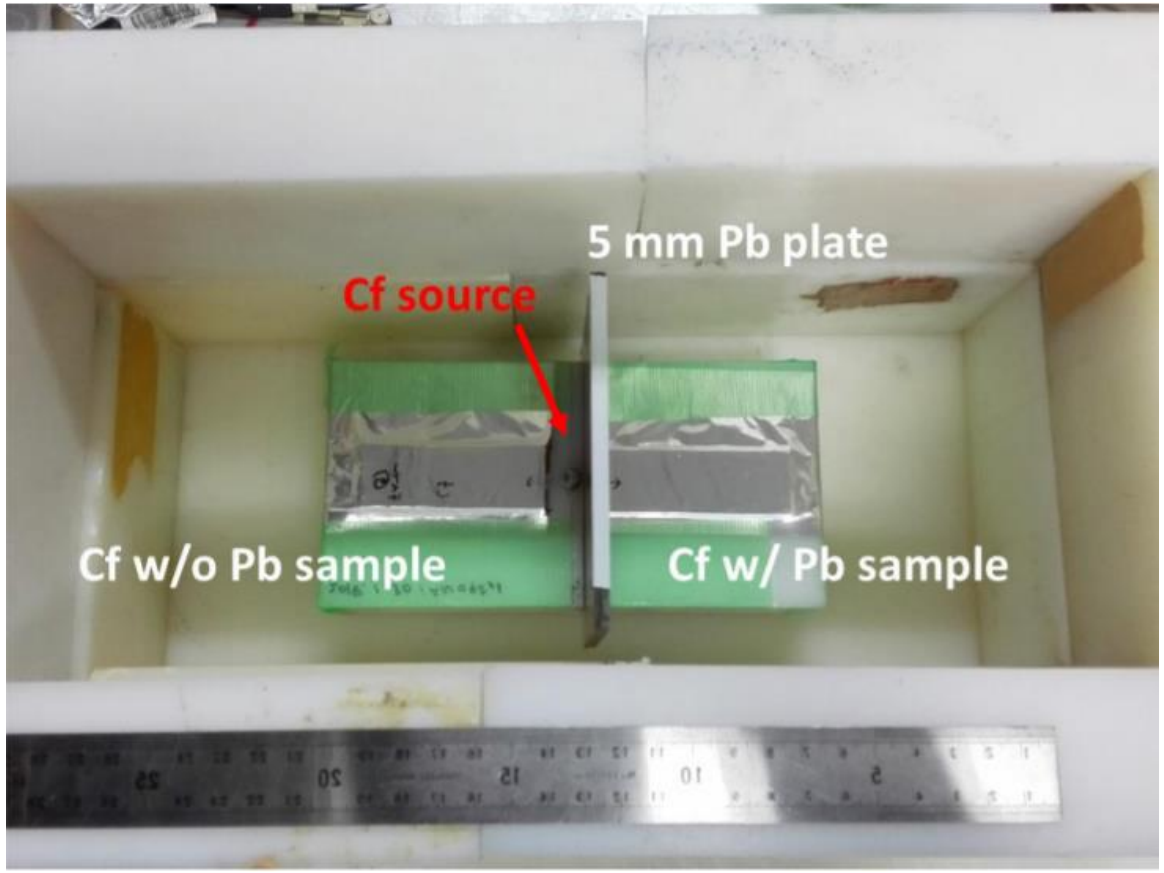
areaHM: Number of pixels with brightness equal to or higher than half of the peak





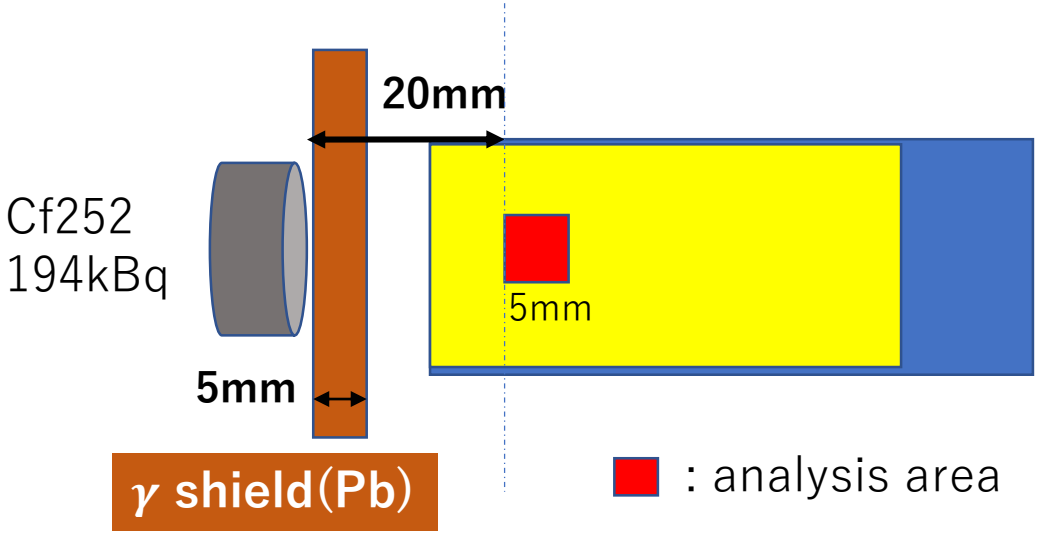
Verification of this analysis with nuclear recoil event by neutron

verify this analysis with neutron event



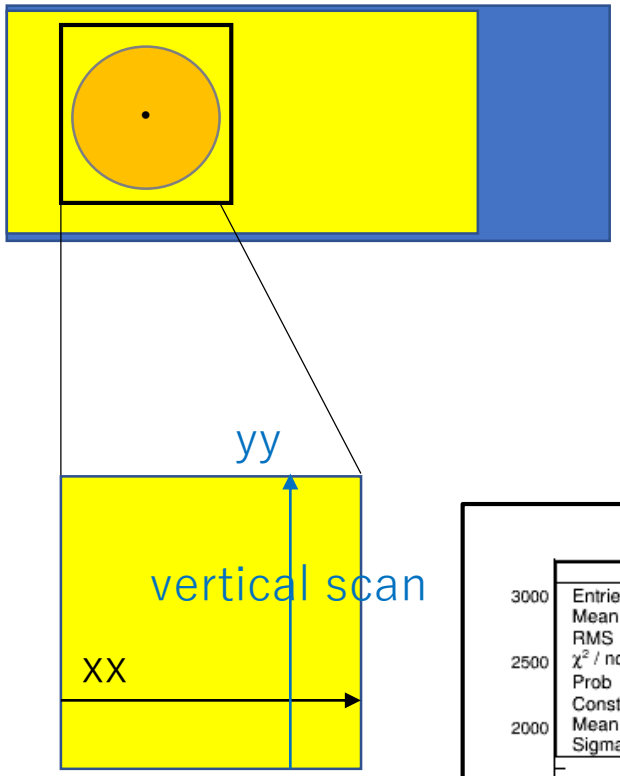
exposed and developed by Umemoto san
01/31/2018

neutron source: Cf252
activity: 194kBq :SF(3.1%;once SF release 3.6 neutron)
γ (0.858MeV, 0.958MeV 25.1%
00179MeV 6.3%)
and others.
exposure time ~24h



verify this analysis with gamma event

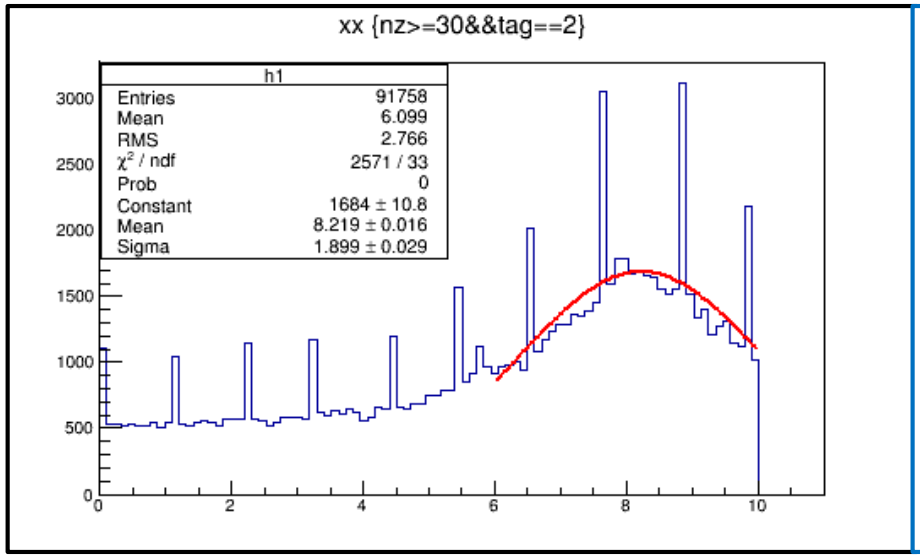
Am241 γ source

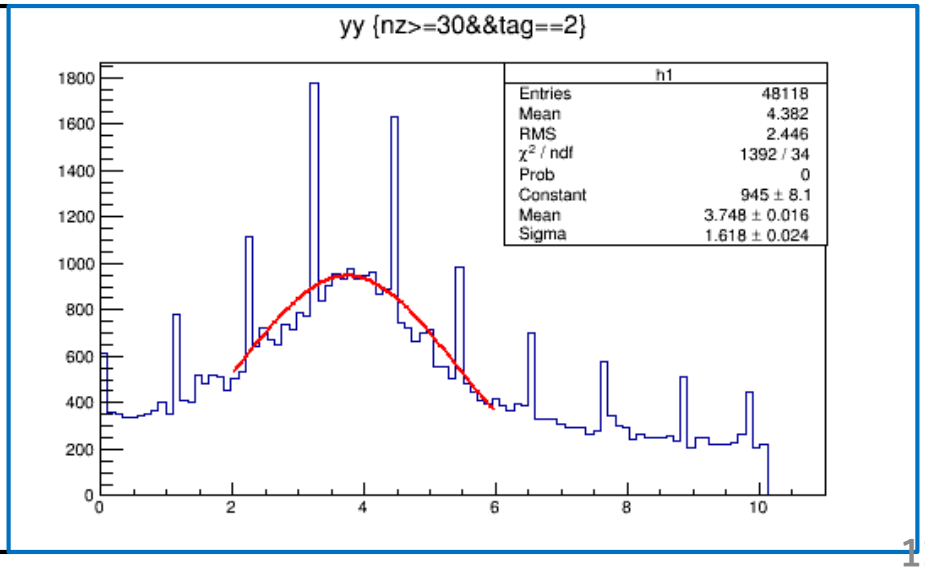


Am241 γ (0.06MeV)~2MBq

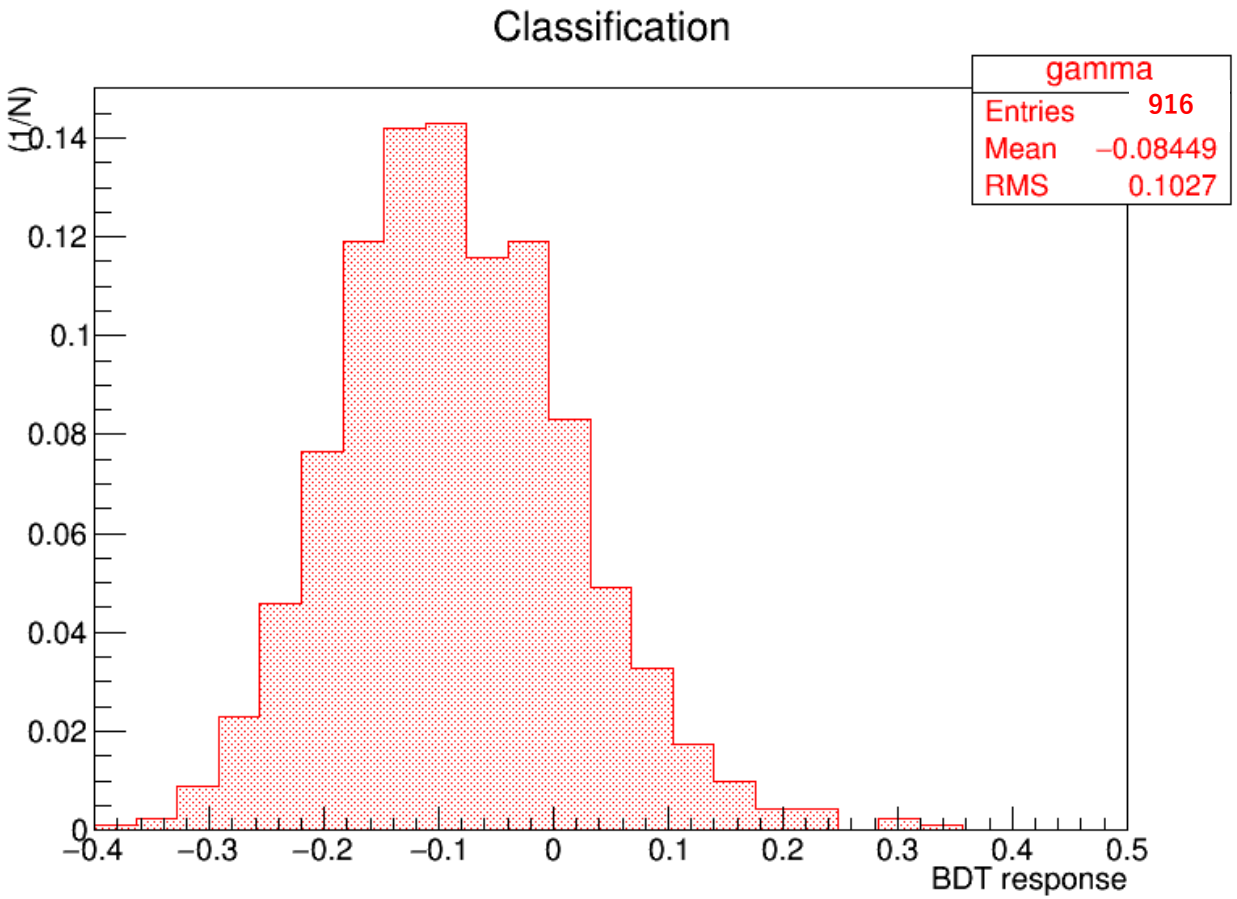
exposure time 30s

To estimate center position of source, I scanned vertical and horizontal straight line.

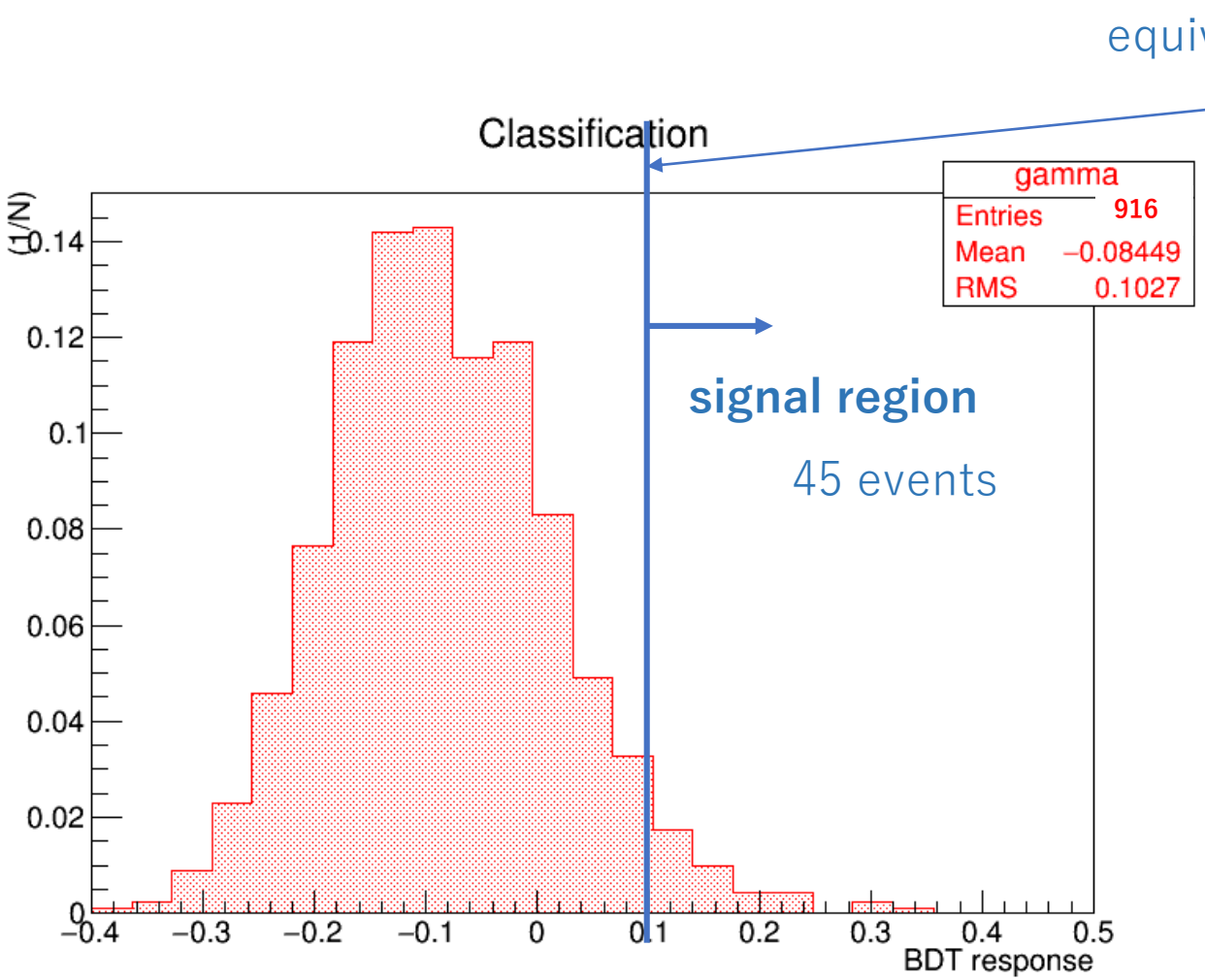




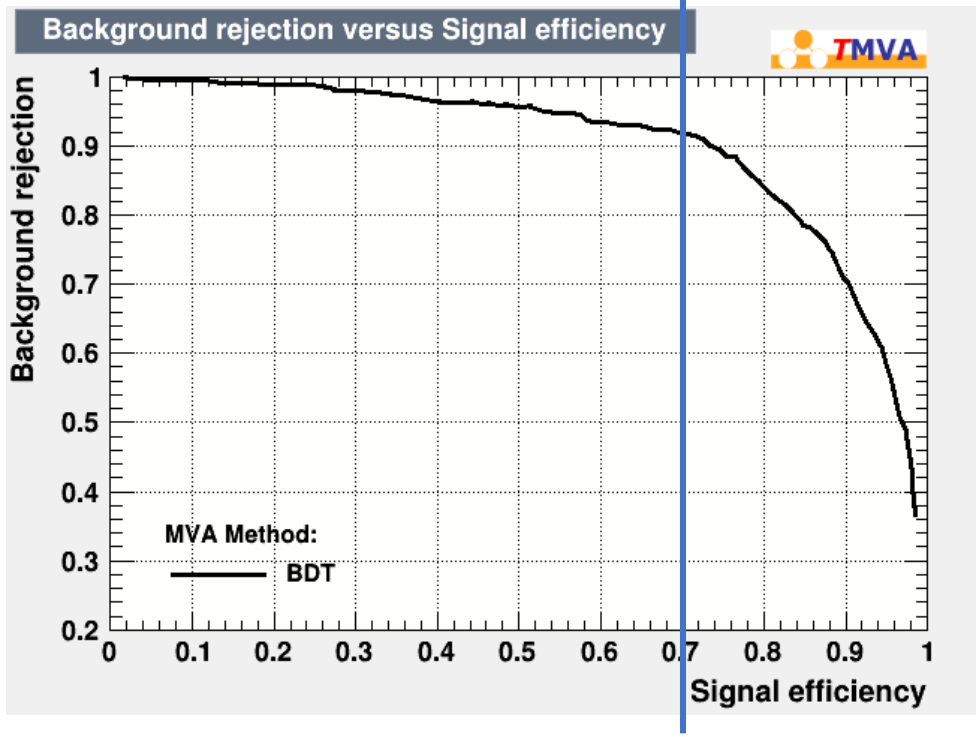
verify this analysis with gamma event



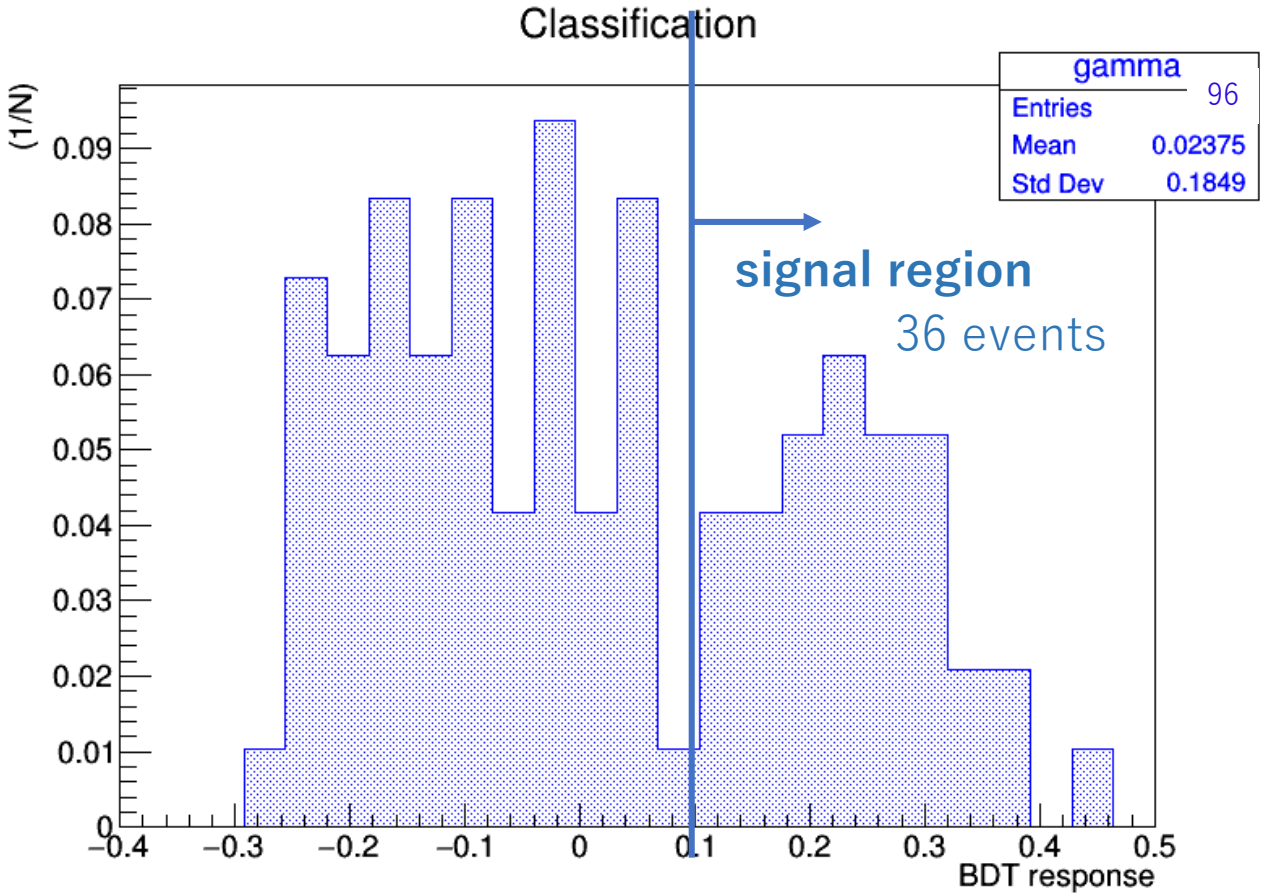
verify this analysis with gamma event



equivalent



verify this analysis with neutron event



In γ classification,
45 events out of 916 classified in signal region

If these 96 events are all derived from γ ray or dust events,
using the classification in γ ray events,
the probability of being classified into 36 events in the signal region is extremely low.

CNO recoil events

Prospect

- We will increase the statics of the neutron events and evaluate it.
- Detection efficiency of γ ray and CNO recoil in this analysis should be calibrated, so I will perform experiment for that.
- Evaluation of classification when crystal size is changed from 40nm to 80nm.

Discussion for analysis to be done in Naples univ.

Discussion for analysis to be done in Naples univ.

Motivation

- I would like to evaluate whether the classifiability improves when plasmon parameters are added to the parameters of classification.

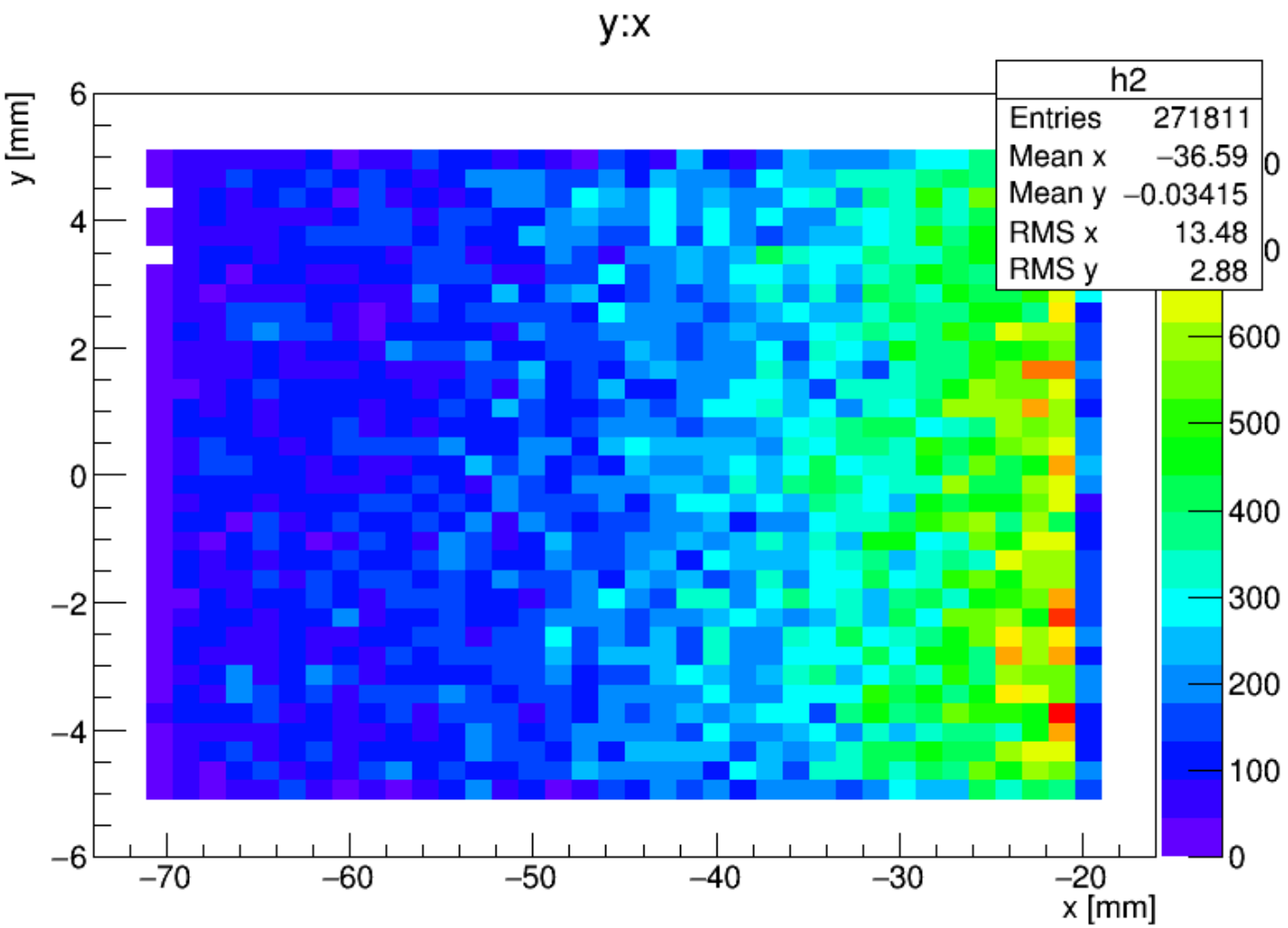
Task

- Analysis of carbon and dust in reference sample that we evaluated this time.
- or same condition samples (but 80nm crystal)

Summary

- ✓Event identification by multivariate analysis is possible
- ✓It is likely to be able to distinguish not only carbon ion track and dust in reference sample but also γ ray event.
- ✓Detection efficiency in this analysis is unverified.

- ✓I will evaluate this classification when plasmon parameters are added.



G4 simulation

irradiance level (1/10 * 24h)