Plasmonic Spectrum analysis with Carbon and dust

05/30 2018

Motivation

- Silver tracks and dusts which are remained with current ellipticity analysis may be identified by spectrum analysis
- To verify this analysis, I evaluate target optical response to some wavelength by PTS2 scanning with optical band pass filter.
- Verify that event identification can be performed by multivariable analysis using information acquired by spectrum analysis

Contents

- Method of optical spectrum analysis
- Demonstrate spectrum analysis with silver Nano crystal
  (I have reported this work at previous meeting)
- Practice this analysis with Carbon and Dust
- Problem and vision

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- **Method of optical spectrum analysis**

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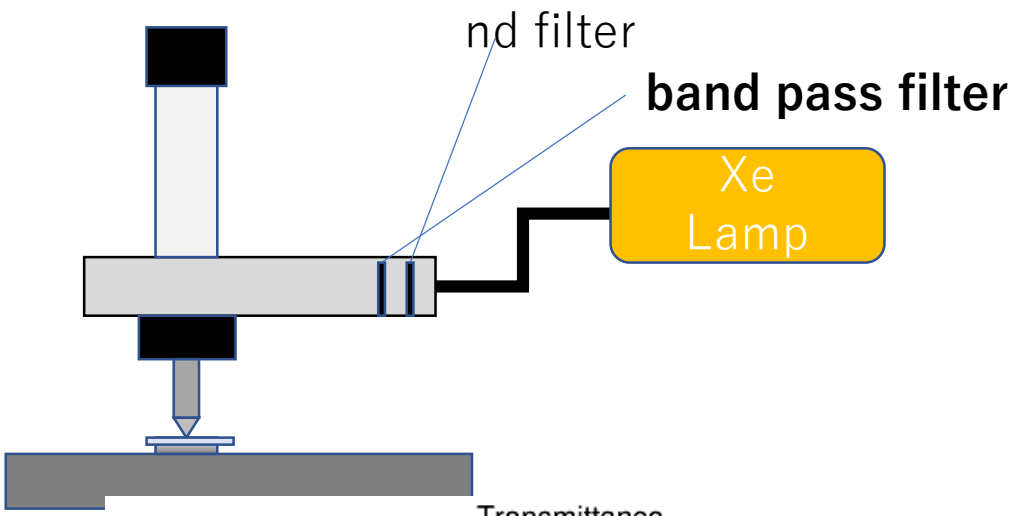
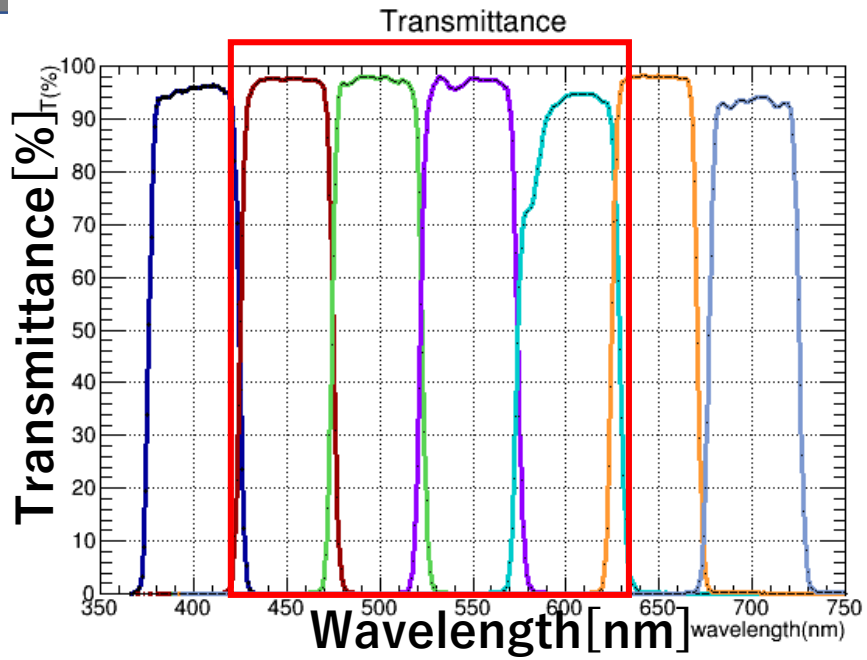
Flow of spectrum analysis





scanning with each bandpass filter

scanning same area with four bandpass filter; 450nm, 500nm, 550nm, 600nm

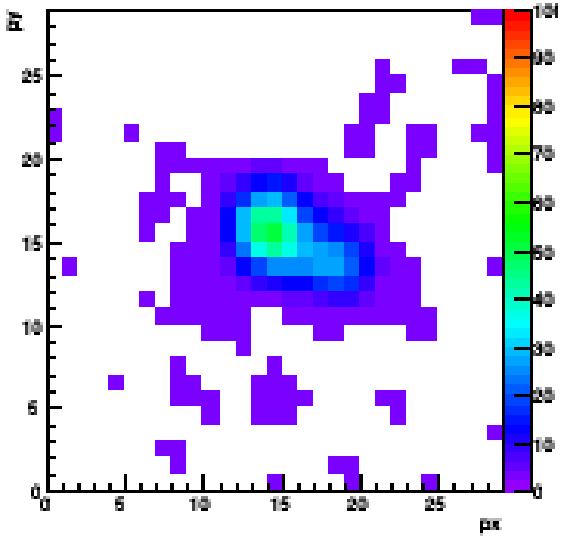
aligning the event at all wavelengths from each image

←Calibrated the wavelength dependence of optical system

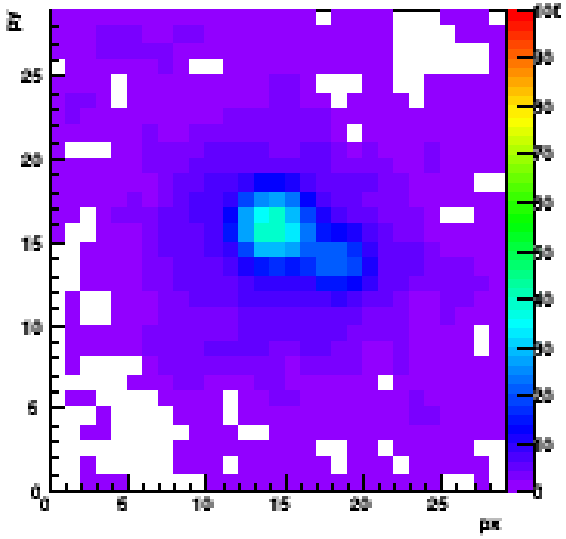
analyzing with brightness of the matched event

Information obtained by spectrum analysis

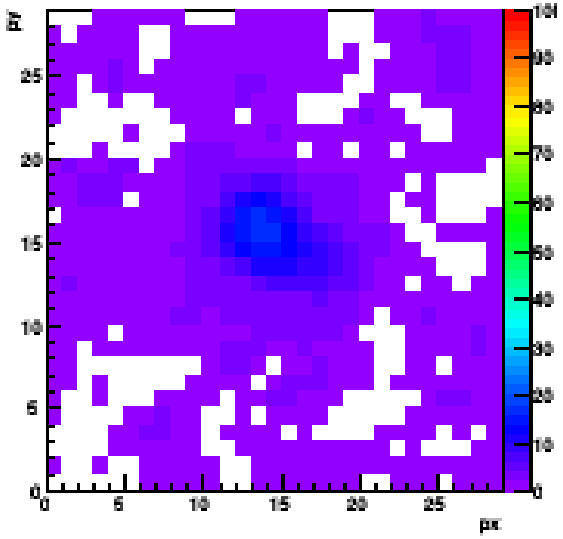
450nm



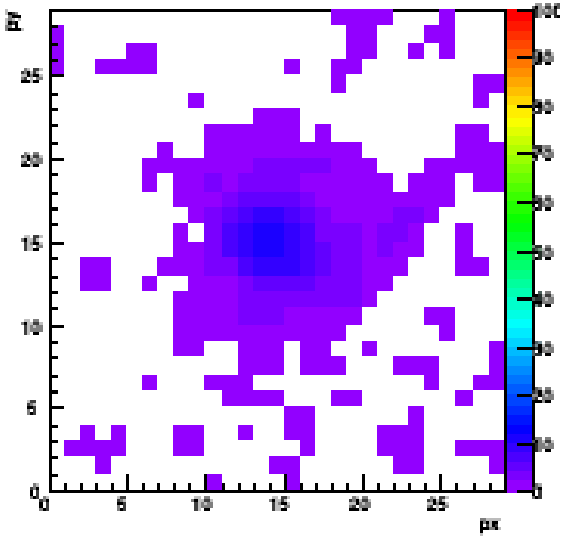
500nm



550nm



600nm



- **Event image**
- **Max brightness**
- **Mean brightness**
- **Area of event**
- **Minor, Major**
- **Brightness barycenter**

for each wavelength

Multivariable analysis

BDT, Deep Learning, etc

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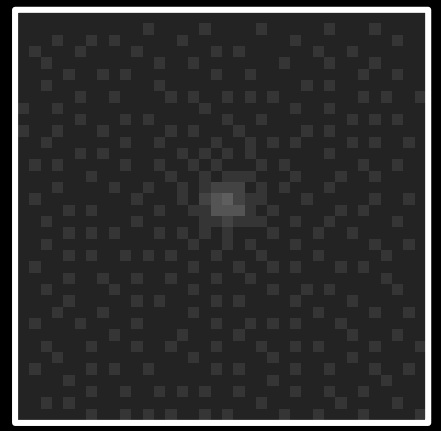
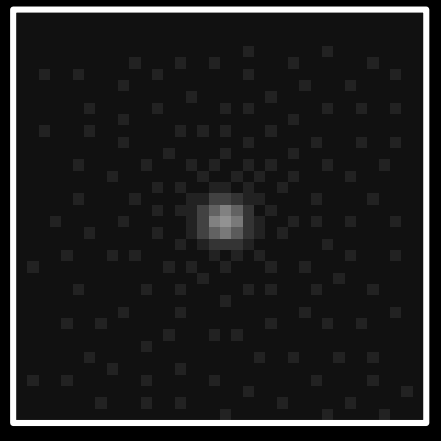
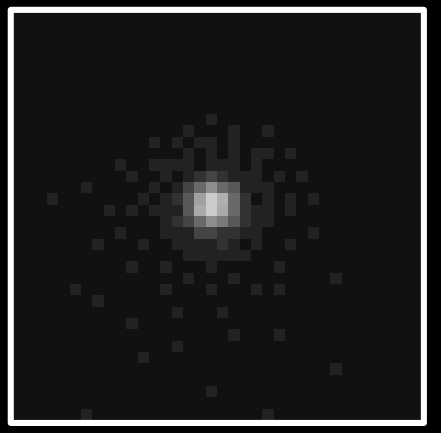
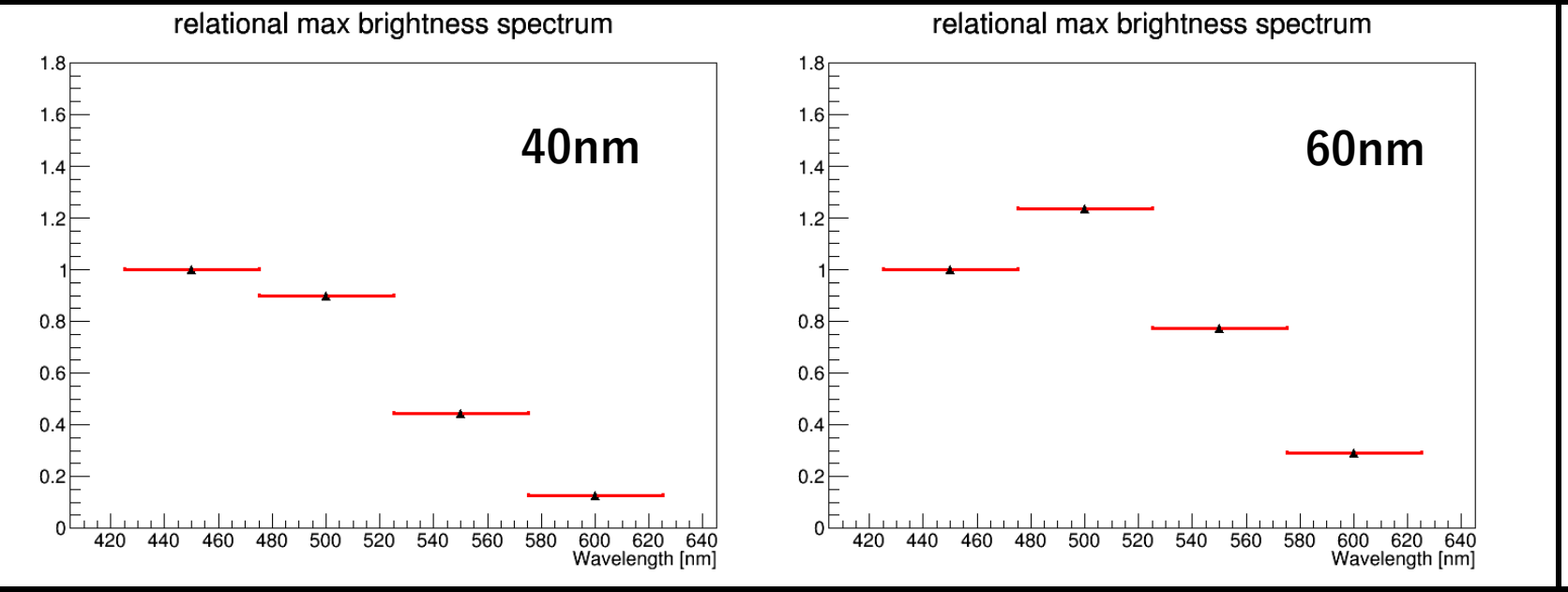
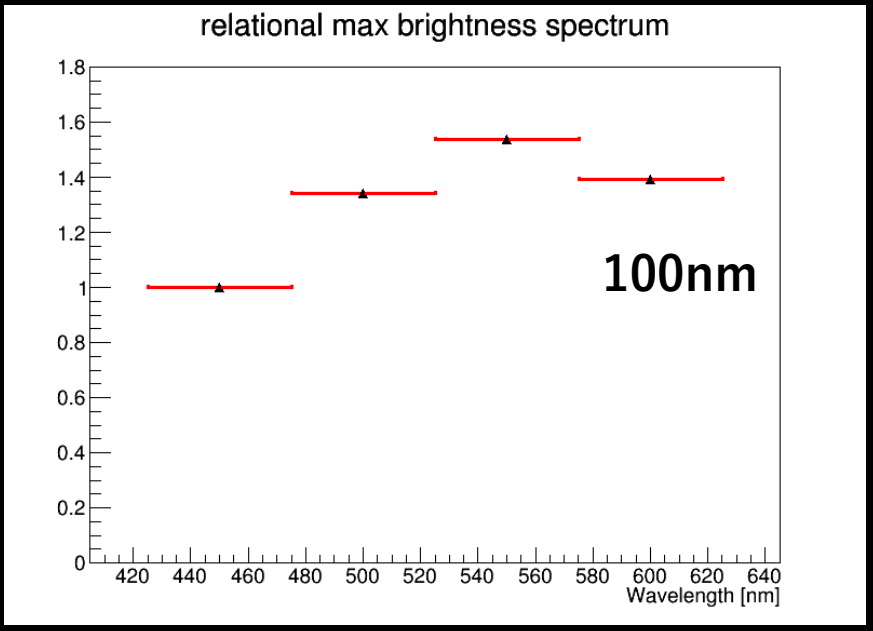
Spectrum of silver nano crystal









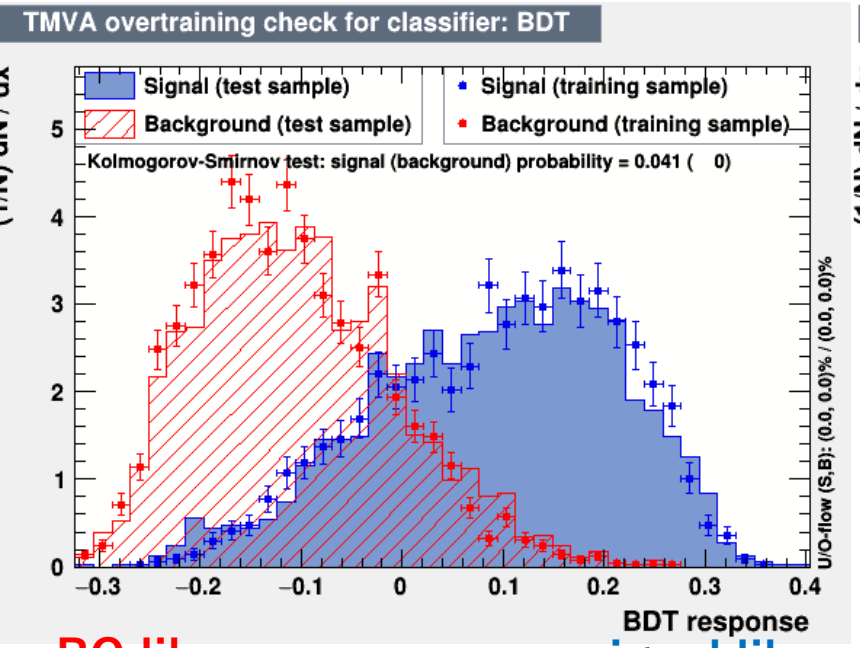


Plot the relative max brightness based on 450nm

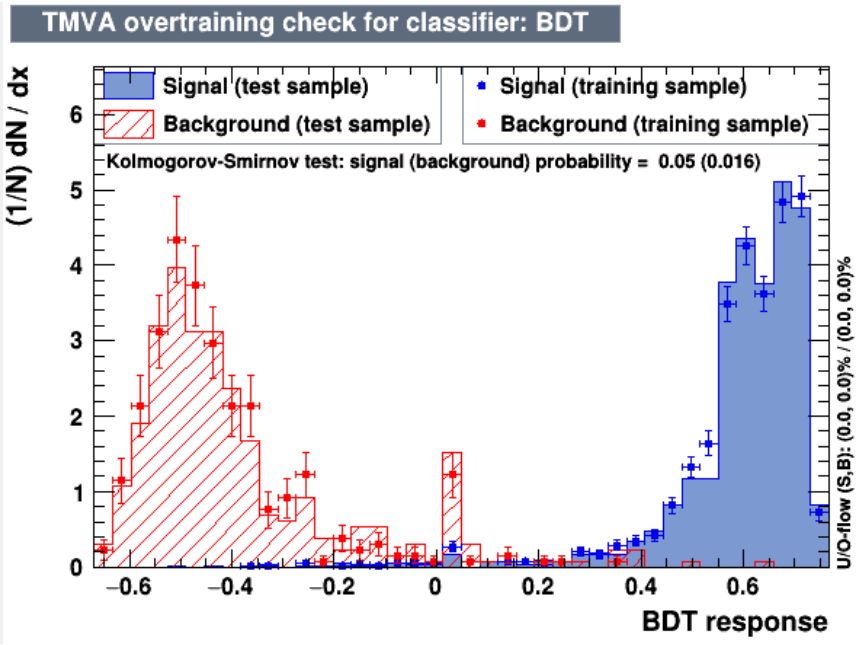
Multivariable analysis for silver nano crystal

- Classified with Boosted Decision Tree
- parameters used：relative max brightness at each wavelength based on 450nm, relative area of event

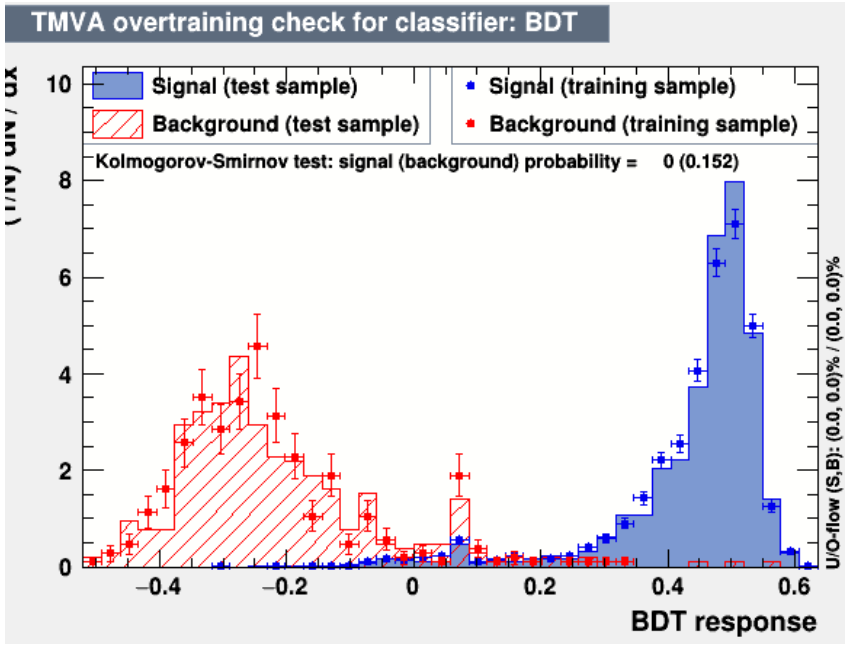
TMVA ver4.2



←BG like



signal like→



40nm vs 60nm ↑ **effect of size distribution ?**

signal: 40nm
BG : 60nm

40nm vs 100nm

signal: 40nm
BG : 100nm

60nm vs 100nm

signal: 60nm
BG : 100nm

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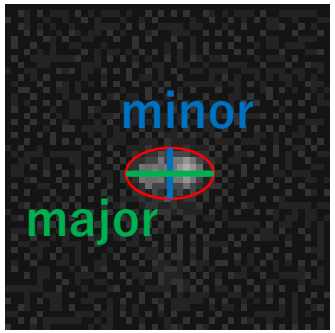
Flow of analysis

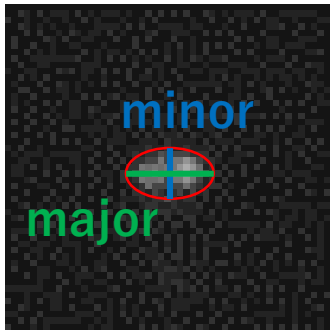


ellipticity=**major**/**minor** > **2**

1st scan (volume scan)
overall scanning

1st selection
Selection parameter: ellipticity, minor
ellipticity >2 && 4≤minor≤6

Flow of analysis



ellipticity=major/minor ＞2

1st scan (volume scan)
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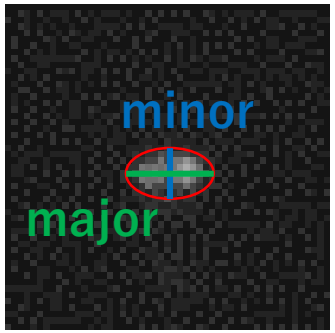
ellipticity >2 && 4≤minor≤6

2nd selection
number of pixel on binary image

Flow of analysis



ellipticity=major/minor ＞2

1st scan (volume scan)
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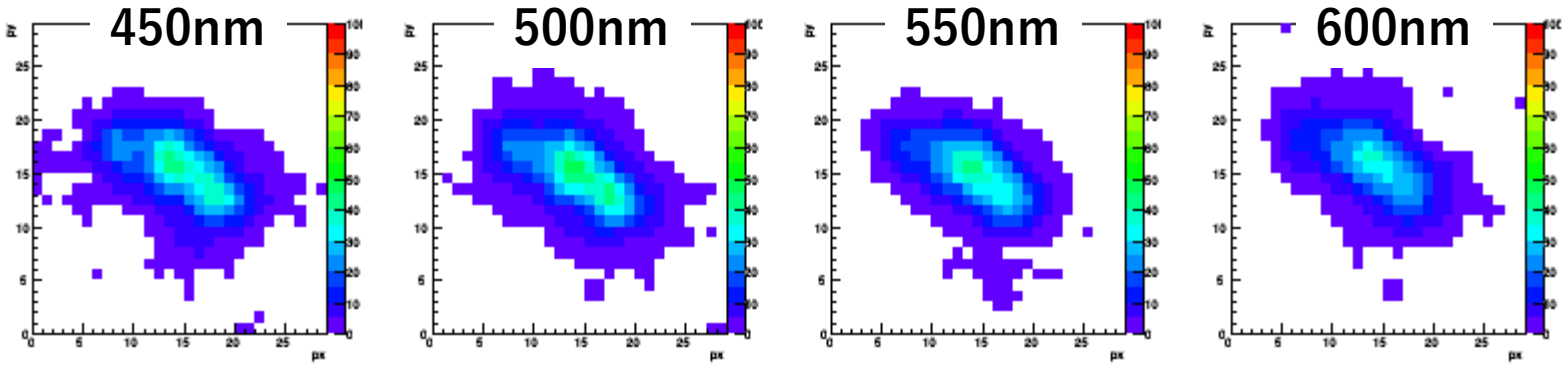
ellipticity >2 && 4≤minor≤6

2nd selection
number of pixel on binary image

aligning the event at all wavelengths from each image

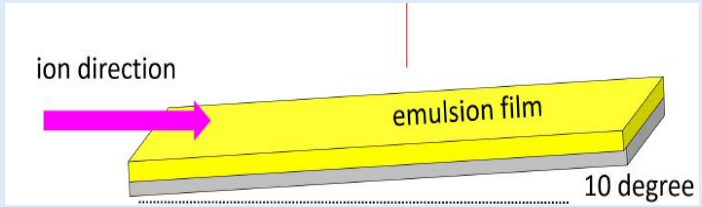
Multivariable analysis of the matched event



Signal and Background

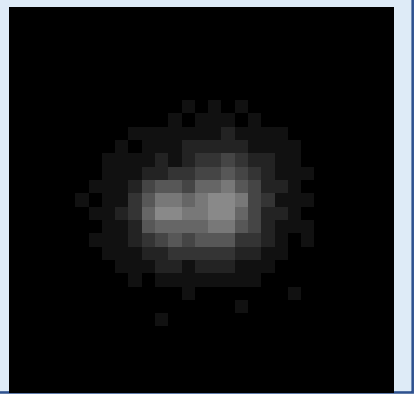
signal

- 200keV Carbon ion sample



- Energy of incident C ion ~ 150 keV
  → expected track length ~400nm
- uniform angle(>10mrad)
- ellipticity > 2.0

240 event

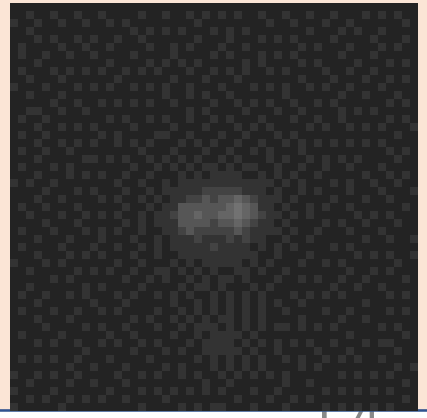


BG

- Fix only sample (FAN085gf)
- random angle
- ellipticity > 2.0

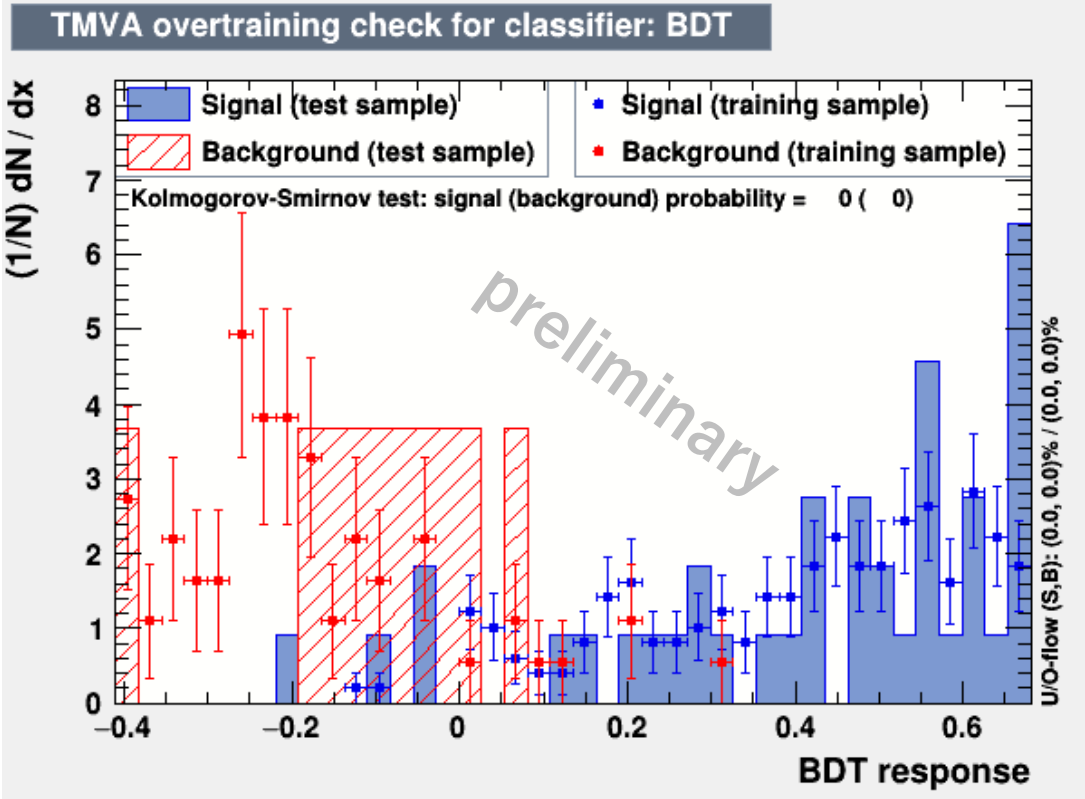
selected 116 event

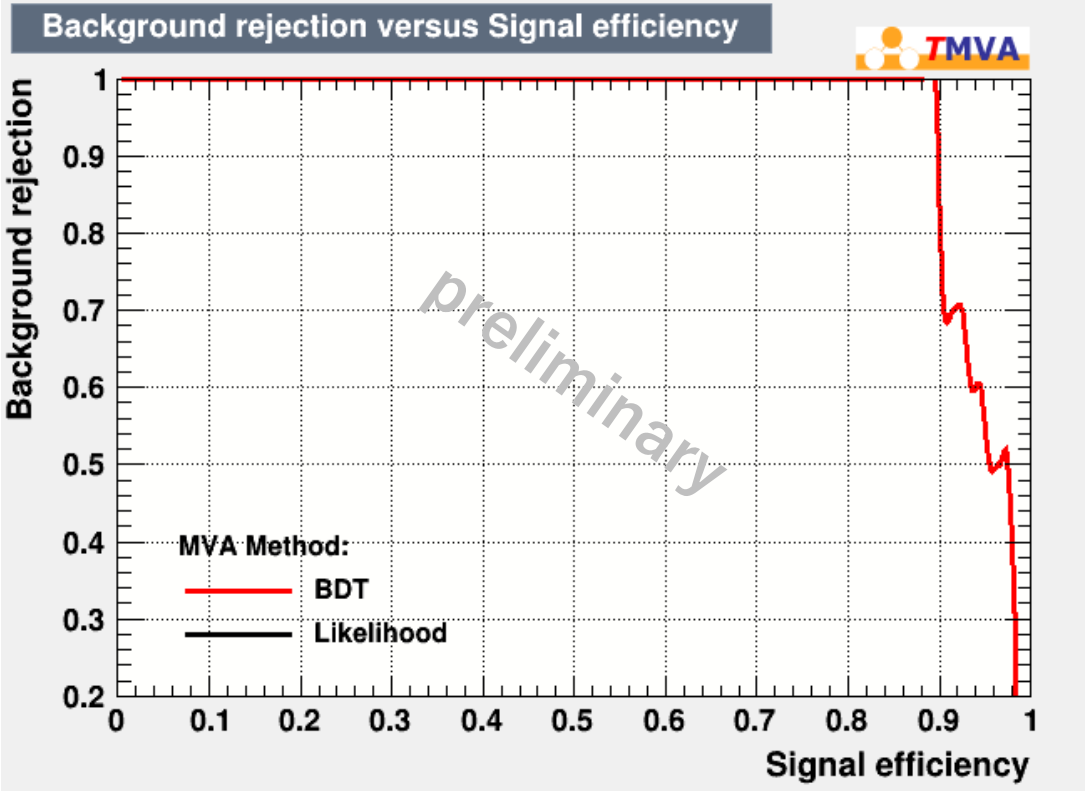
matched 79 event



Classify carbon and dust with BDT

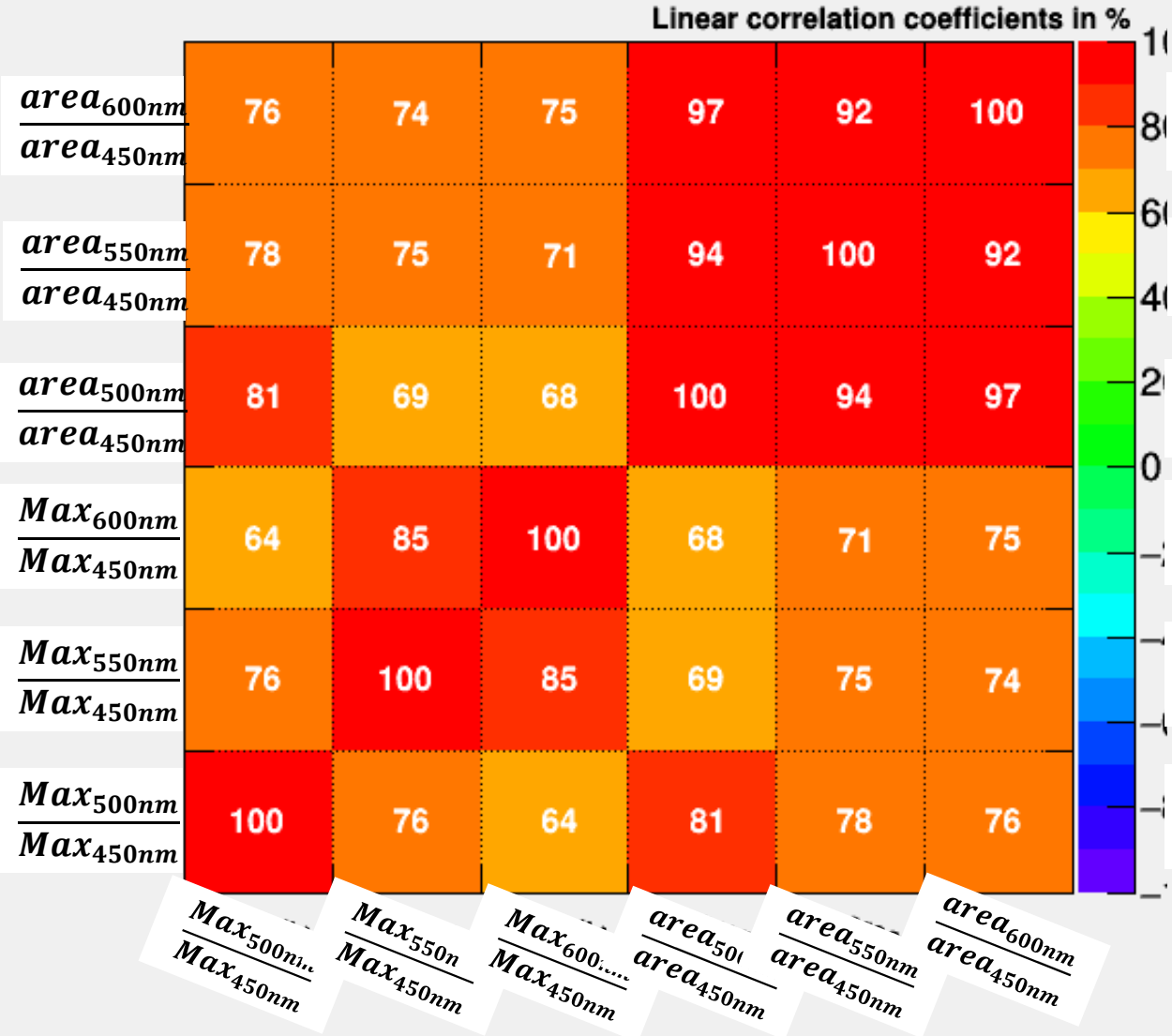
Parameters used： relative max brightness at each wavelength based on 450nm, relative area of event



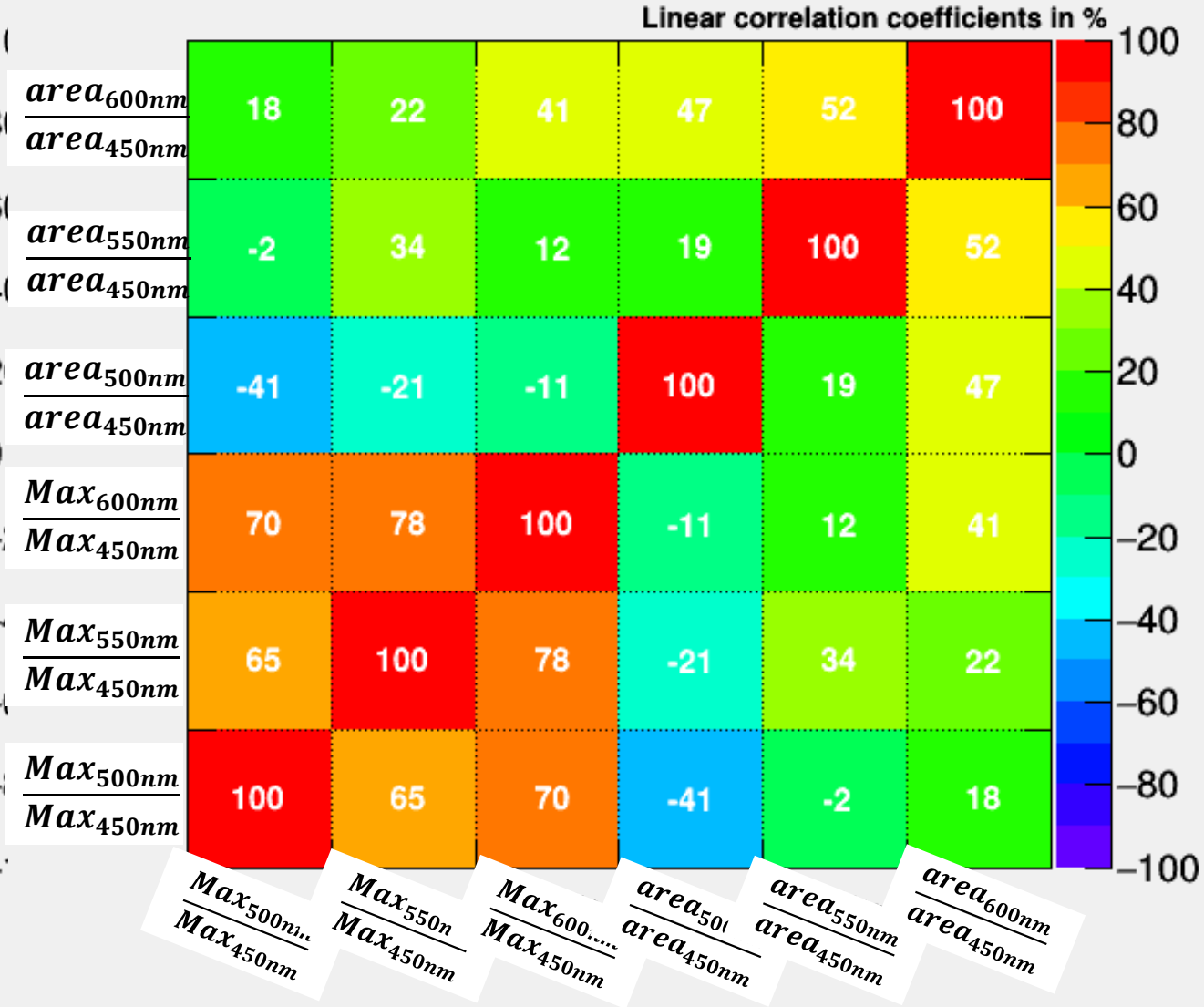


BDT correlation plot Carbon track vs Dust

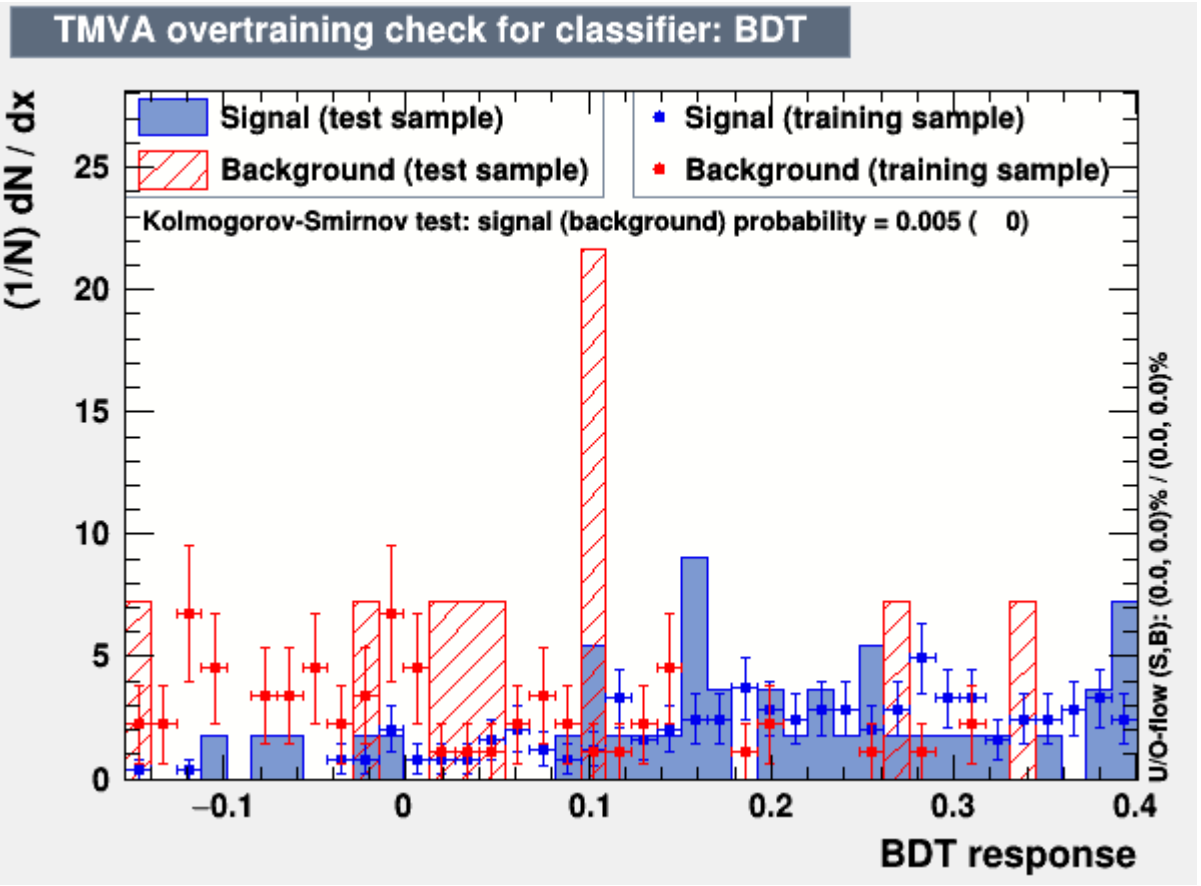
Correlation Matrix (signal)



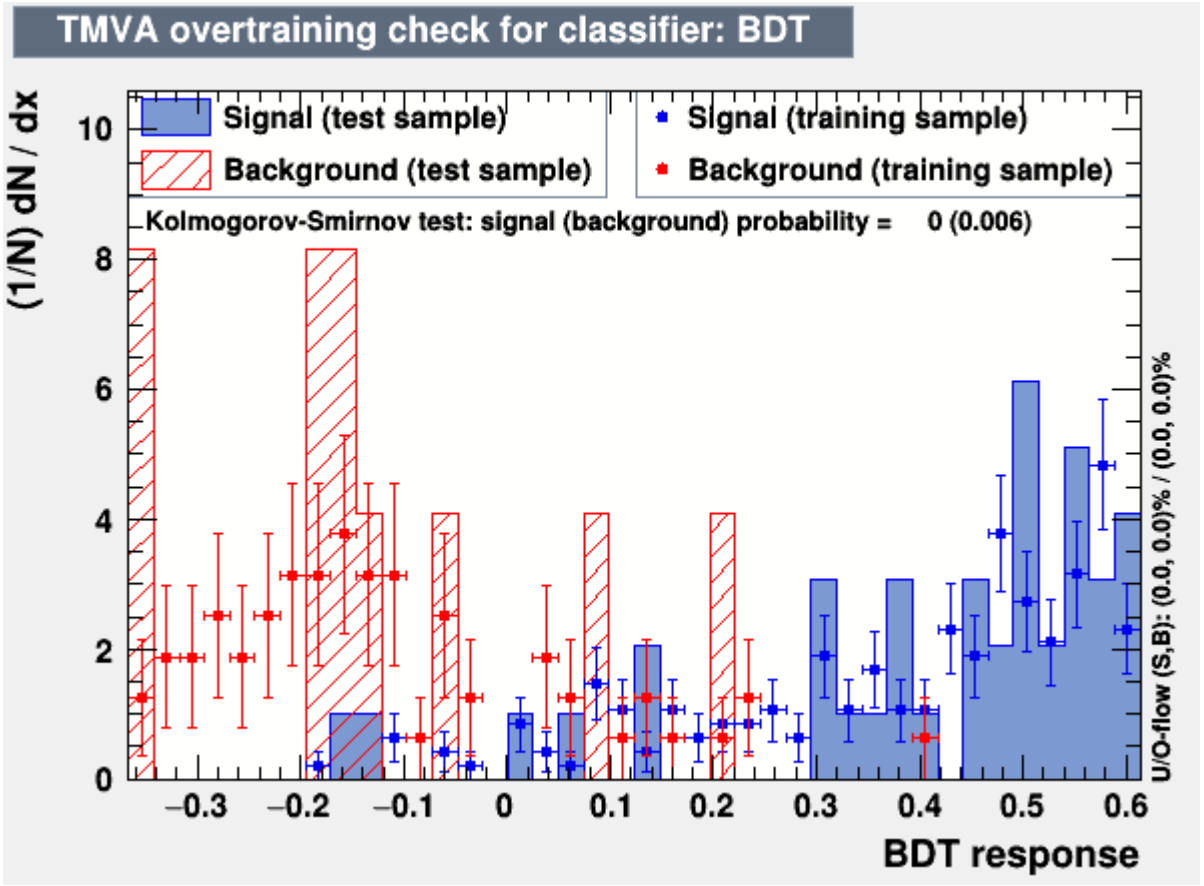
Correlation Matrix (background)



Classify carbon and dust with BDT



use parameter: relative area



use parameter: relative max brightness

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Problem and vision

Problem

- I have scanned and analyzed only 142 signal event and 79 BG event. I need much more event, at least 1000 event for multivariable analysis.

necessity for much more scanning

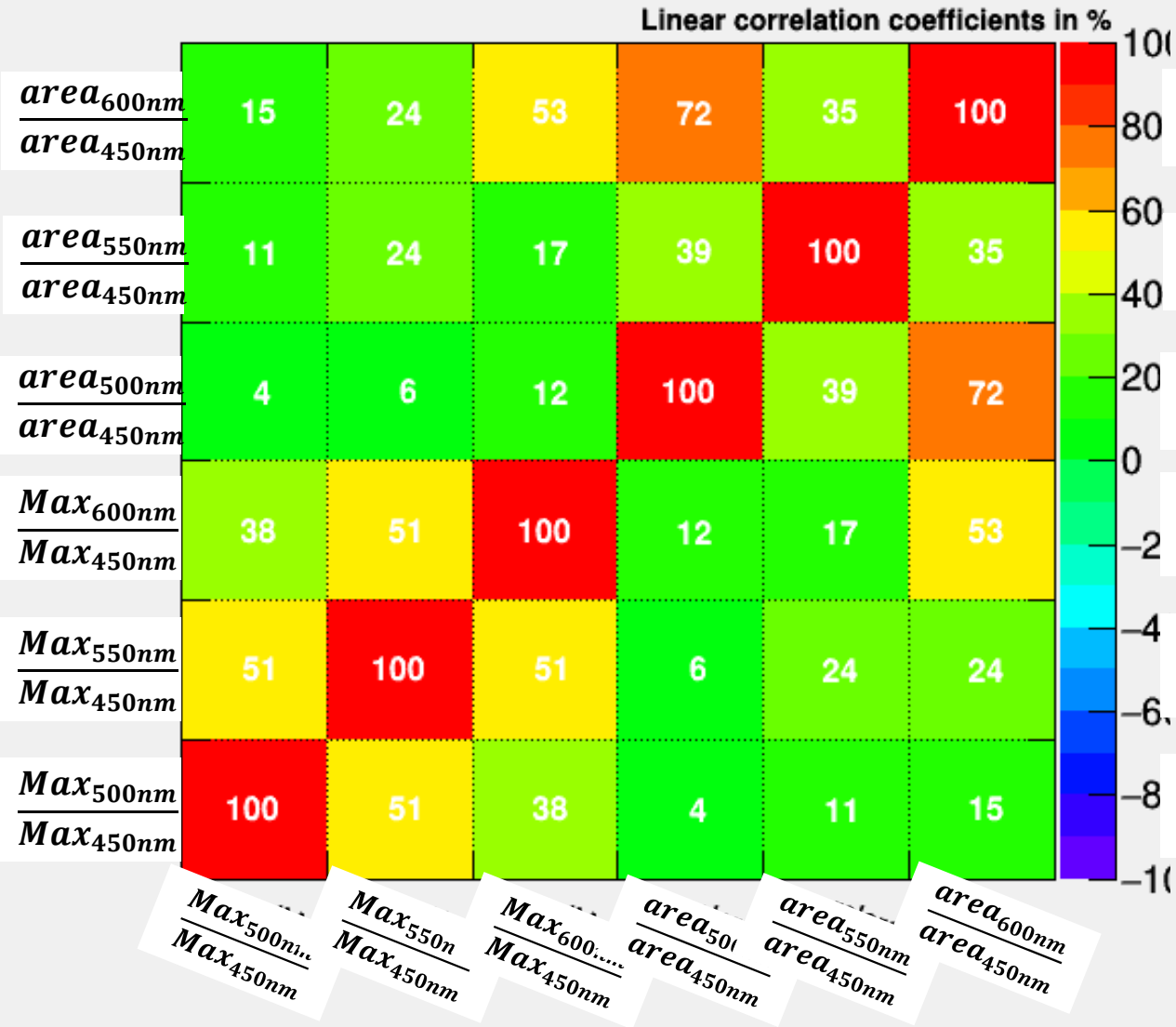
Vision

- Identify neutron samples using the learning model.
- Evaluation with smaller ellipticity event
- Add evaluation parameter
  e.x. wavelength, shift of brightness barycenter, …

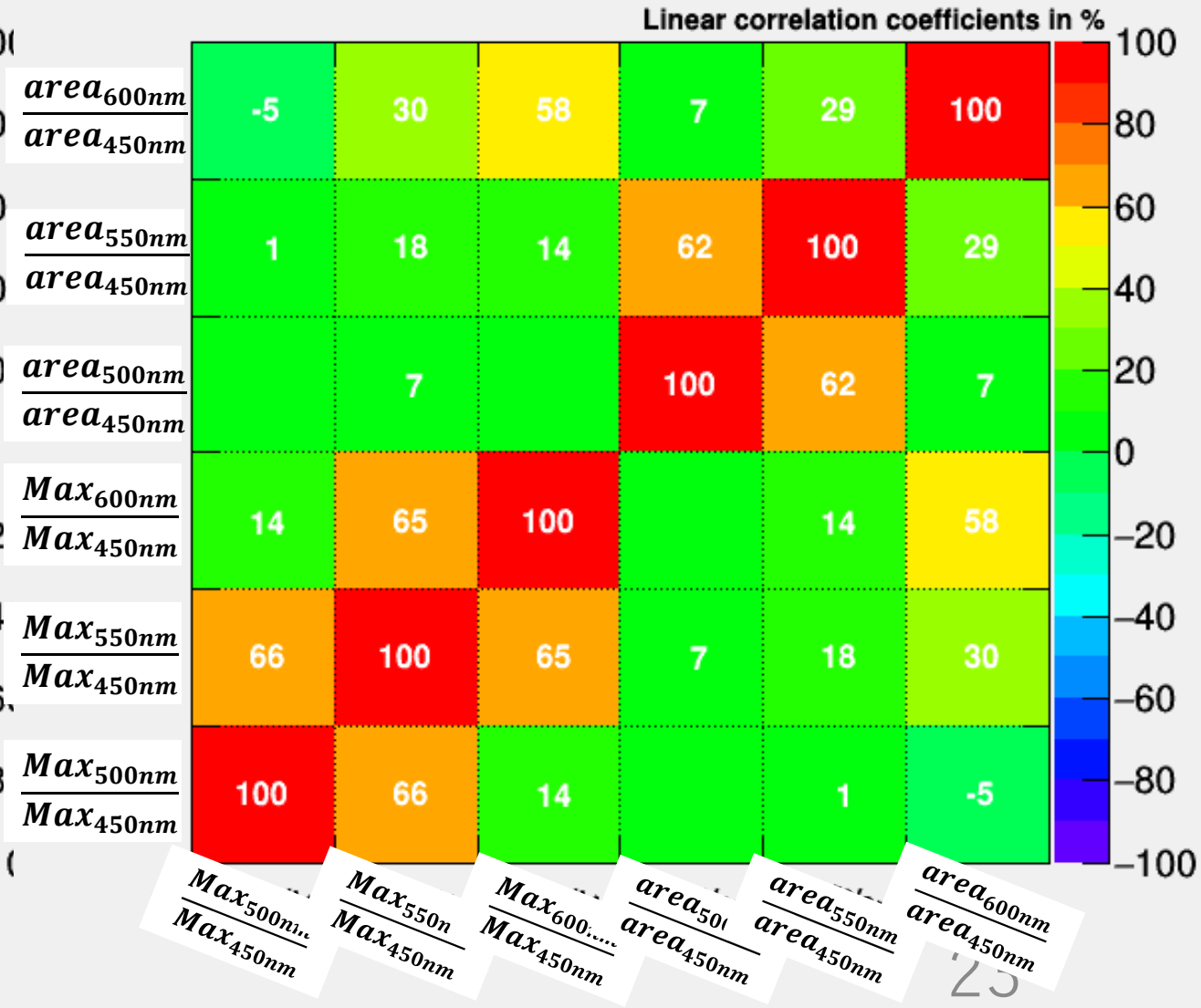
Back up

BDT correlation plot 40nm vs 60nm

Correlation Matrix (signal)

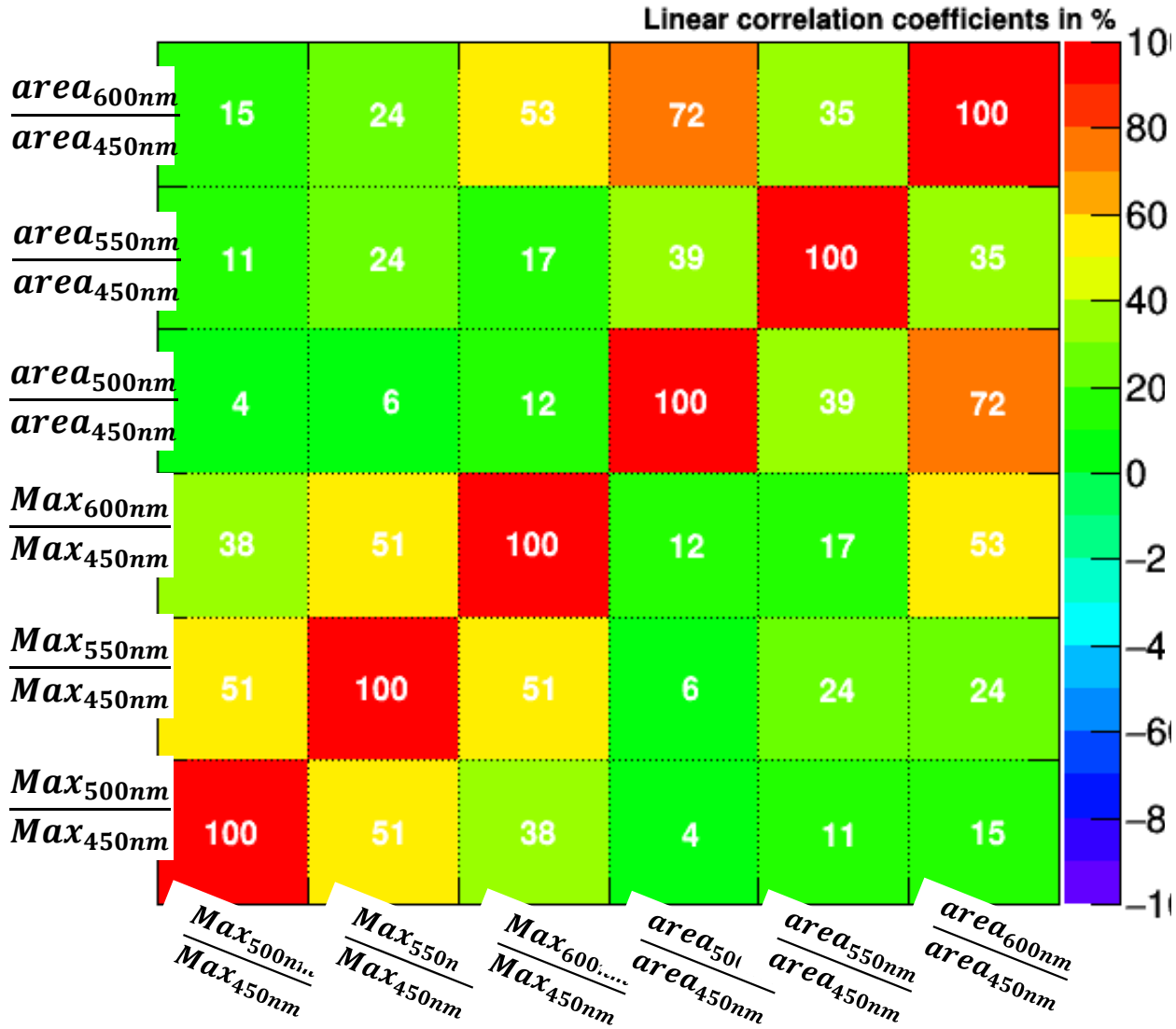


Correlation Matrix (background)

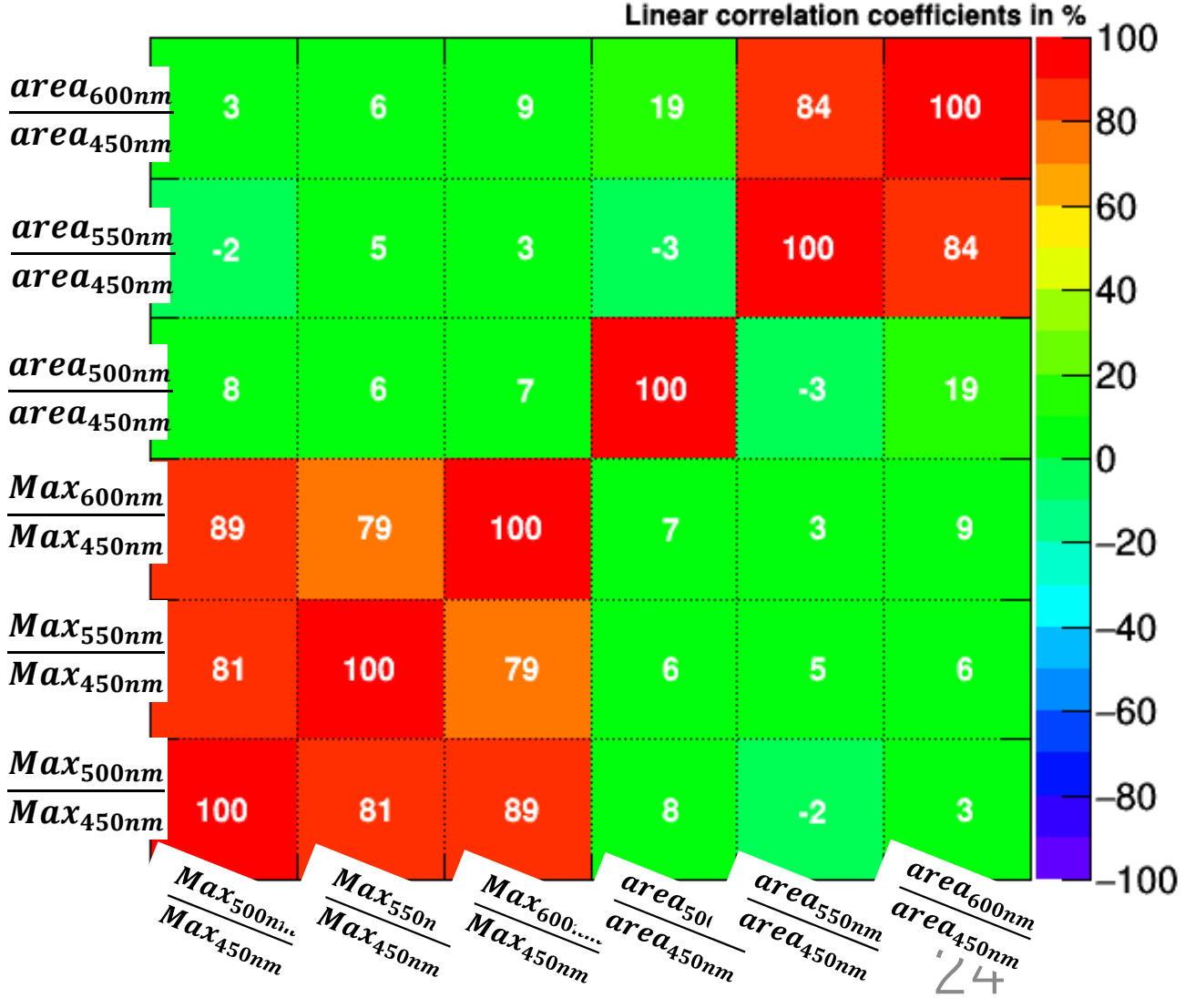


BDT correlation plot 40nm vs 100nm

Correlation Matrix (signal)

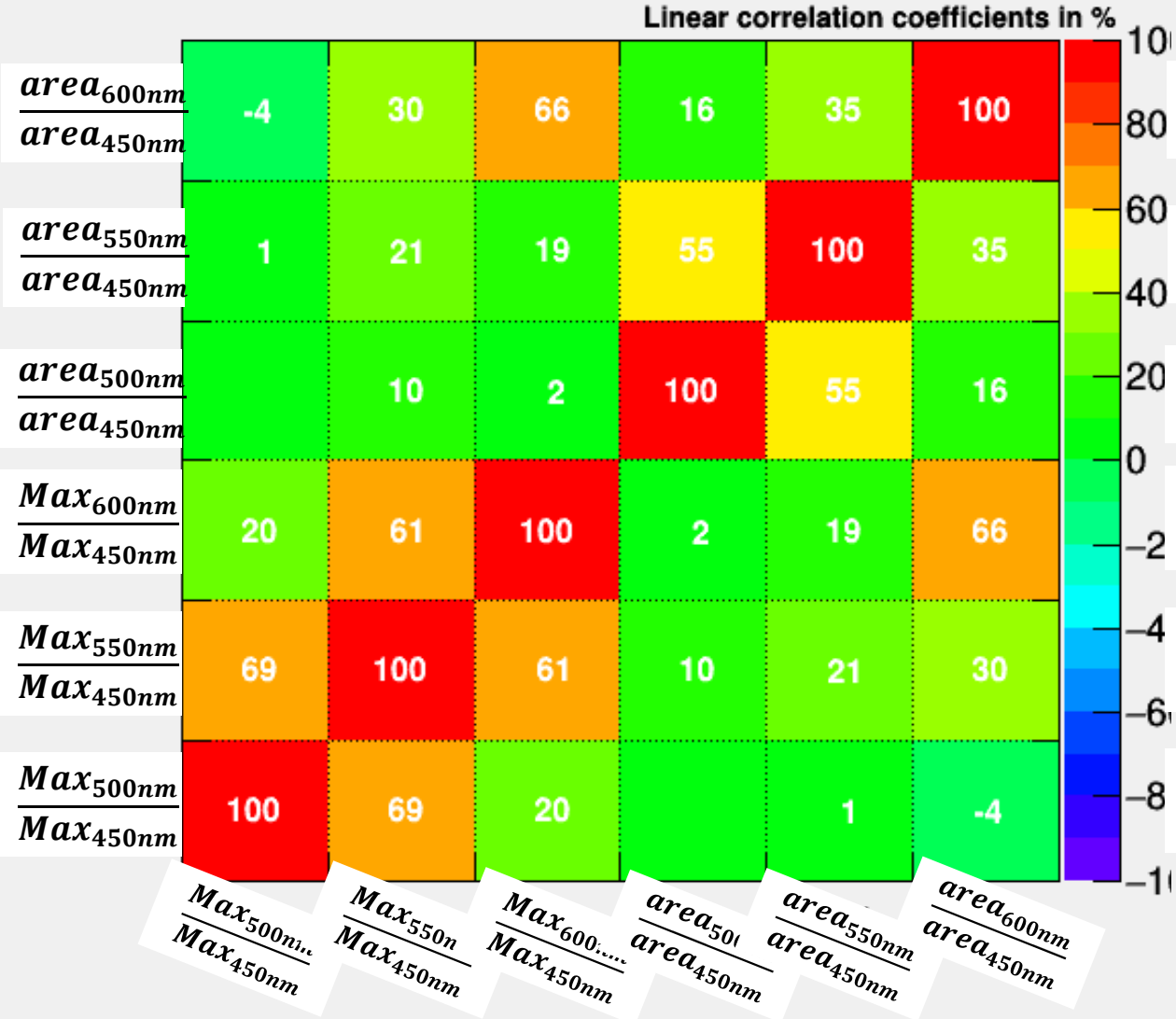


Correlation Matrix (background)

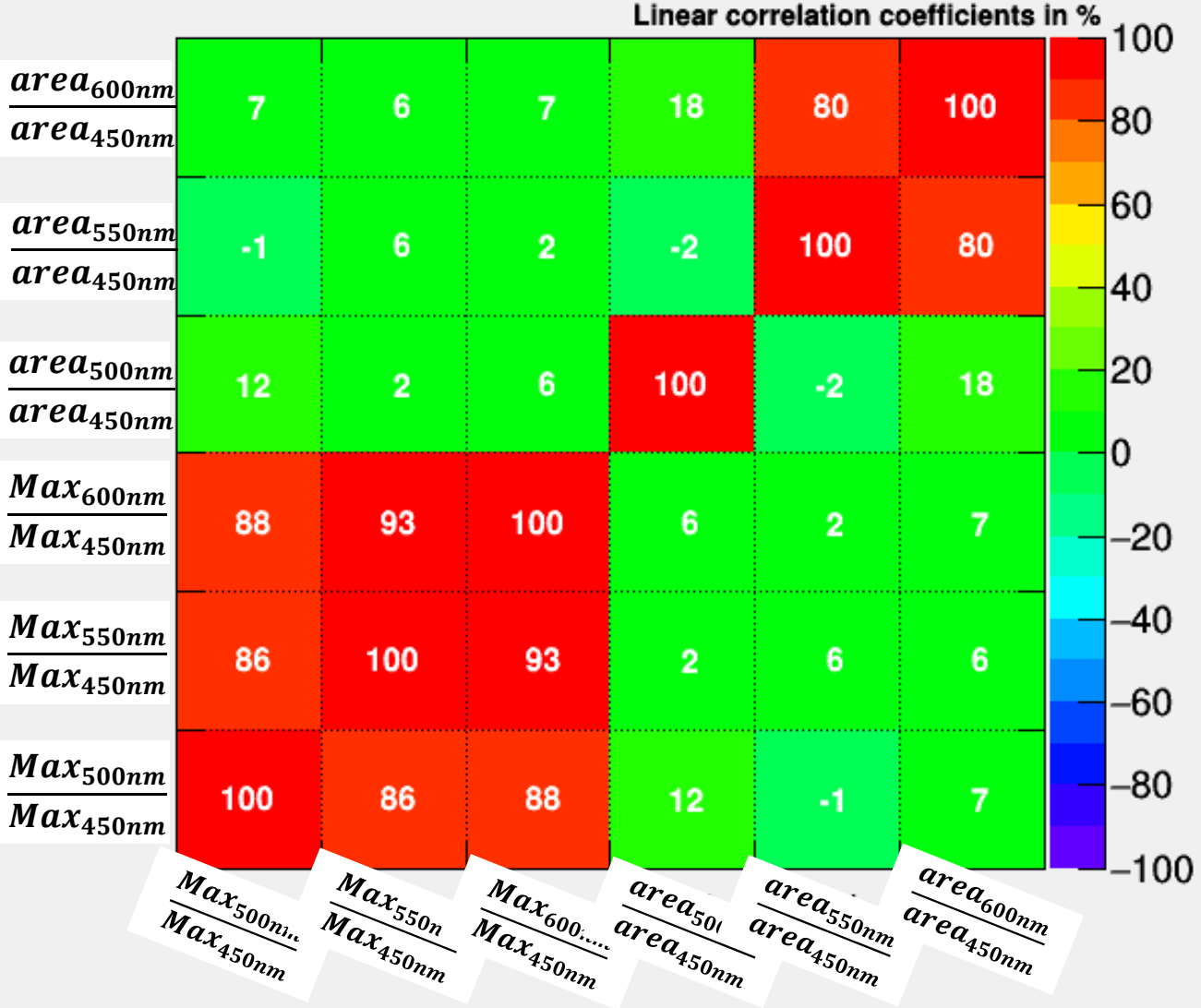


BDT correlation plot 60nm vs 100nm

Correlation Matrix (signal)



Correlation Matrix (background)



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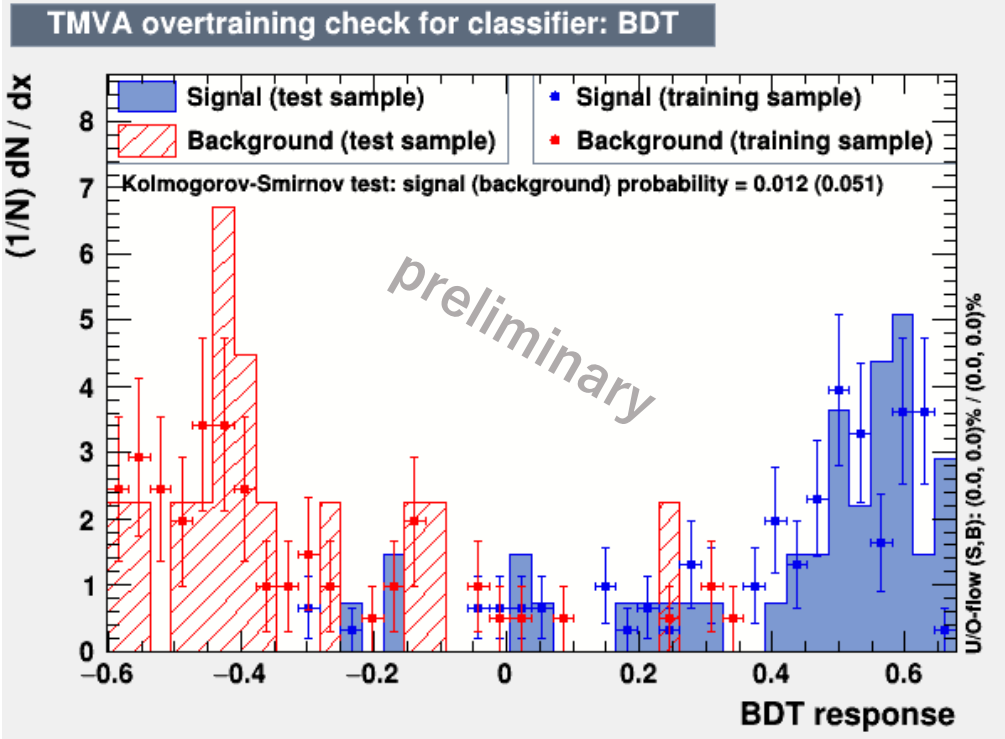
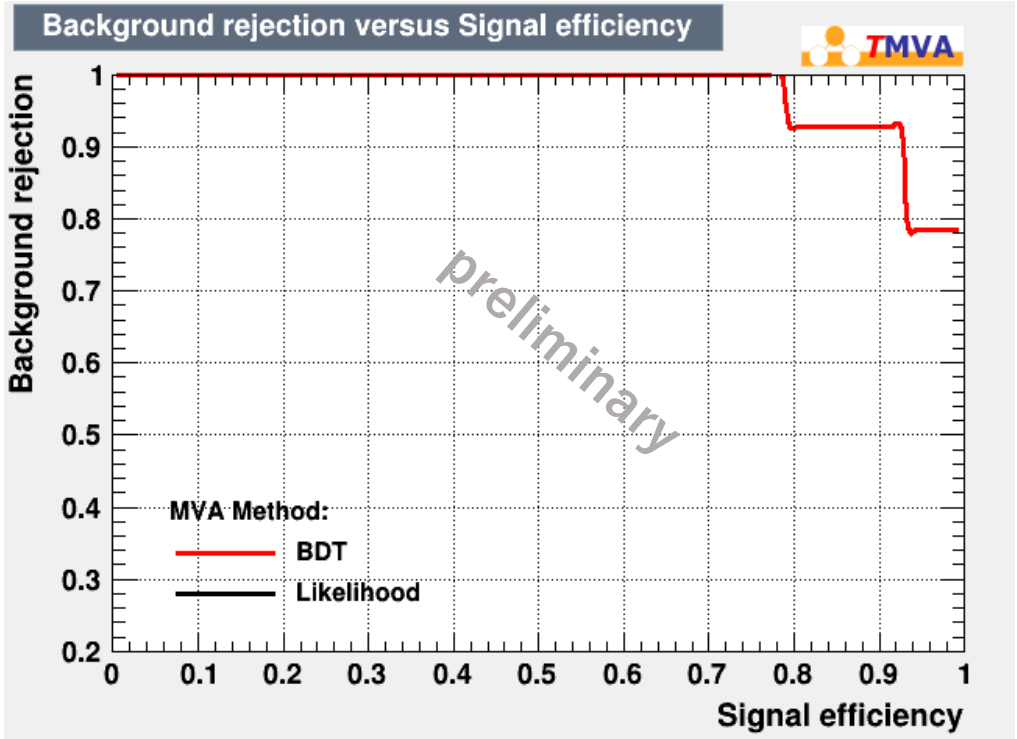
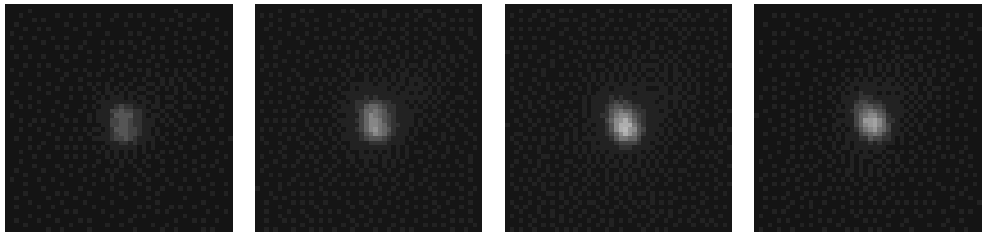
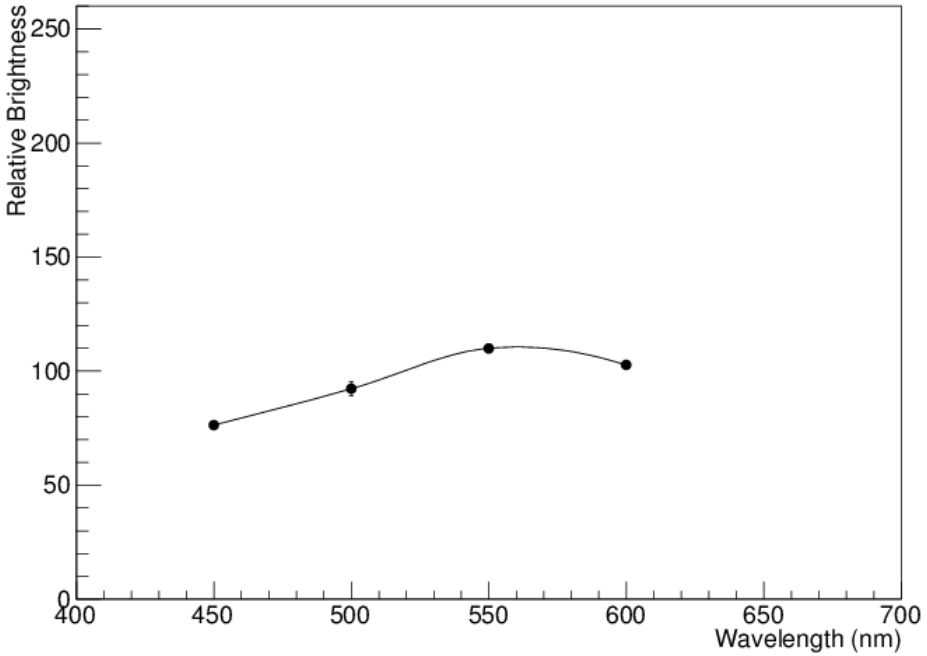




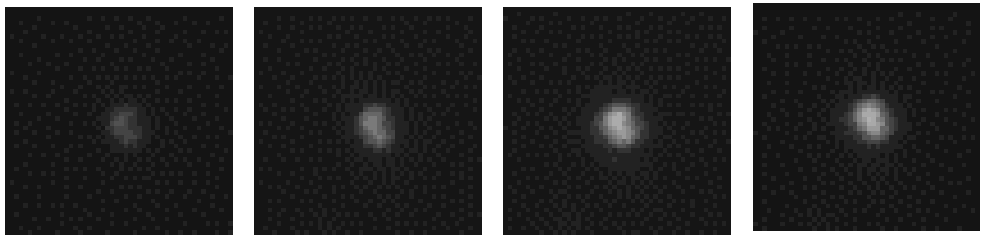
Dusts spectrum

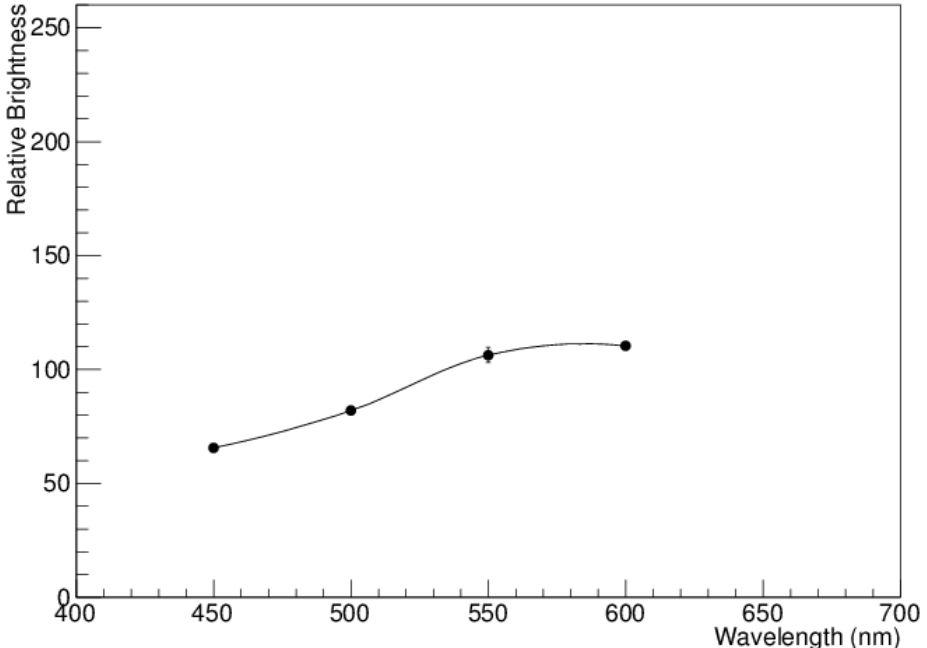
Ev25 surface
Elli 1.49





Ev35 surface
Elli 1.42





450 nm **500 nm** **550 nm** **600 nm**