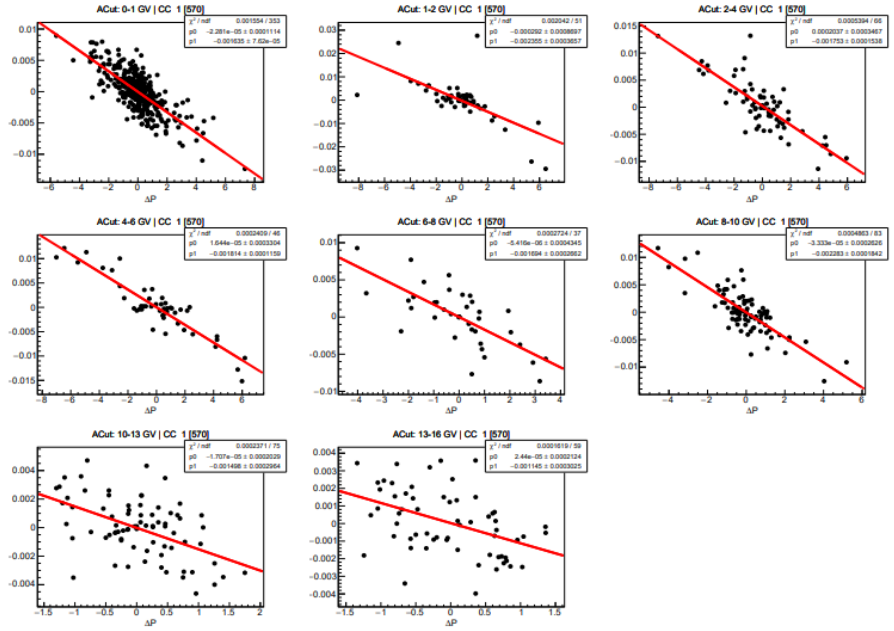
Yield function of ice Cherenkov detector operation during ocean voyage during 2009 – 2010 survey year

Outline:

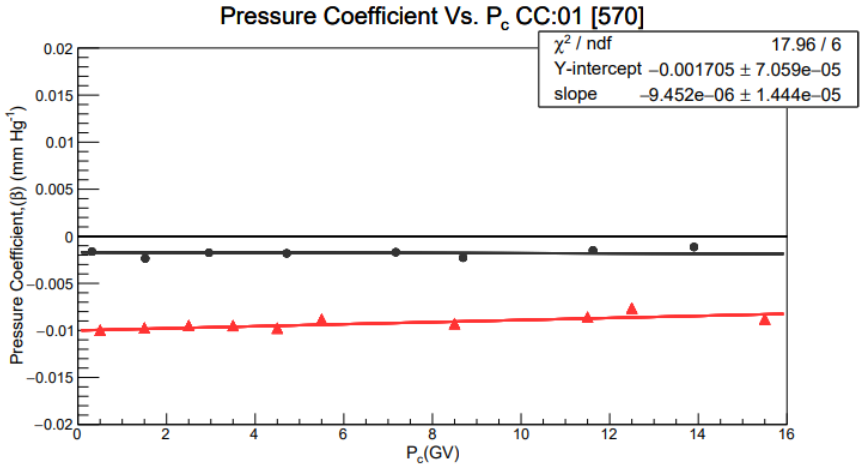
- Results
  - Analysis
    - Barometric pressure correction
    - Surface temperature correction
    - Temperature correction in different layer
  - Simulation
    - Histogram of deposited energy
    - Mean of deposited energy for various energy
    - Mean of deposited energy for various ice thickness

Barometric pressure correction

1. Remove data from port effect
2. Plot the relation between ΔlnC and ΔP



3. Pressure coefficient vs. Pc



4. Correct data for barometric pressure based on the method obtained from Nuntiyakul et al. (2014)

$$C_{\mathrm{p}} = C_{\mathrm{un}} e^{\beta(P - P_{\mathrm{ref}})},$$

5. Remove data when the ship was docking or moving near the coast of Antarctic and the variability of the ship more than 1

6. Separate data into two interval SB and NB

SB: DOY326 – DOY360
NB: DOY420 – DOY473

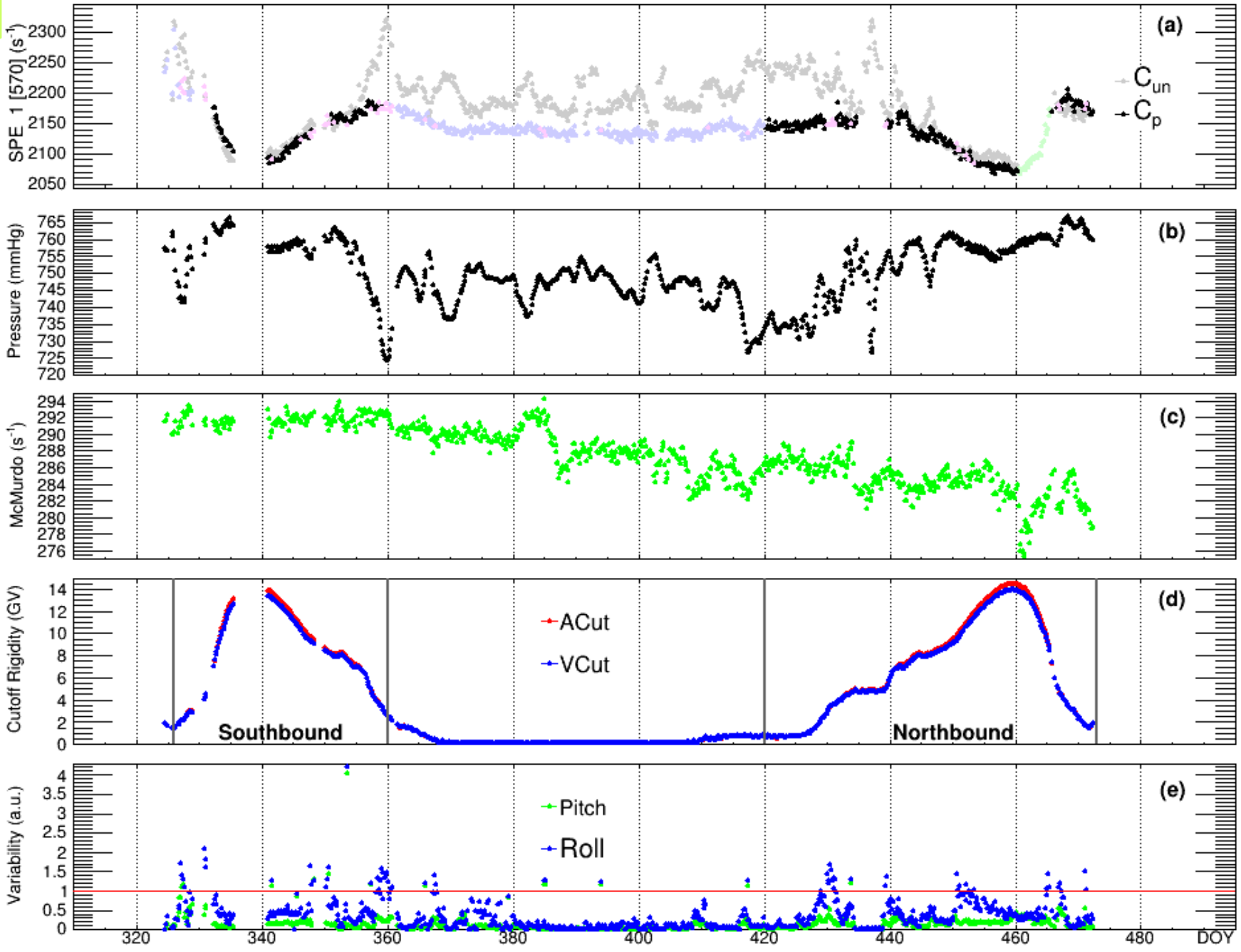
7. Finding the response function by using the Dorman function

Barometric pressure correction

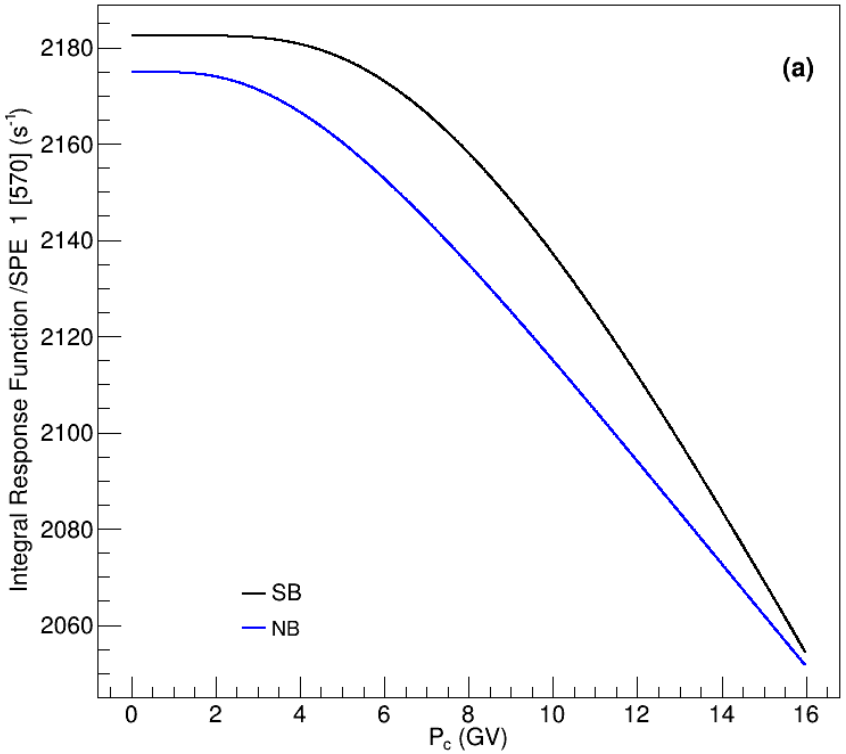
Data Reduction:

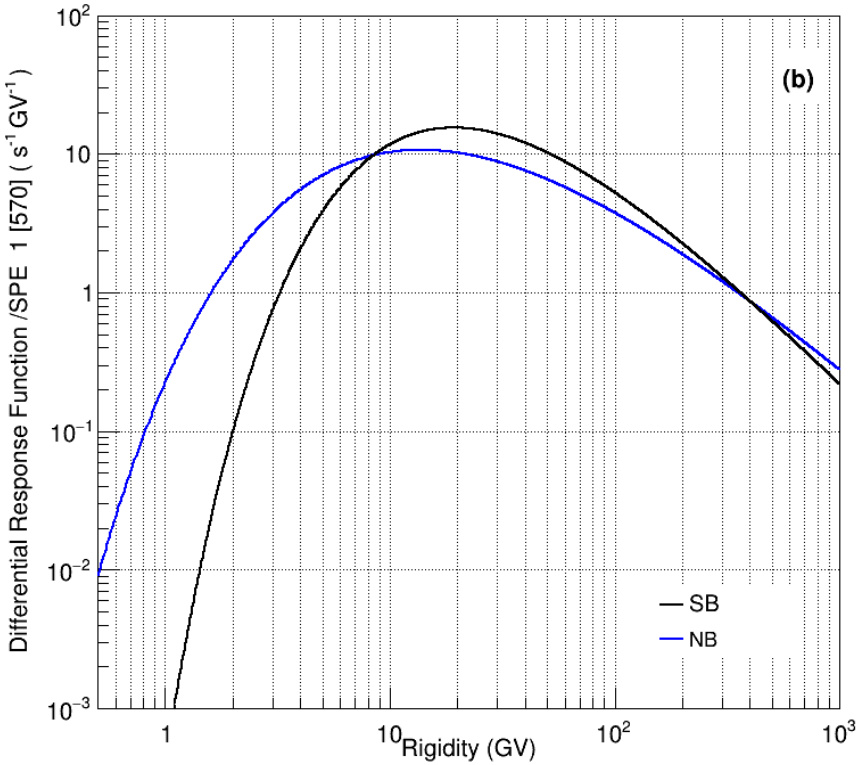
Data in light colors, i.e., Red, Purple, Green have been removed from our analysis. We consider only **Black** color in this analysis.

- ❑ Pressure Uncorrected Data
  - Gray is raw data obtained from "LatSur" files.
- ❑ Pressure Corrected data
  - Red data that has Pitch and Roll variability (a.u.) >1
  - Purple data when the ship was docking or moving near the coast of Antarctic
  - Green data during FD event (notice time period from green in McMurdo count rate)
  - **Black** data corrected for barometric pressure



Barometric pressure correction





Dorman equation:

$$N = N_0\left(1 - e^{-\alpha P_c^{-\kappa}}\right),$$

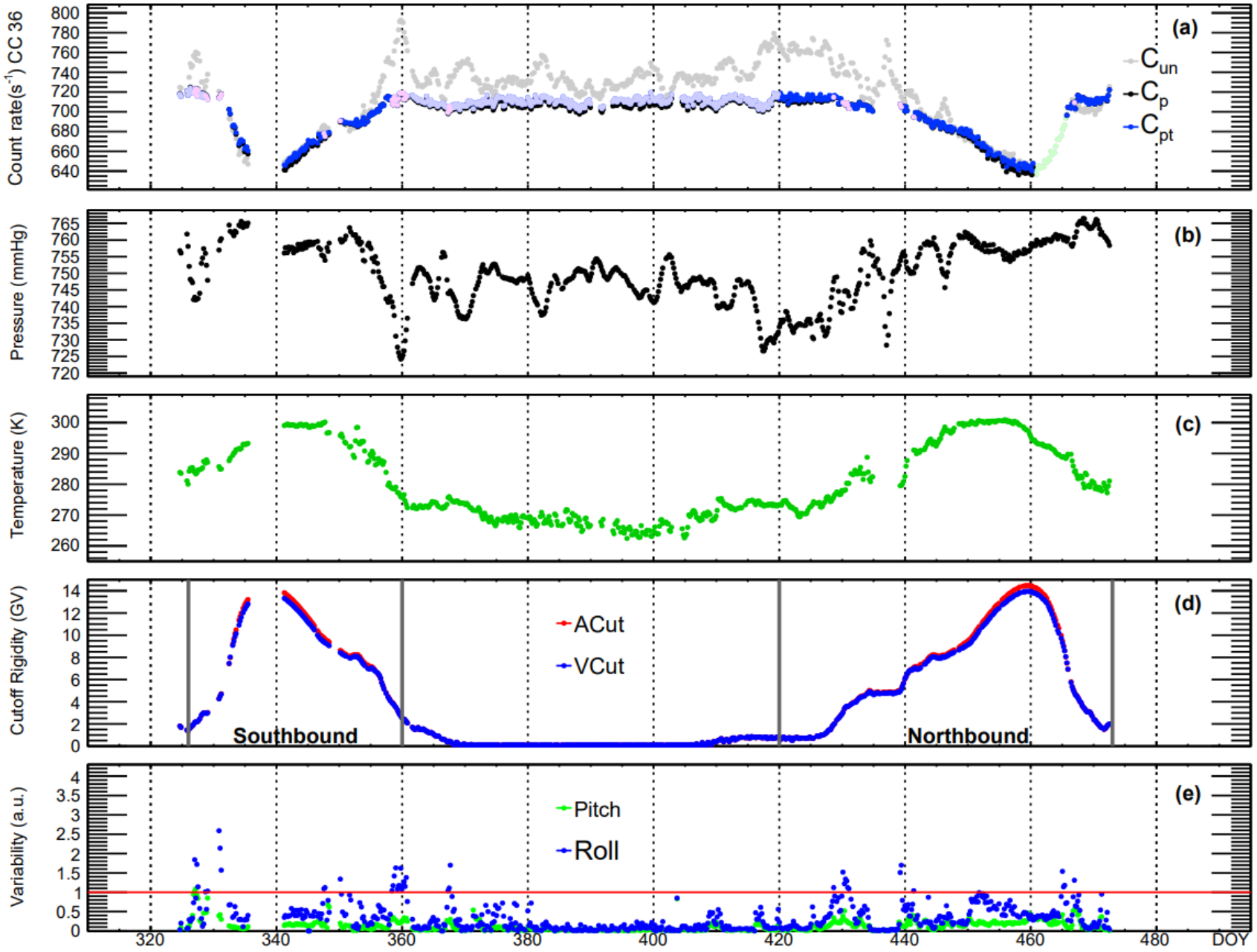
$$N = \int_{P_c}^{\infty} (DRF)dP$$

$$DRF = N_0 \alpha P^{-\kappa-1} \kappa \left(e^{-\alpha P^{-\kappa}}\right),$$

where $N_0, \alpha, and\ \kappa$ are free parameters.

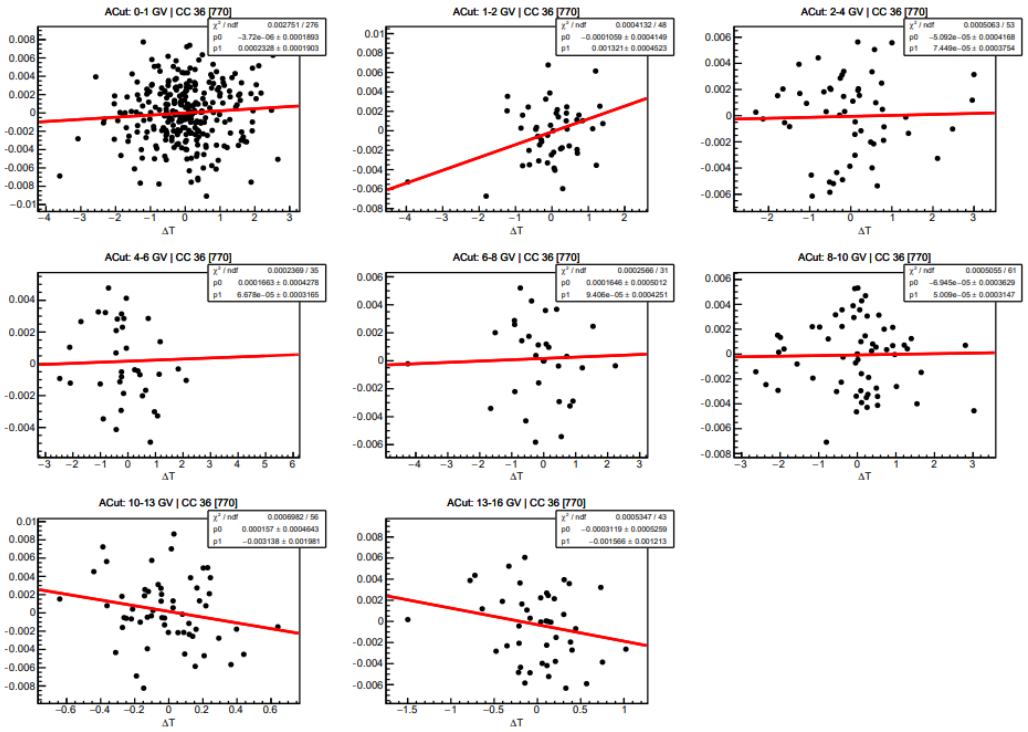
Surface temperature correction

NOTE: This graph is an example signal at SPE discriminator setting 770 (condition code 36)

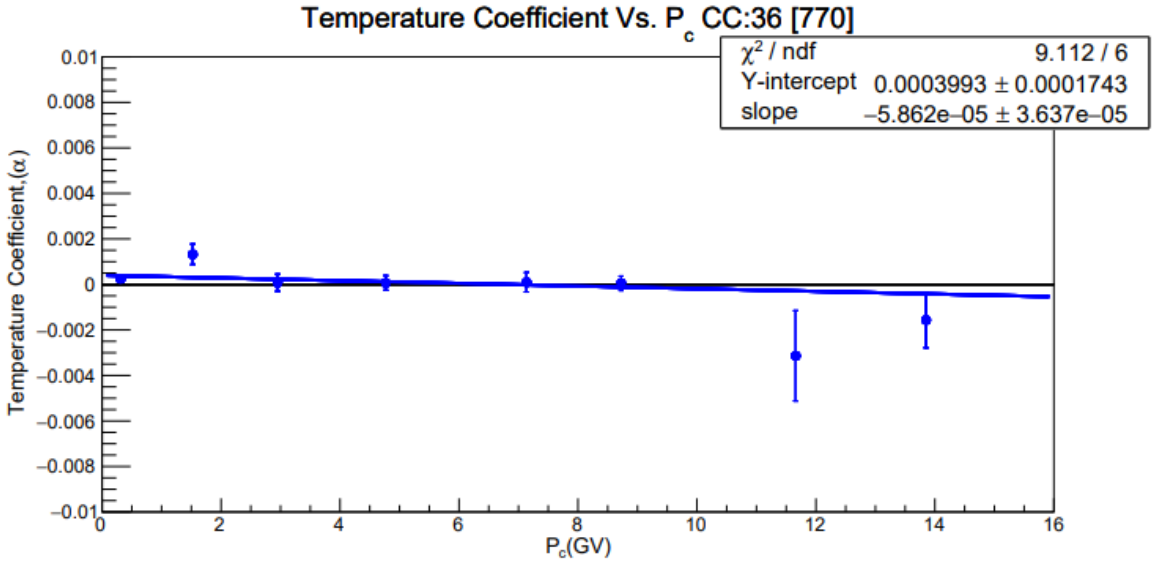


Surface temperature correction

1. Plot the relation between ΔlnC and ΔT



2. Temperature coefficient vs. Pc



3. Correct data for surface temperature

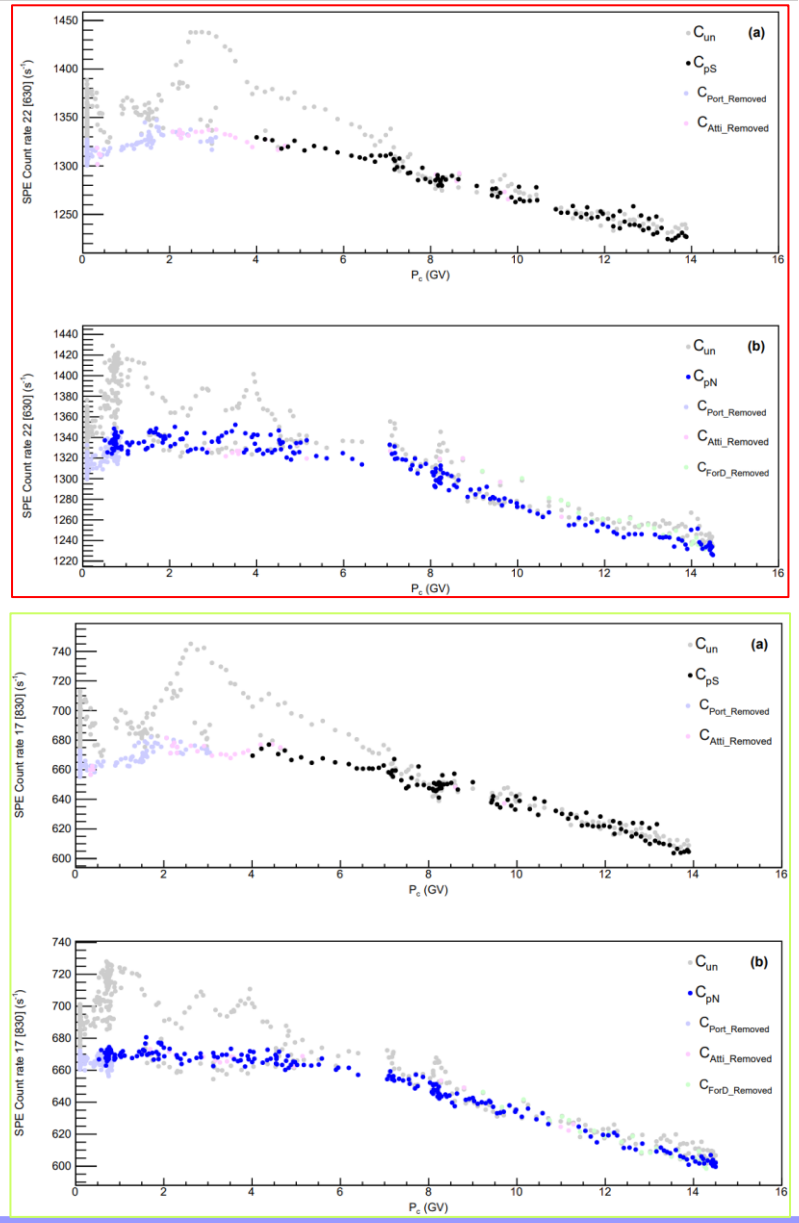
$$C_{\mathrm{pt}} = C_{\mathrm{p}} e^{\beta(T - T_{\mathrm{ref.}})}$$

4. Separate data into two interval SB and NB

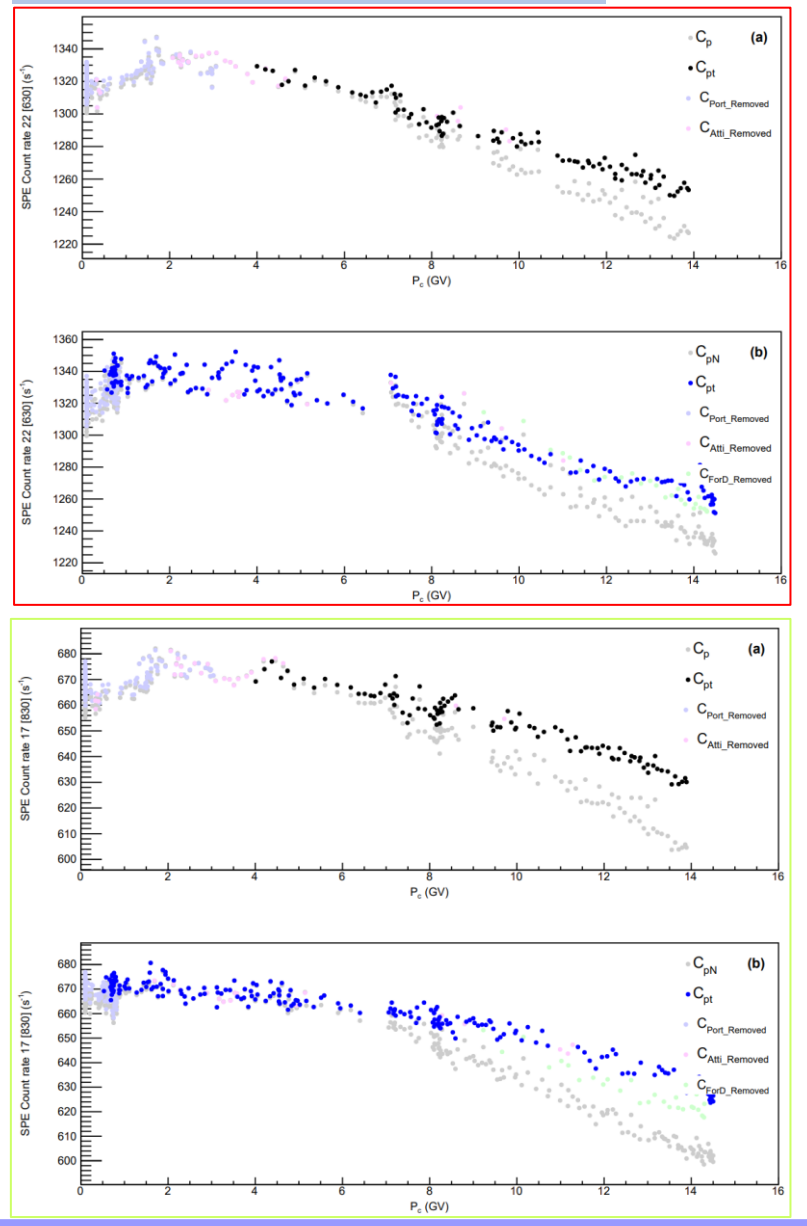
5. Finding the response function by using the Dorman function

Surface temperature correction

Pressure correction (before correcting the temperature)



Surface temperature correction



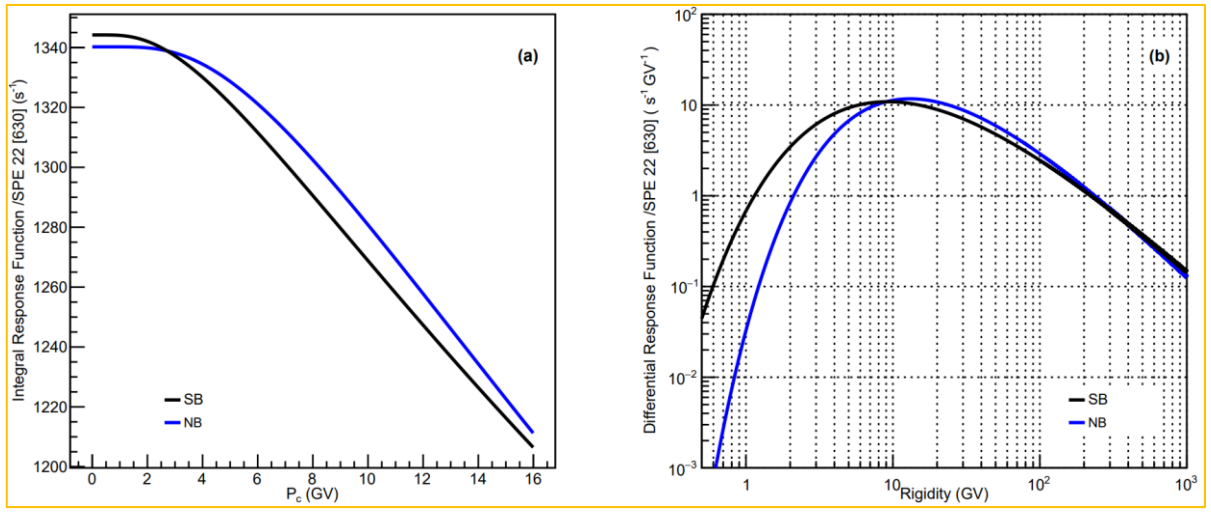
Top: a signal at SPE discriminator setting 630 (condition code 22)

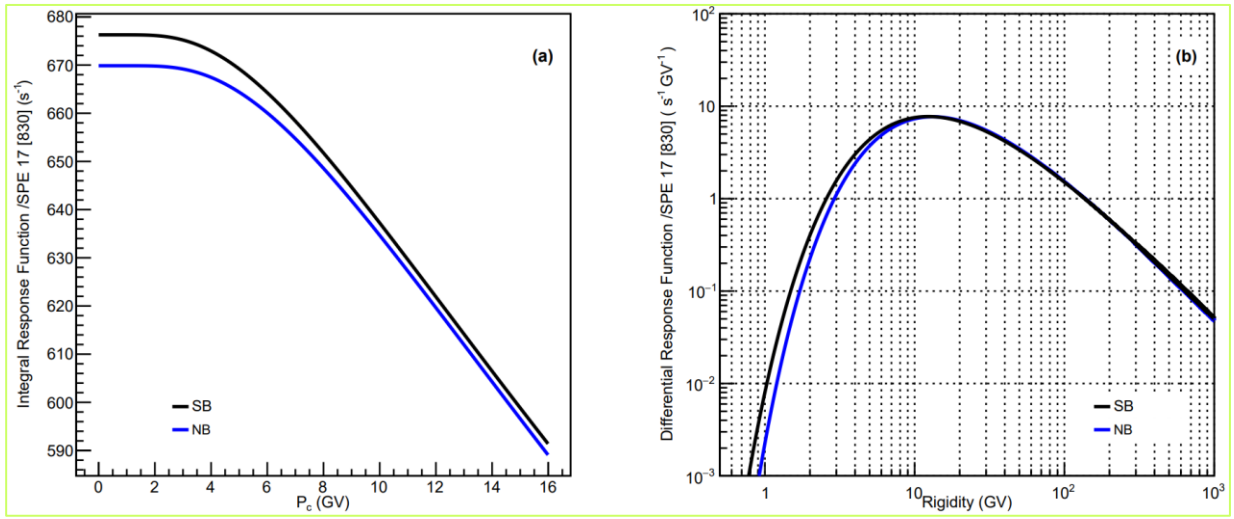
Bottom: a signal at SPE discriminator setting 830 (condition code 17)

Surface temperature correction

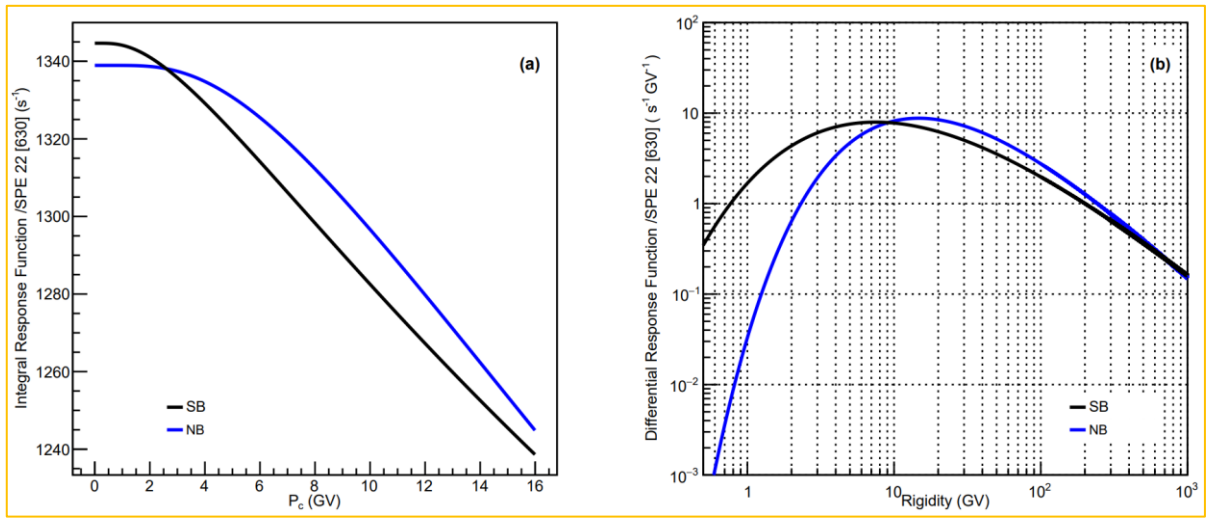
Left is a signal at SPE discriminator setting 630 (condition code 22)
Right is a signal at SPE discriminator setting 830 (condition code 17)

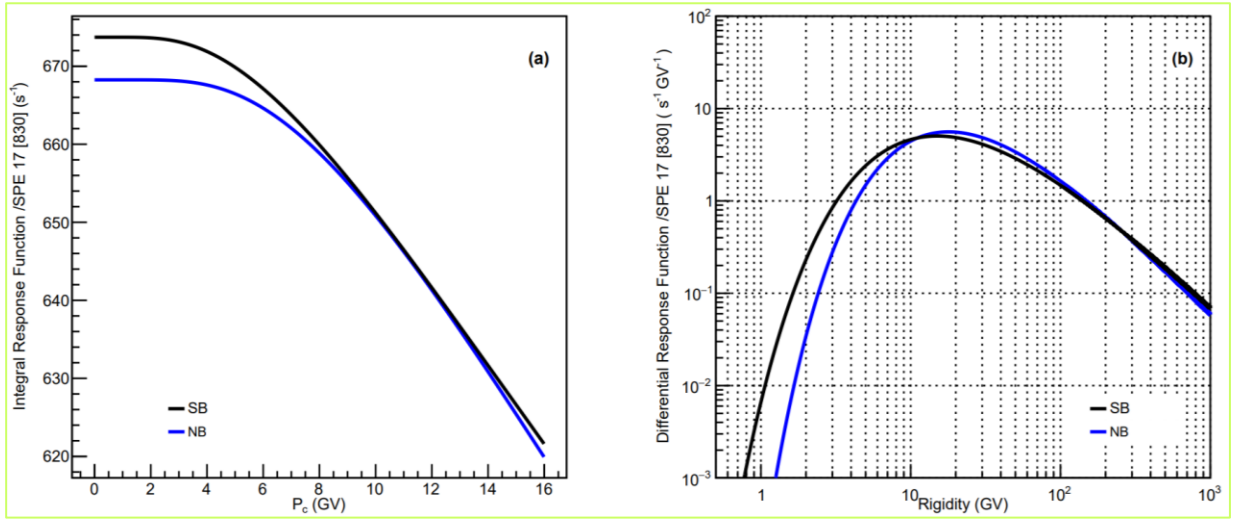
Pressure correction (before correcting the temperature)



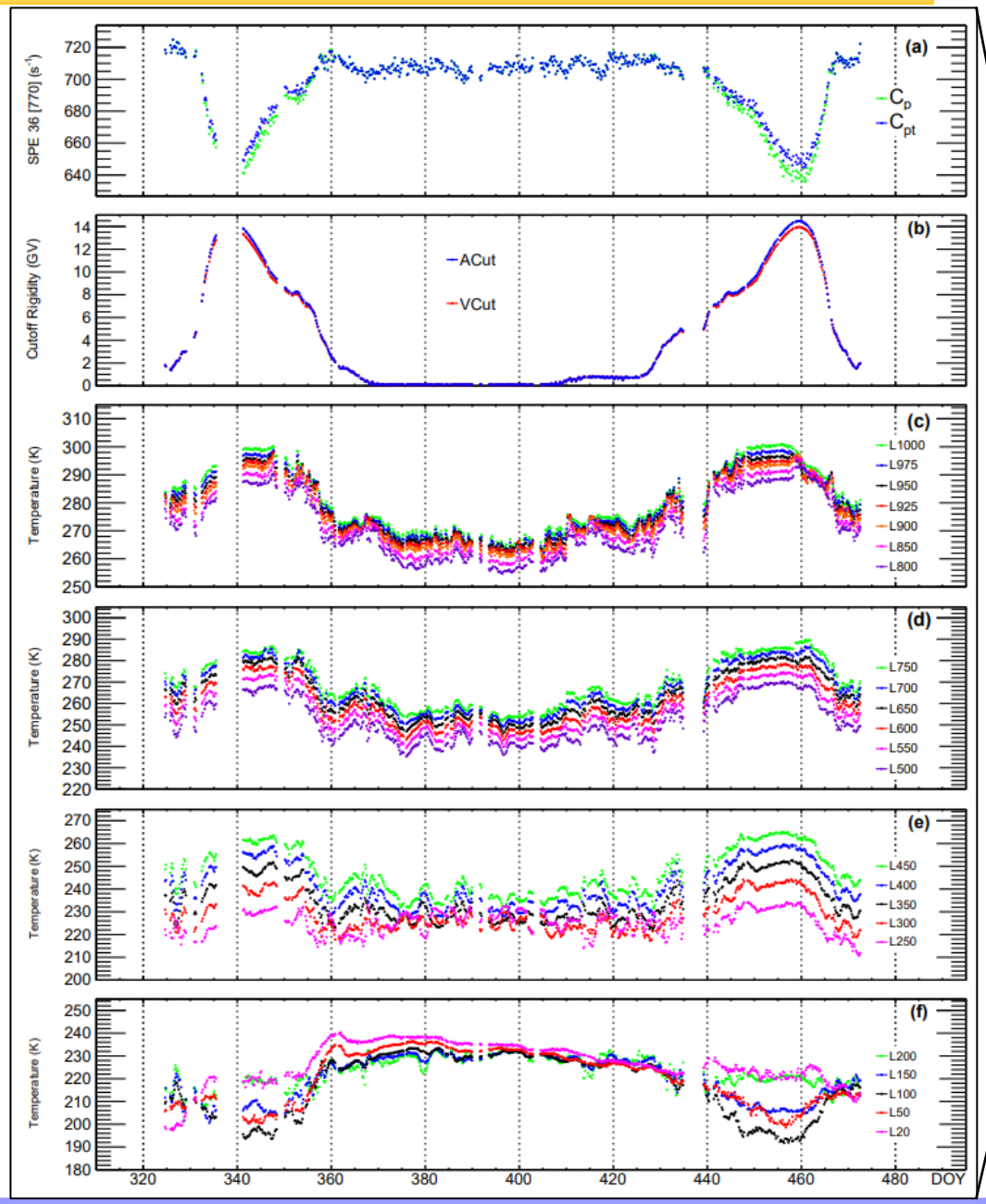


Surface temperature correction

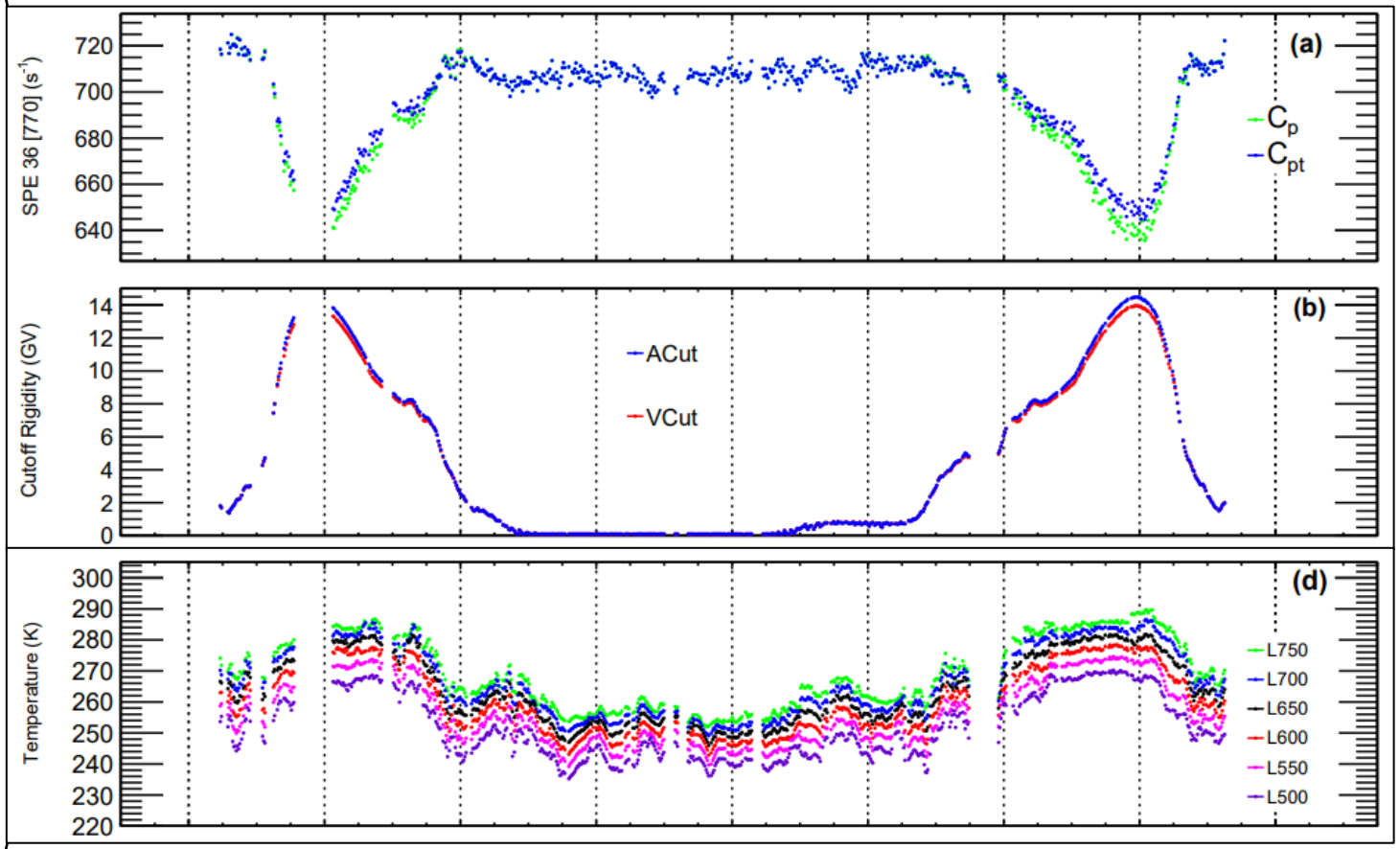




Temperature correction in different layer

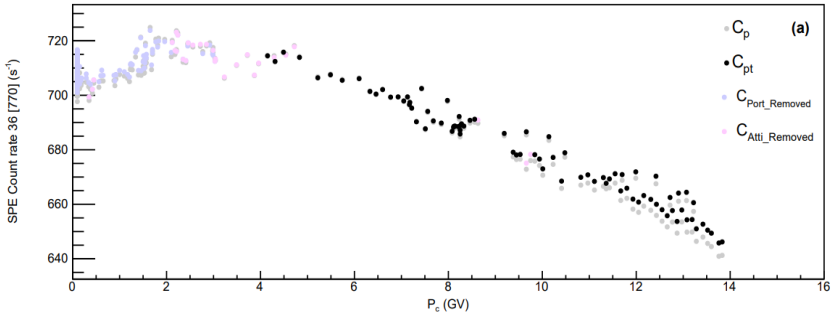


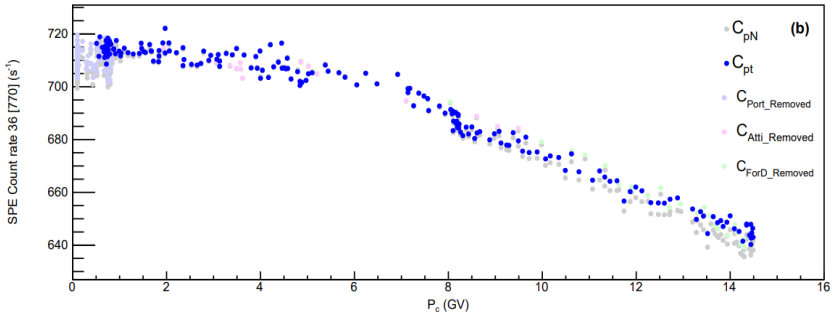
NOTE: This graph is an example signal at SPE discriminator setting 770 (condition code 36)



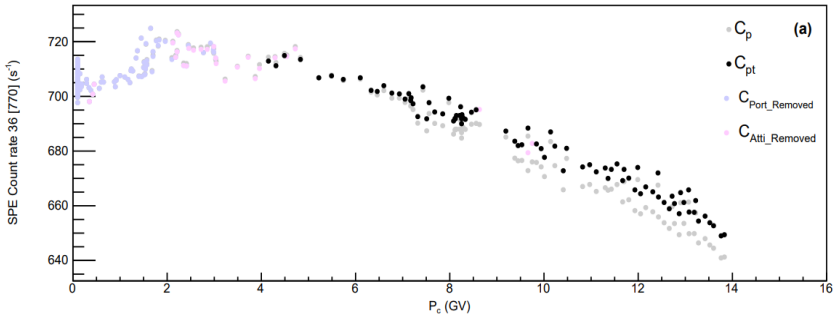
Temperature correction

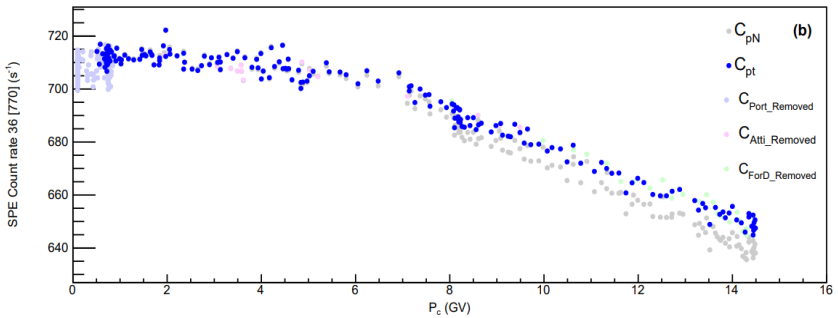
surface temperature



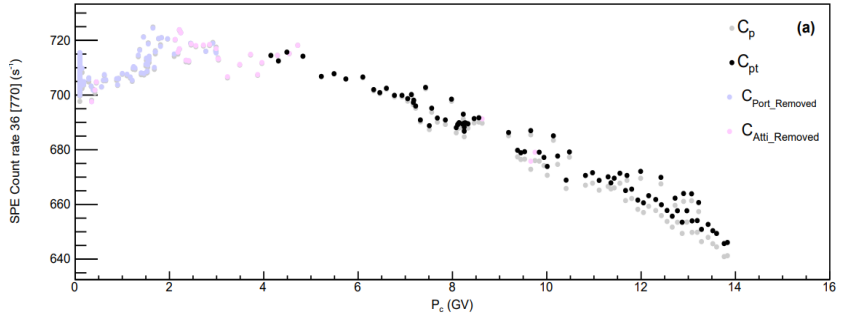


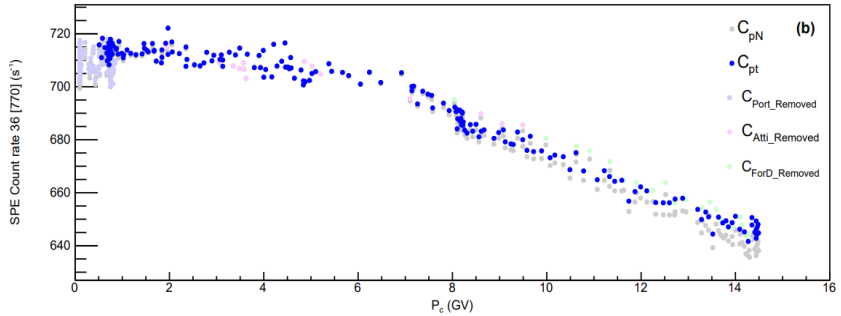
temperature at 550 hPa





temperature at 750 hPa

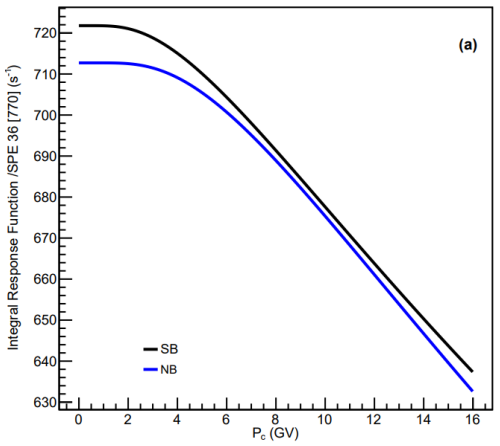


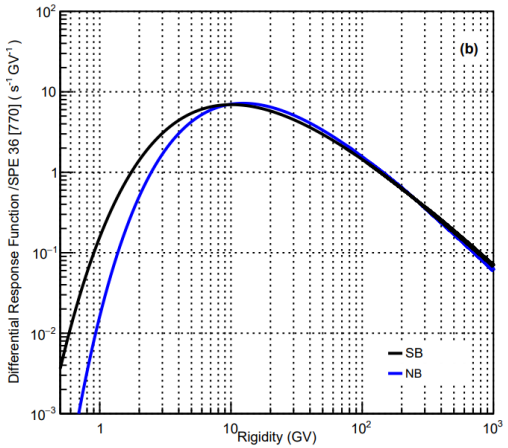


NOTE: This graph is an example signal at SPE discriminator setting 770 (condition code 36)

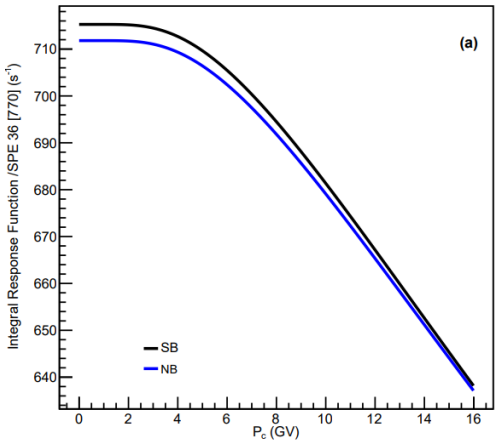
Temperature correction

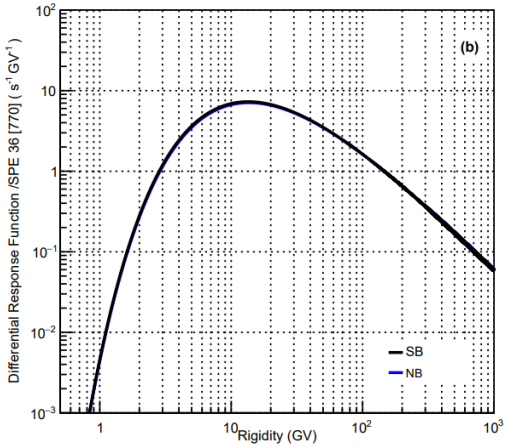
surface temperature



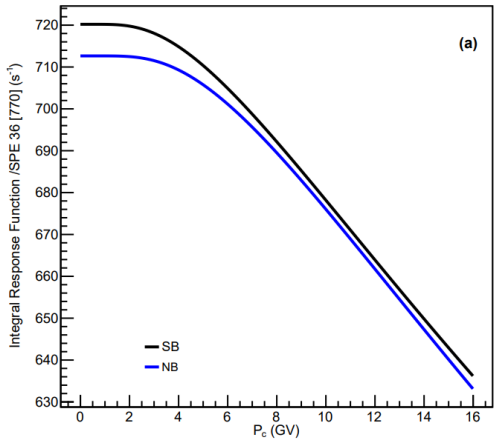


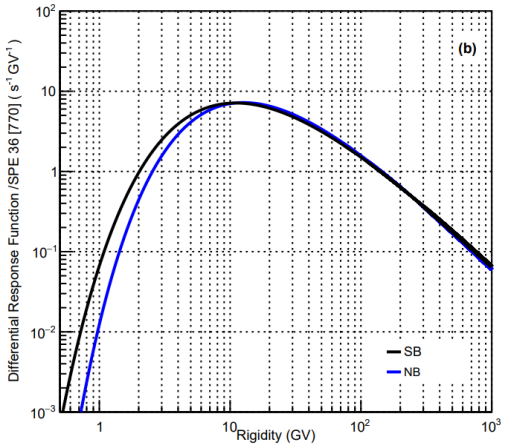
temperature at 550 hPa





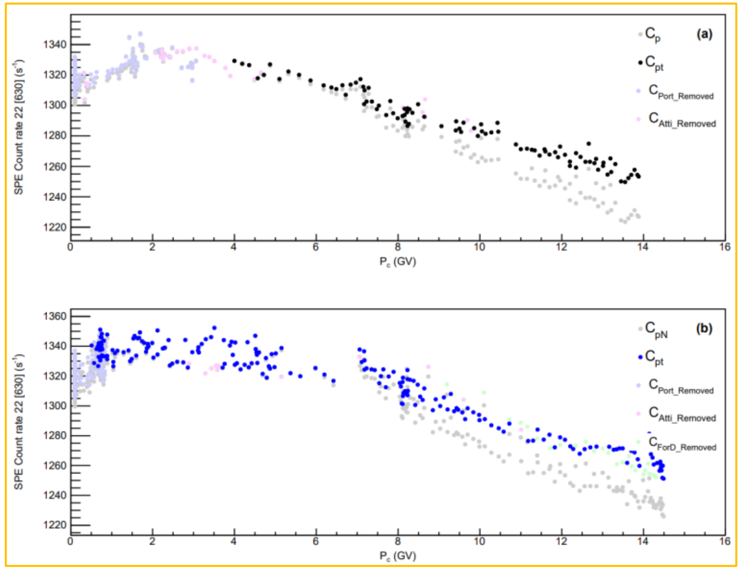
temperature at 750 hPa

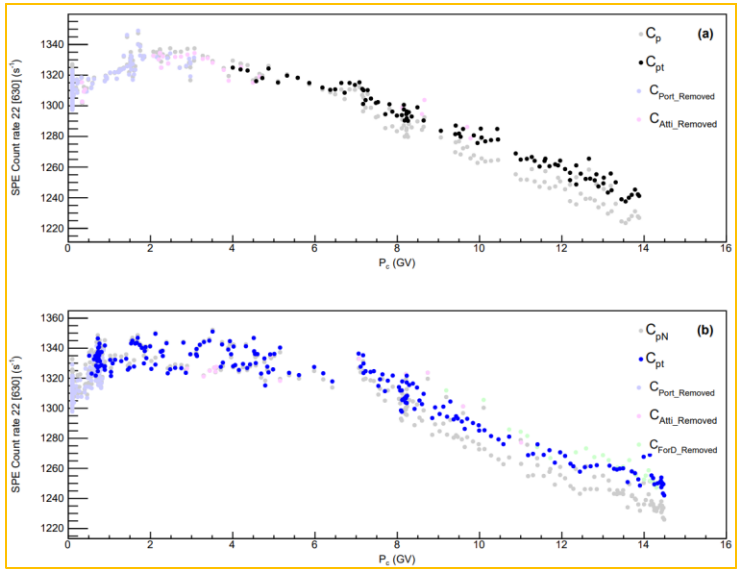


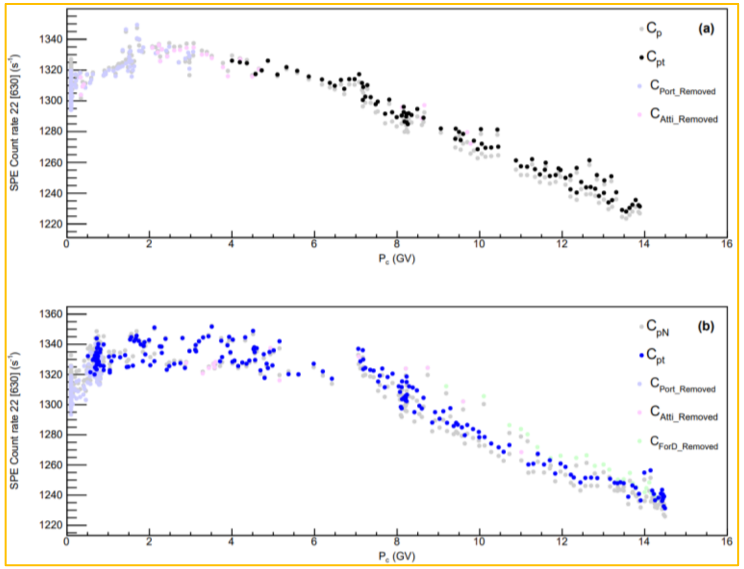


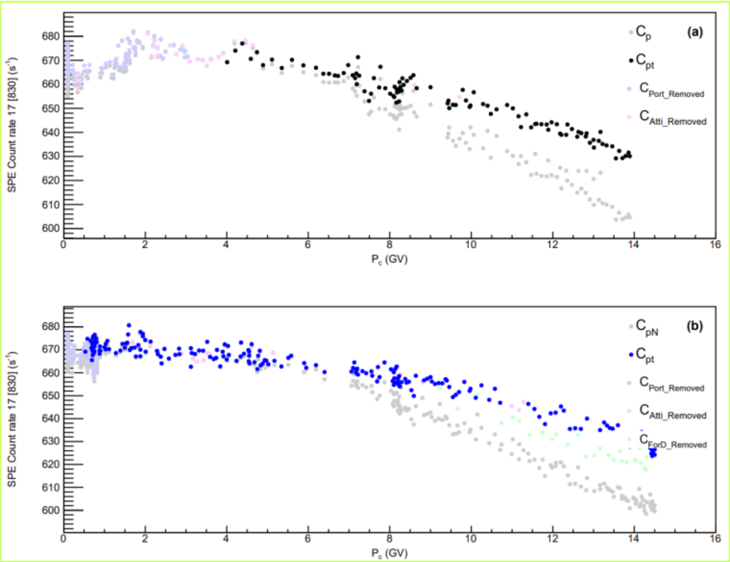
NOTE: This graph is an example signal at SPE discriminator setting 770 (condition code 36)

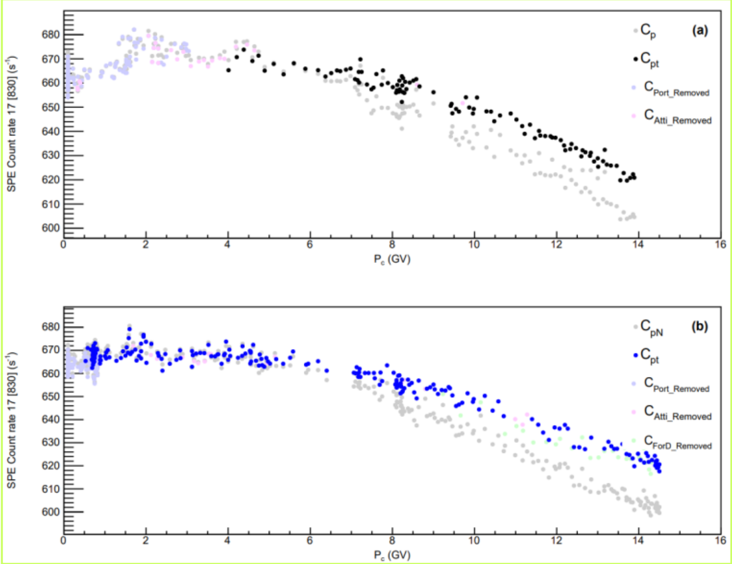
surface temperature | temperature at 550 hPa | temperature at 750 hPa

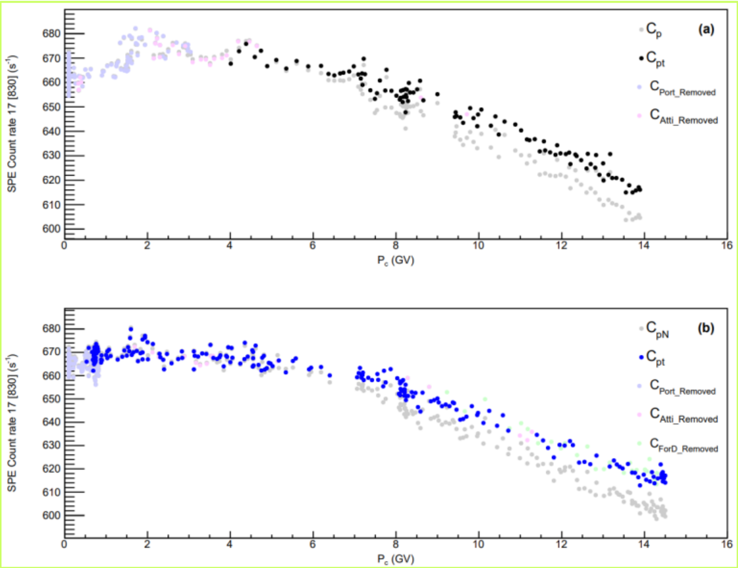




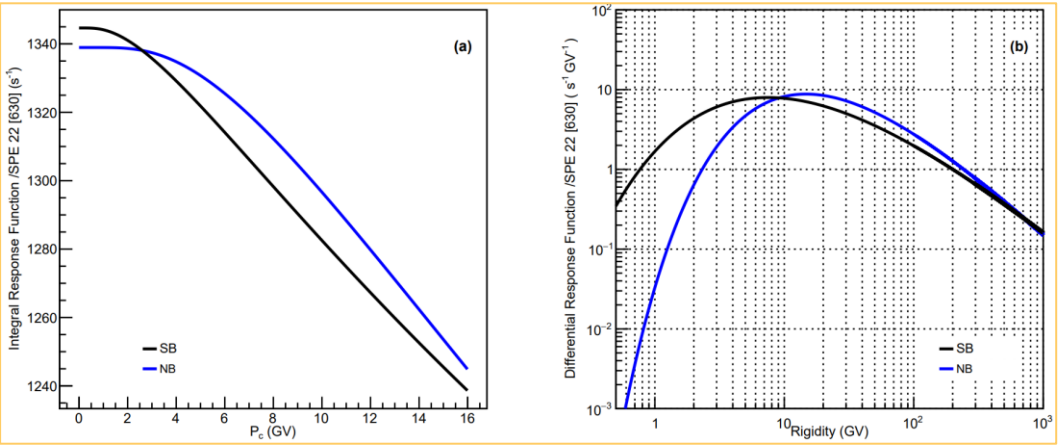




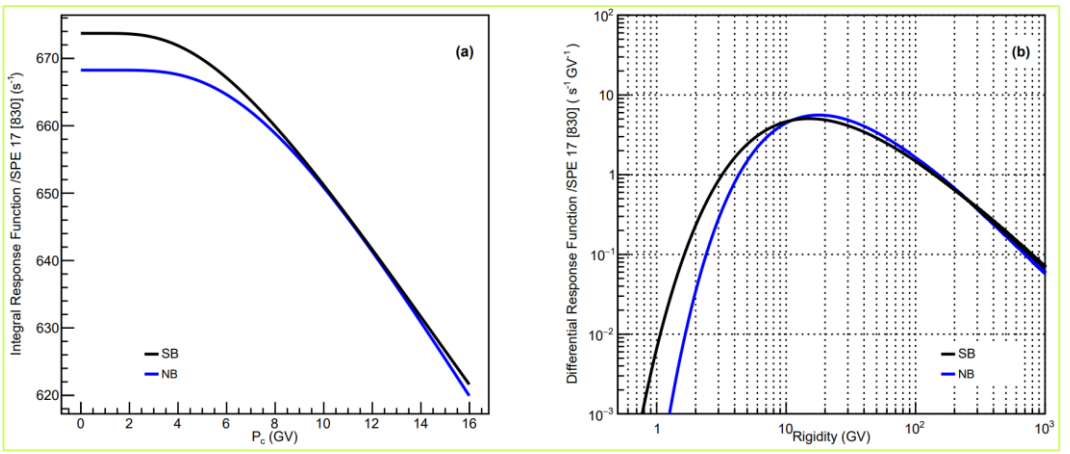


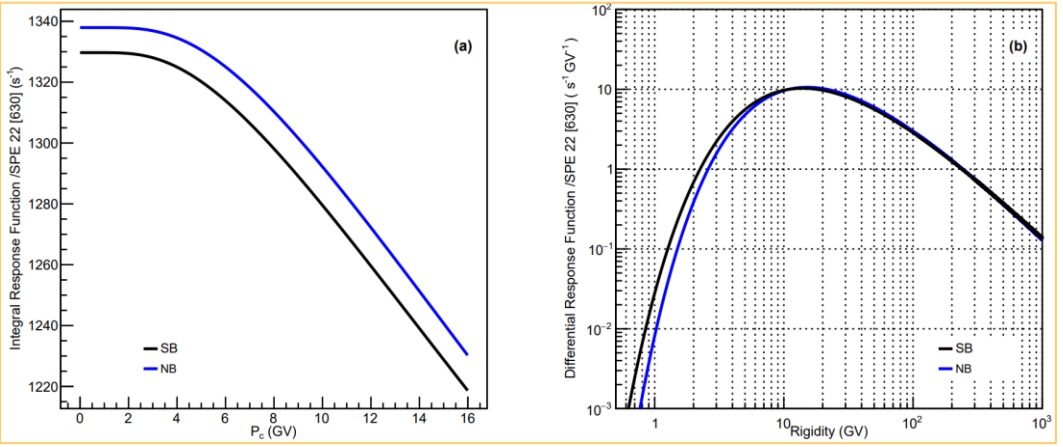


Top: a signal at SPE discriminator setting 630 (condition code 22), Bottom: is a signal at SPE discriminator setting 830 (condition code 17)

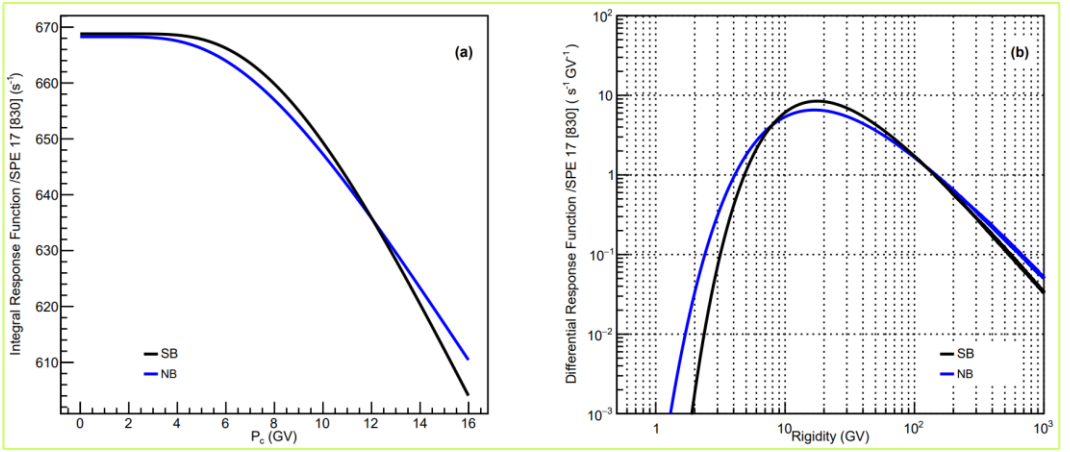


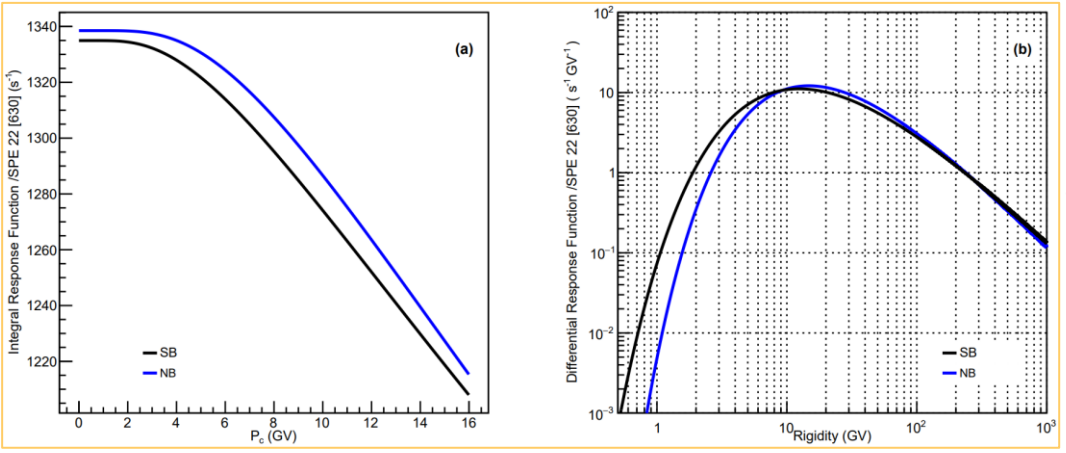
surface temperature



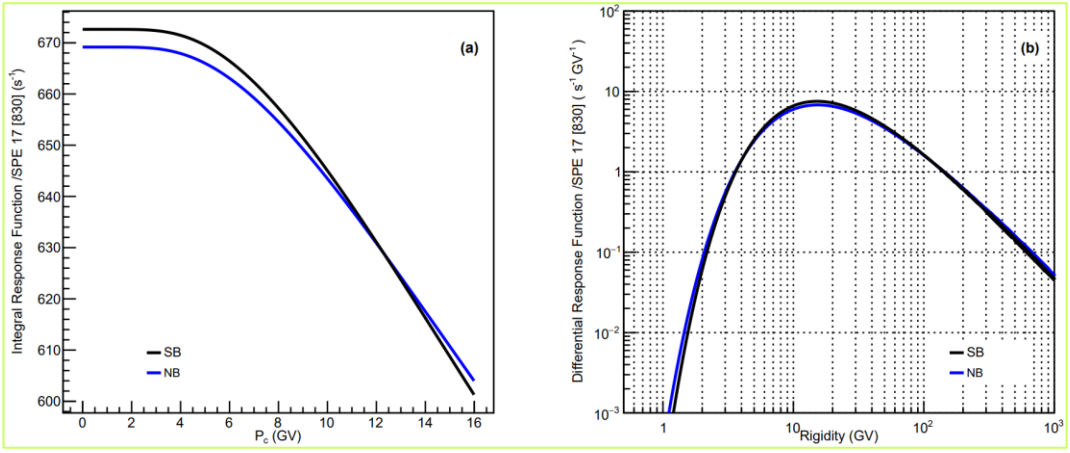


temperature at 550 hPa





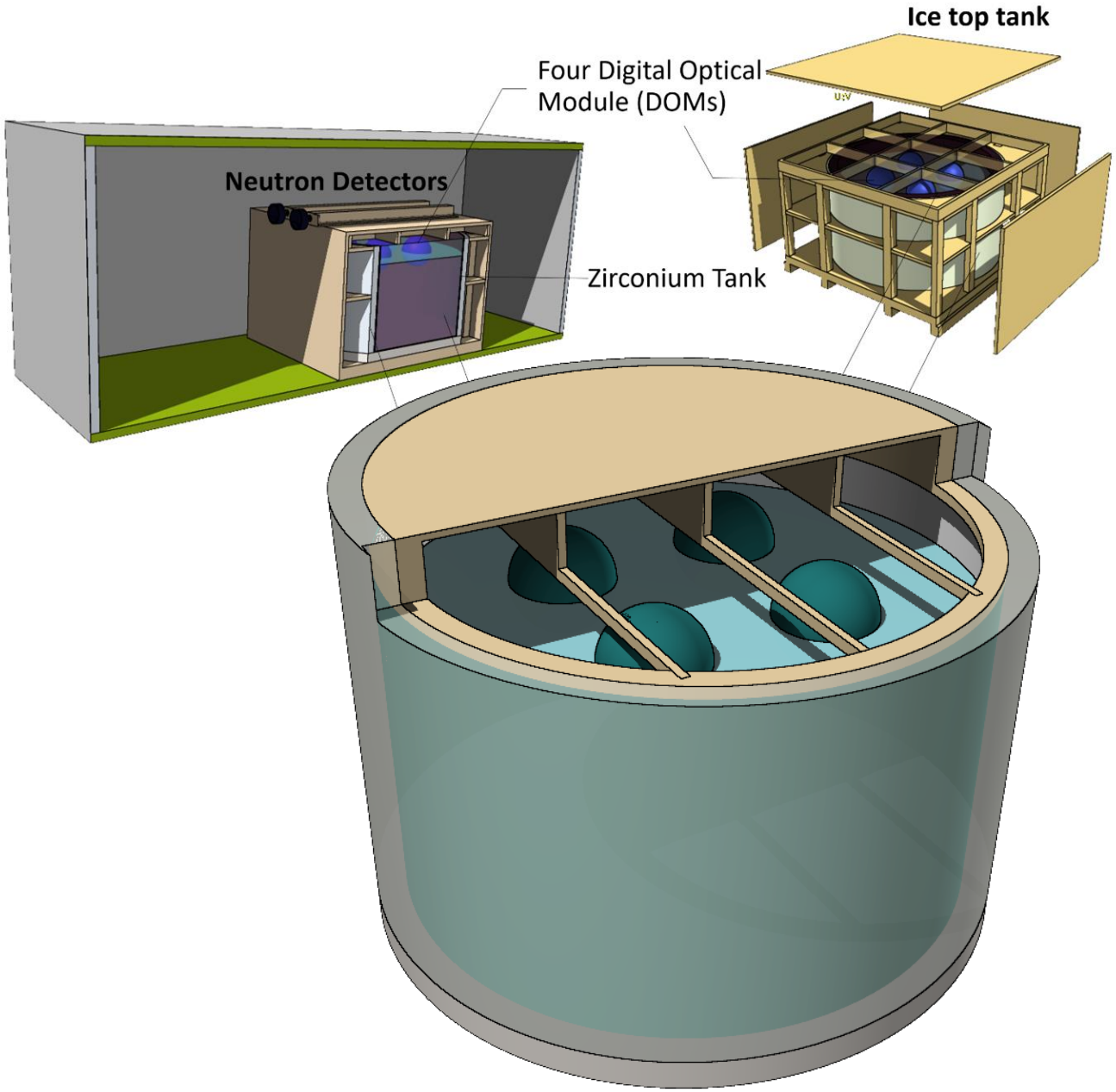
temperature at 750 hPa



Left is a signal at SPE discriminator setting 630 (condition code 22), Right is a signal at SPE discriminator setting 830 (condition code 17)

FLUKA Simulation

- IceTop Tank without container and paraffin bare
- FLUKA
  - ❑ Cycle: 20
  - ❑ Particle number: 5,000
  - ❑ Energy: 500 MeV, 1 GeV, 2 GeV and 5 GeV
  - ❑ Particle Type: Muon- and Muon+
  - ❑ Beam size: Single beam (pencil-like beam)

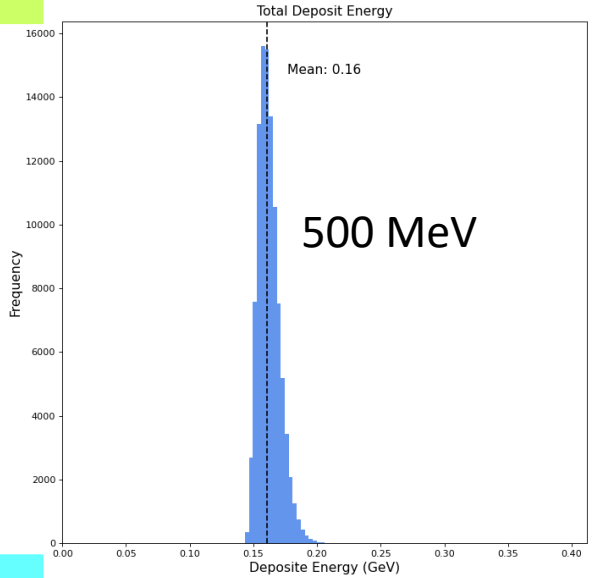


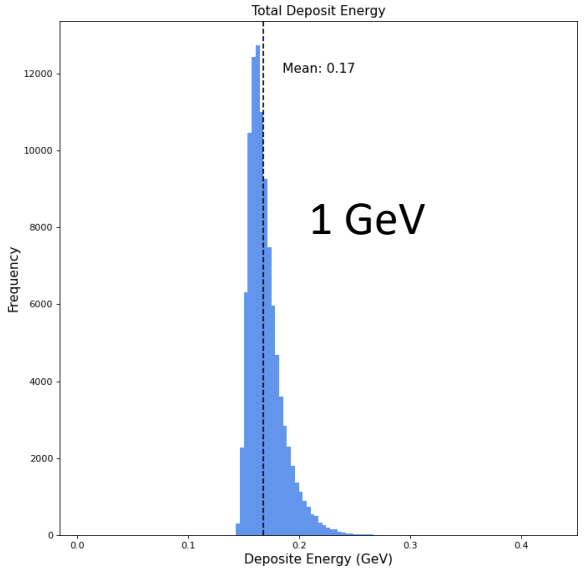
Made by Ink Audcharaporn

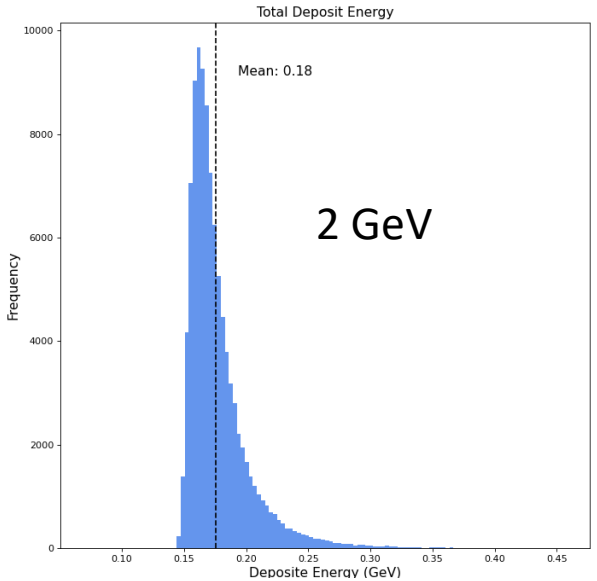
Histogram of deposited energy

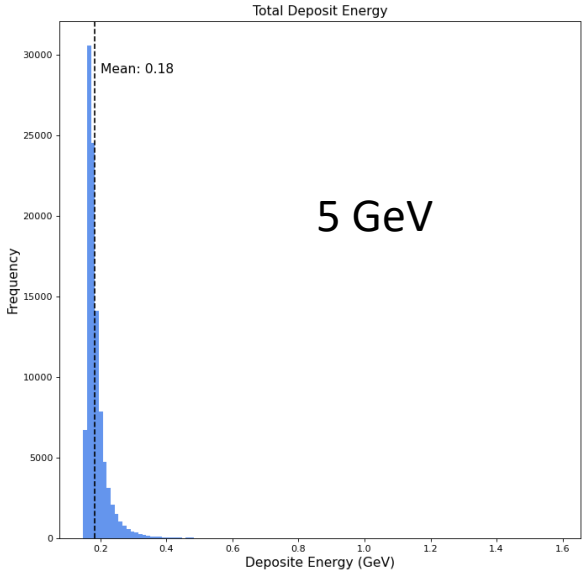
cycle: 20, particle number: 5,000, beam size: single beam

MUON-

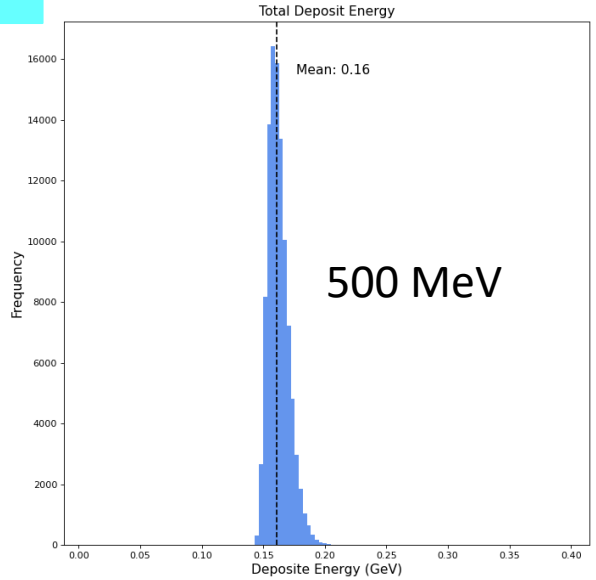


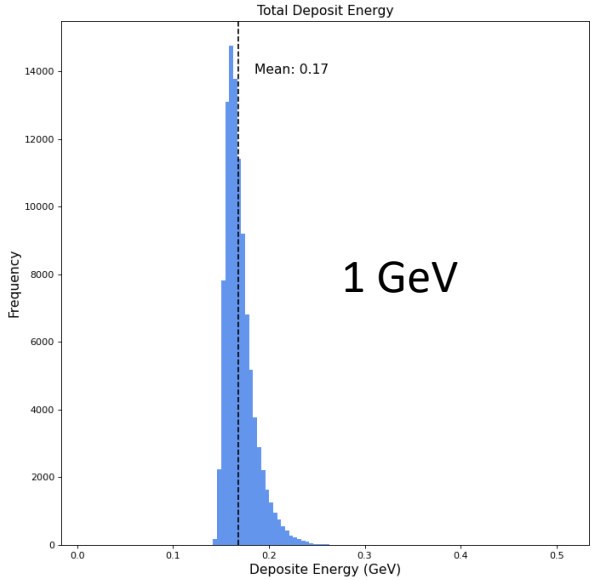


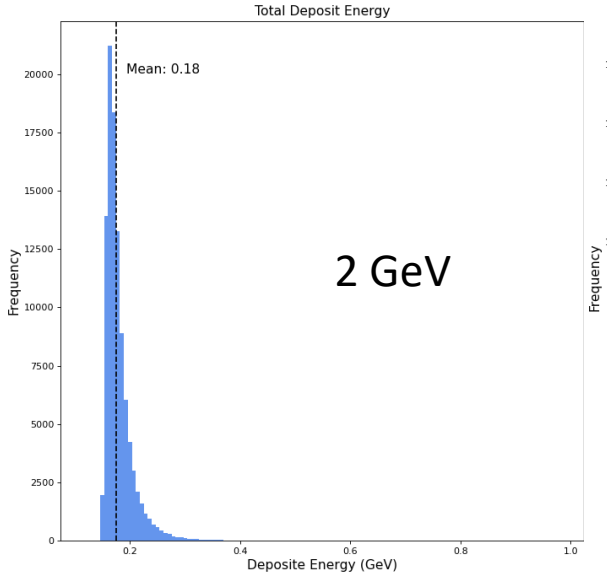


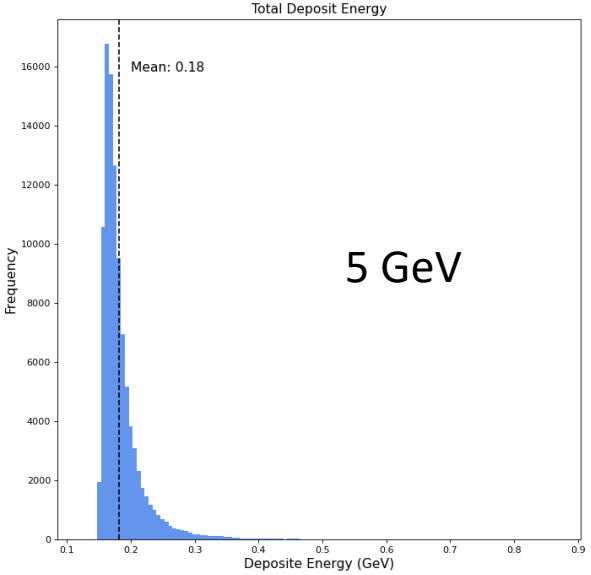


MUON+



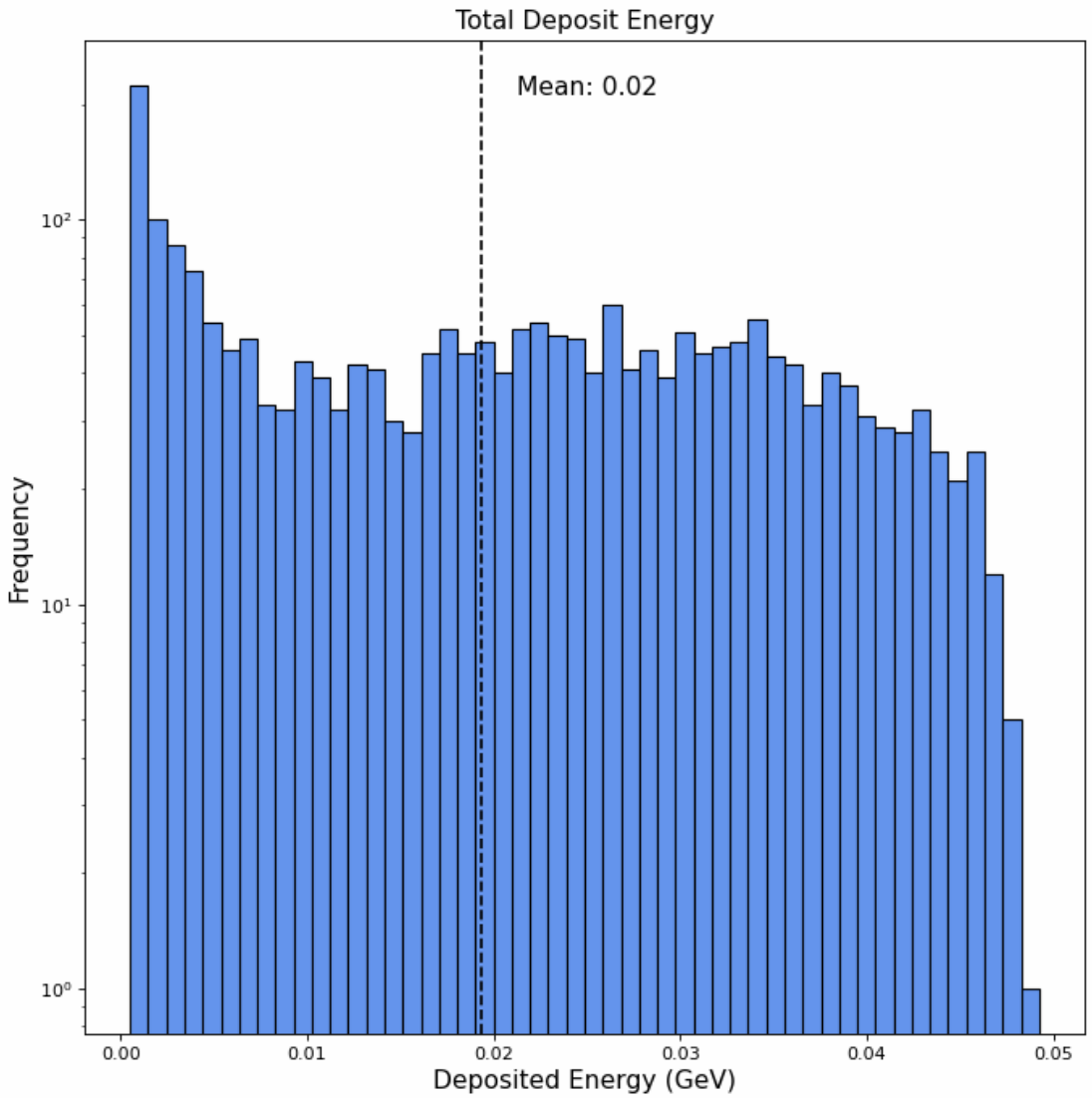


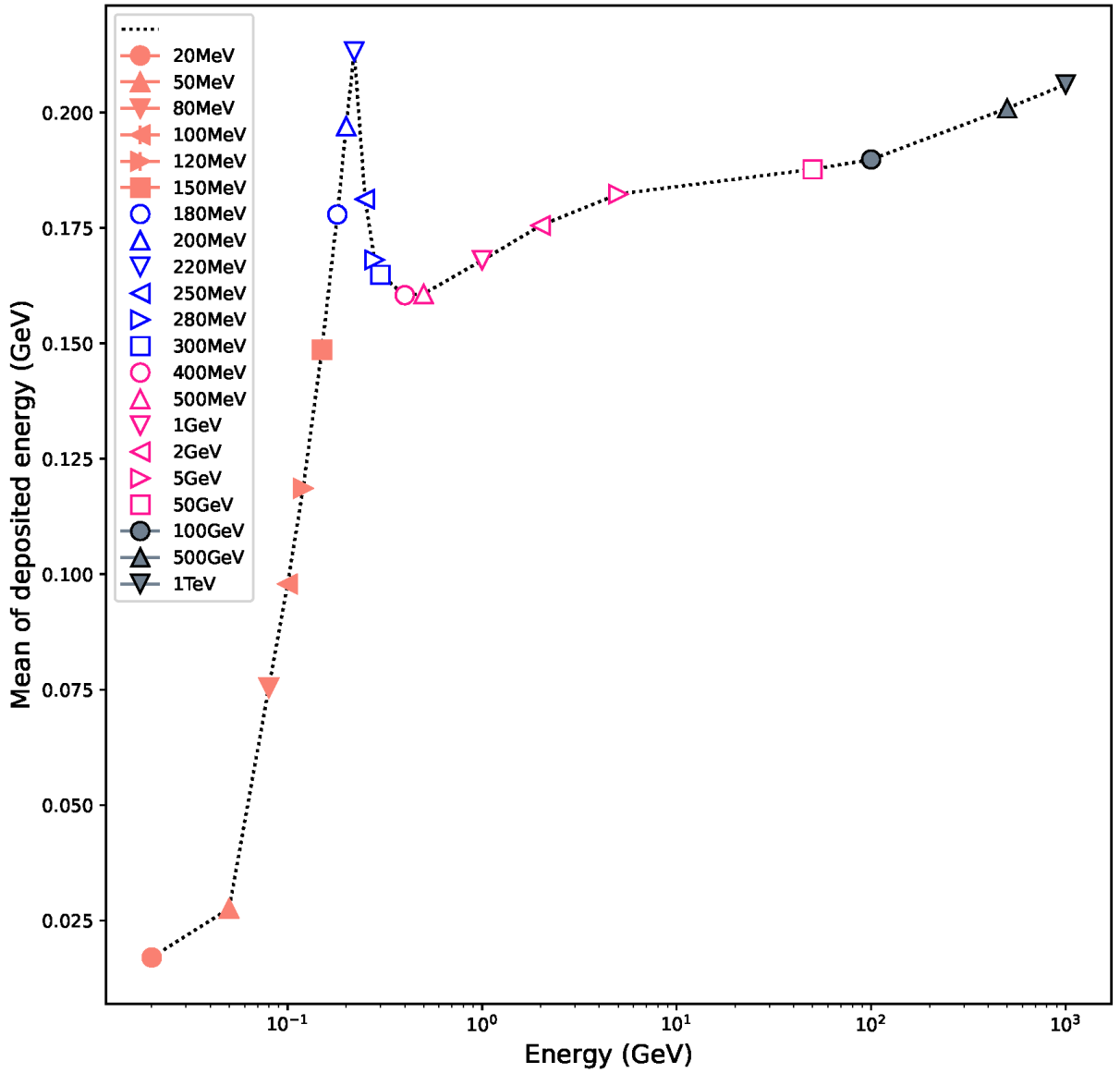




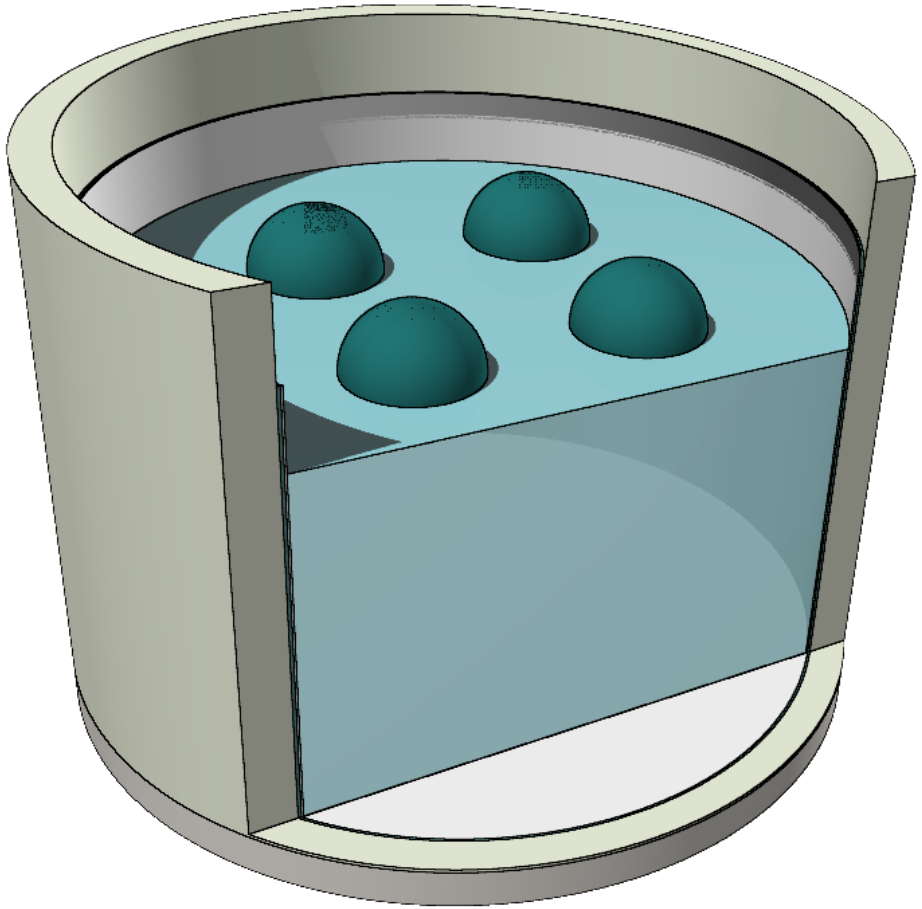
Mean of deposited energy for various energy

Cycle: 10, Particle numbers: 1,000, Energy: 1 eV - 1 TeV, Particle type: Muon-





Mean of deposited energy for various ice thickness



Made by Ink Audcharaporn

Cycle: 10
Particle numbers: 1,000
Energy: 1 GeV
Particle type: Muon-
Ice thickness: 1 cm - 150 cm

Mean of deposited energy for various ice thickness

Cycle: 10, Particle numbers: 1,000, Energy: 1 GeV, Particle type: Muon-, Ice thickness: 1 cm - 150 cm