

Muon TB2023 Analysis

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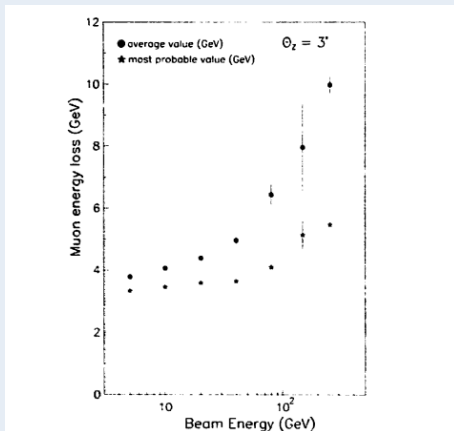
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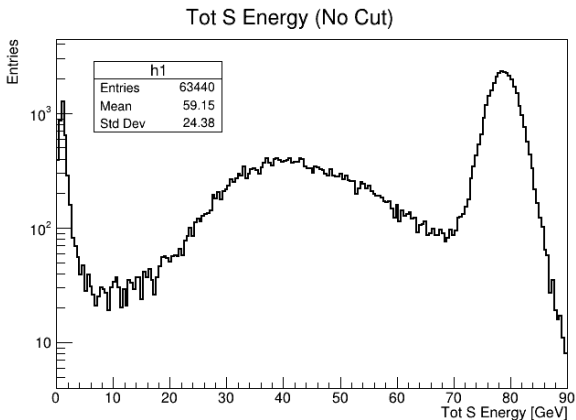
Objective

We would like to reproduce this plot made for SPACAL:



Tot Scintillating Energy

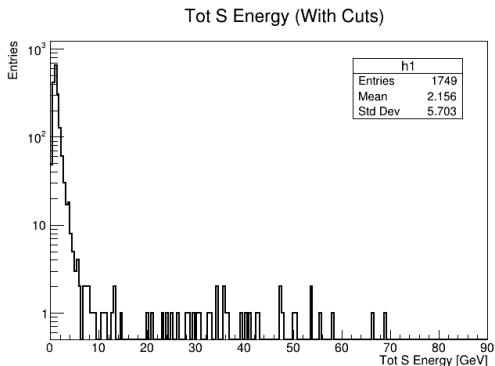
- We want to extract Muons from e^+ runs (2.5° vertical angle and 1.5° horizontal angle). As an example, let us consider run 173 and 188, **80 GeV**.



Preliminary cuts

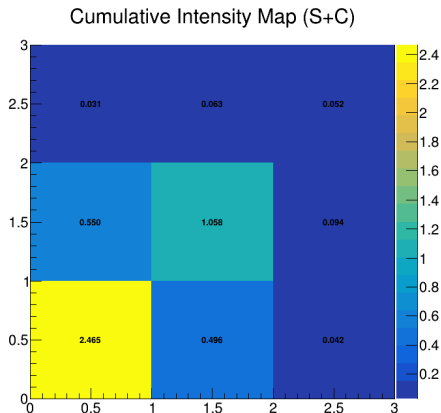
The e^+ beam is contaminated by Muons and Pions. In order to select Muons, some cuts are applied:

- $M_{\text{Counter}} > 160$
- $500 < \text{Preshower} < 640$
- $\text{TOT S Energy} < 0.9 \cdot E_{\text{beam}}$



Investigate Pions contamination

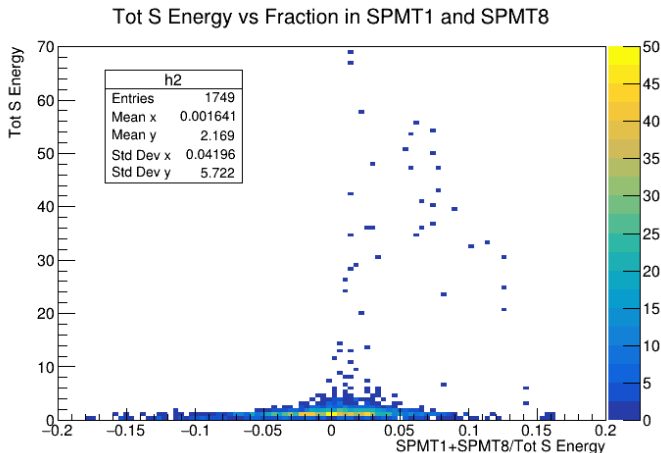
We want to eliminate Pions based on how they lose energy in the two external PMTs: PMT1 and PMT8.



PMT8	PMT7	PMT6
PMT5		PMT4
PMT3	PMT2	PMT1

Investigate Pions contamination

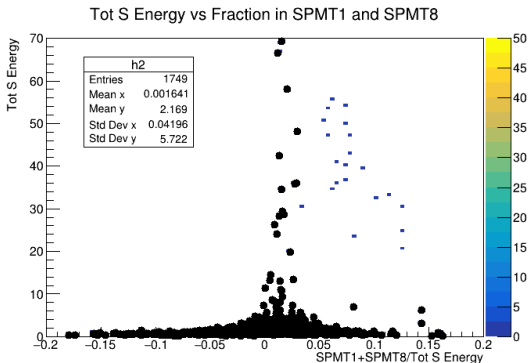
We plotted the fraction of S energy lost in the two external PMTs with respect to the total S energy lost in the Calorimeter



Additional cut

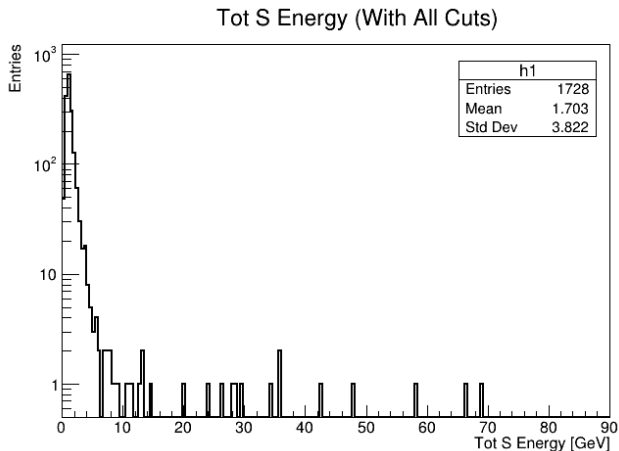
To eliminate events that have lost S energy above a fixed threshold in the two external PMTs (PMT1 and PMT8), without eliminating Muons that have radiated in the calorimeter. This additional cut was implemented:

$$\begin{aligned} & !((\text{SPMT1} + \text{SPMT8}) / (\text{totSiPMSene} + \text{SPMTenergy}) > 0.03 \\ & (\text{totSiPMSene} + \text{SPMTenergy}) > 10) \end{aligned}$$



All cuts applied

Final distribution with all cuts:

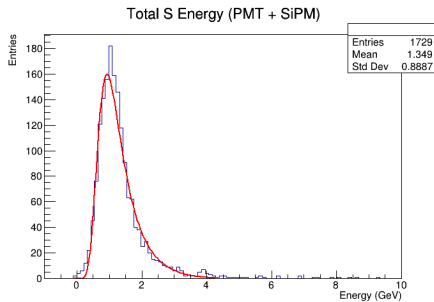
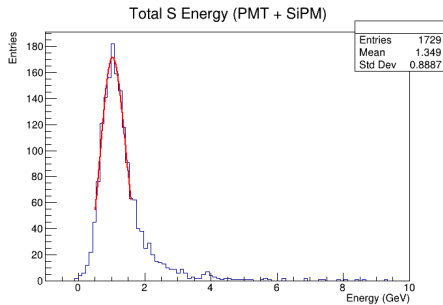


Implemented methods:

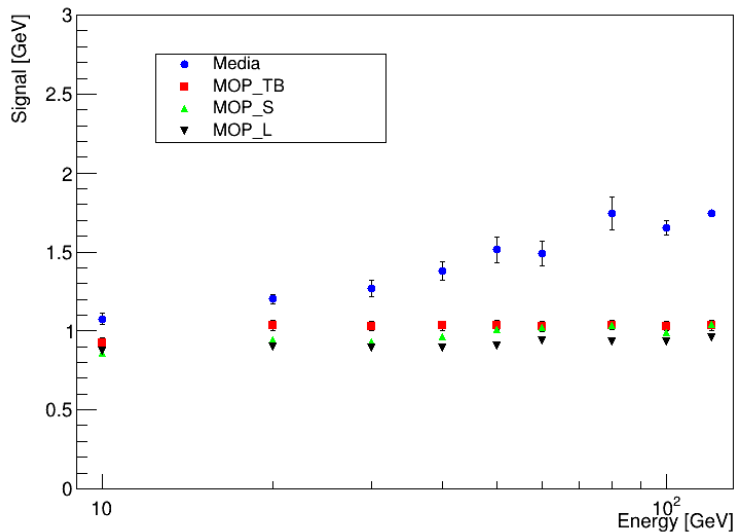
To reproduce the plot from SPACAL with different approaches:

- Mean
- MOP_S value: using the MOP given by a Vavilov fit performed in a restricted area around the peak
- MOP_L value: using the MOP given by a Vavilov fit performed in a larger area (this takes into account the tail of the distribution)
- MOP_3 value: using the MOP given by the weighted sum of the three most populated bins of the histogram

Vavilov fits



S Signal vs Beam Energy



Results and what to do:

- As in SPACAL, the mean value of the signal gets increased by $\simeq 50\%$ from 10 GeV to 100 GeV
- We want to add the 160 GeV energy value, it needs some corrections
- Implement error bars for MOP values