Muon Scan Testbeam 2024

Follow up presentation 29/04 Study simulation higher energies First glance no brehmstralung simulation

Recap

- The analysis of muon data revealed a non-muon peak in the total PMT energy and in Tile Catcher distributions.
- Last time I have shown you correlation plots, which demonstrate the probable **pion nature** of the peak.
- Here some correlation plots, in particular Muon Counter VS Energy Leakage, Tot Energy Scint vs Energy Leakage, Tot Energy Cherenkov vs Energy Leakage, C/S vs Energy Leakage.
- Ntuples (simulation) MuonsGeant4_11 (April).

Last time: Correlation studies: Muon Counter VS Total Leakage Run 982, 120 GeV totLeakage:MCounter



Last time: Correlation studies: Total Leakage VS tot energy Scint



New: Correlation studies: Total Leakage VS tot energy Cherenk



Last time: Correlation studies: Total Leakage VS Tail Catcher

The events for

Run 982, 120 GeV



New: Correlation studies: Total Leakage VS C/S Run 982, 120 GeV



Peak of C/S distribution, correlated with total Leak values > 4600, support the pion origin.

Last time: Pre Shower calibration - data vs sim



Pre Shower - data vs sim - Post Cut (w/o PS cut)



Normalized on the data integral.

Tail Catcher - Sim fixed

new Sim ntuples: /eos/user/a/apareti/OutputHidraSim/OutputMuons_06may2025/



Run 982, 120 GeV

Tail Catcher - post cut

new Sim ntuples: /eos/user/a/apareti/OutputHidraSim/OutputMuons_06may2025/



Run 982, 120 GeV

Last time: Signal Mean vs Muon Energy Scan



Signal Mean vs Muon Energy Scan - Sim - Higher energies

new Sim ntuples: /eos/user/a/apareti/OutputHidraSim/OutputMuons_06may2025/



Fit non compatible with a constant. Looks a change of slope at 180 GeV. Difference between scintillant and cherenkov compatible with a linear fit.



Not significative change of slope, between the two ranges. However in the higher range, the linear fit is more compatible (best chi-square).

Even if the lower range is subdivided in other ranges, the fit results are not significantly different.

Sbirciata: Signal Mean vs Muon Energy Scan - Sim - No brehmstralung

new Sim ntuples:

/eos/user/a/apareti/OutputHidraSim/OutputMuons_06may2025_noBremsstrahlung/



The Cherenkov looks growing slower than the scintillant. However the cherenkov should not see nothing, since the radiation contribution is off.

Sbirciata: Sim - No brehmstralung - Scintillator



Normalized on the no brehmstralung integral.

Sbirciata: Sim - No brehmstralung - Cherenkov



17



Last time: Pre Shower - Calibration

DISCLAIMER: "Rough" calibration

HP: The MIP corresponds to the peak of the distribution. (In polistirene is supposed to be few MeV)

	Peak	Pedestal (run 993)
Simulation	9.36 MeV	/
Data	388 ADC count	303 ADC count

The peak is corresponding to most populated event. Calibration (388-303)/9.08 = 9.361 ADC/MeV

Last time: Pre Shower - Calibration



Test beam 2024 data cuts

- After this studies, muon candidates are selected in region defined as:
 - Xmin<XDWC2<Xmax *
 - Ymin<YDWC2<Ymax *
 - 350 ADC<Pre Shower<450 ADC
 - TailC<180 ADC, TailC>242 ADC
 - totLeakage < 4600 ADC
 - 160 ADC < Muon Counter < 8000 ADC

*Xmax, Xmin, Ymax, Ymin are run dependent, X(Y) max/min = Mean +/- 2 d

Data set (dati e sim)

Data:

- Muon energy beam scan **110 GeV 170 GeV**, intervals of 10 GeV (7 points)
- N° events ~ 20k (except 110 GeV, with 95k)

Simulation (Thanks Andrea!):

- Muon energy beam scan 10, 20, 40, 60, 80, 100, 110, 120, 130, 140, 150, 160, 170, 180, 200, 250 GeV (16 points).
- N° events 100k
- Ntuples /afs/cern.ch/user/a/apareti/public/HidraSimOutput/MuonsGeant4_11



No statistically significant change in slope, in >80 GeV better chi-square.