Lost muons study

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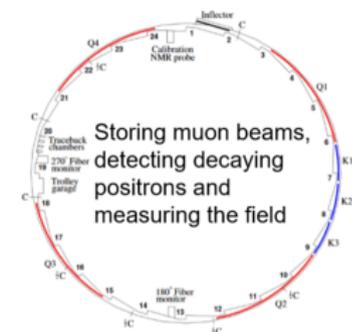
Shanghai Jiao Tong University
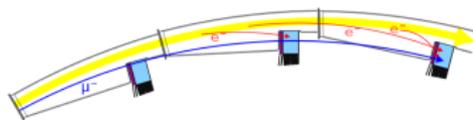
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Outline

- What is lost muons
- Construct lost muons
- Protons and deuterons contamination
- Optimize MIP energy cut selection
- Conclusion and Prospects

What is lost muons

As muons are escaping the storage ring, this causes a distortion to the perfect exponential decay. These muons are called "lost muons".

(a) The distribution of 24 calorimeters in the storage ring

(b) Lost muon by finding 3 coincidences between consecutive detectors

What is lost muons

The final fitting function:

$$N = N_0 e^{-t/\tau}[1 - A\cos(\omega_a t + \phi)] \times N_{cbo} N_{VW} \Lambda \tag{1}$$

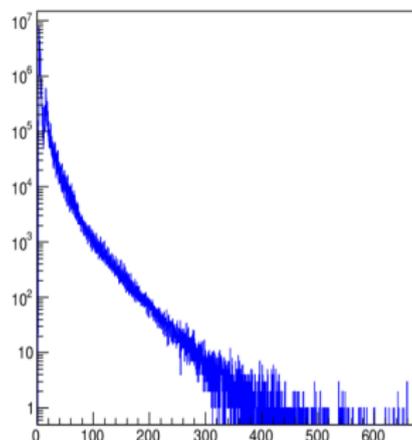$$N_{cbo} = 1 - e^{-t/\tau_{cbo}} A_{cbo} \cos(\omega_{cbo}(t)t + \phi_{cbo}) \tag{2}$$

$$N_{VW} = 1 - e^{-t/\tau_{VW}} A_{VW} \cos(\omega_{VW} t + \phi_{VW}) \tag{3}$$

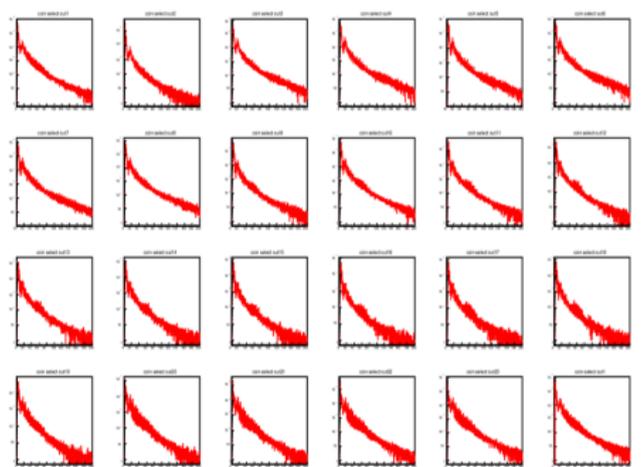$$\Lambda = 1 - K_{loss} \int_0^t L(t') e^{t'/64.4} dt' \tag{4}$$

Lost muons will certainly affect the final result and the lost muon is one of the major systematic sources which is showed in the fitting function is Λ.

Construct lost muons

By looking for a MIP like particle hits three consecutive calorimeters.

(c) Lost muons distributions for 60h datasets

(d) Lost muons distributions in 24 claos for 60h datasets

Protons and deuterons contamination

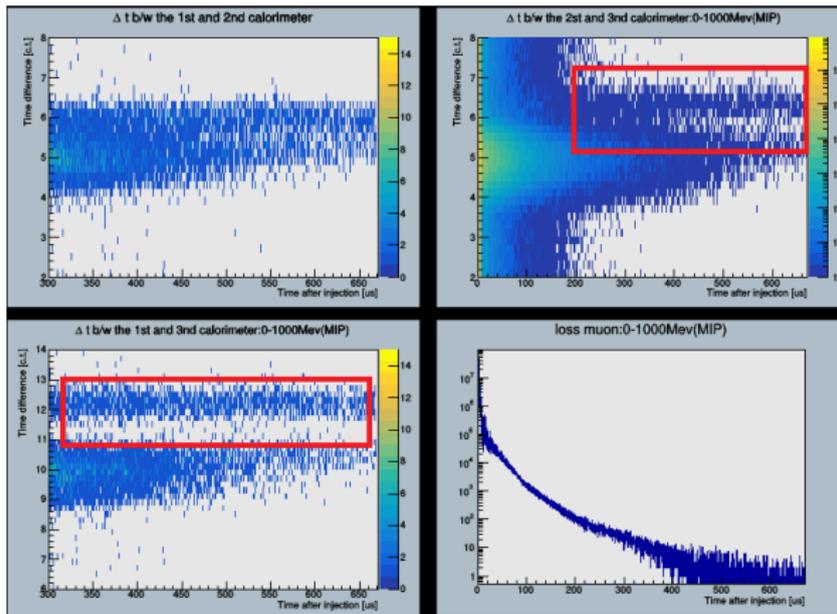   If we apply losser selection restrictions on the MIP energy to look for lost muons.

Figure: MIP energy selection range:0-1000 Mev

Protons and deuterons contamination

By study the TOF of muons,deuterons,protons,we find that the lost muons we construsted have contaminated by protons and deuterons.

Species	ToF (obs.)	ToF (naive)	ToF (meas.)	ToF (BB)	
Muons*	4.93	–	–	–	
Protons	5.13	5.15	5.18	5.17	c.t.
Deuterons	5.89	5.76	5.95	5.85	

Optimize MIP energy cut selection

To eliminate the effects of protons or deuterons contanmination by optimizing the MIP energy cut selection.
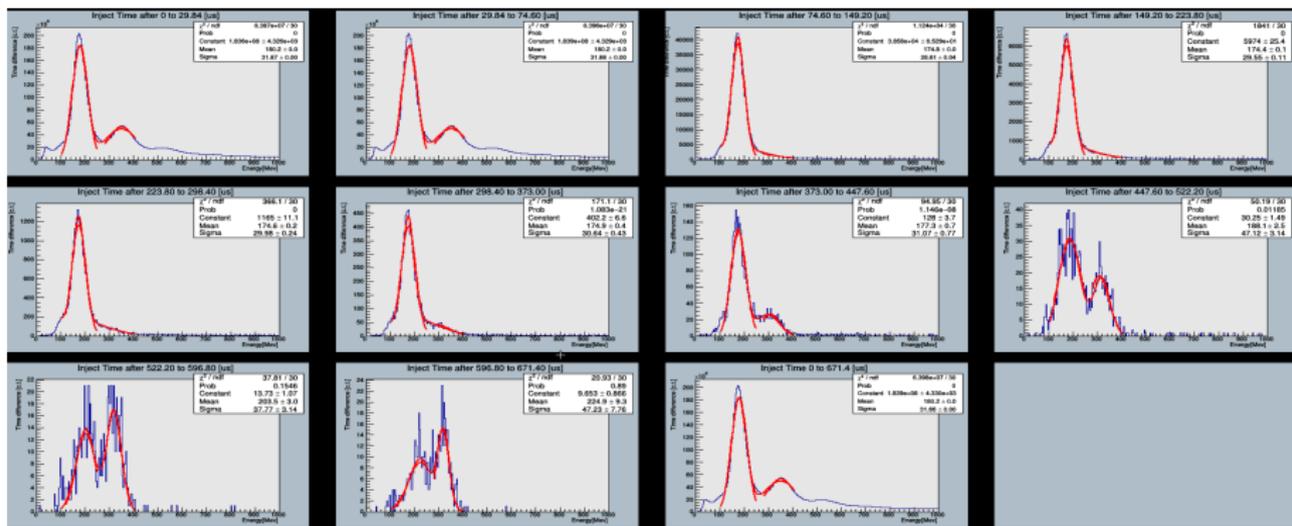

Figure: Deposited energy distribution with MIP energy cut:0-1000Mev

Optimize MIP energy cut selection

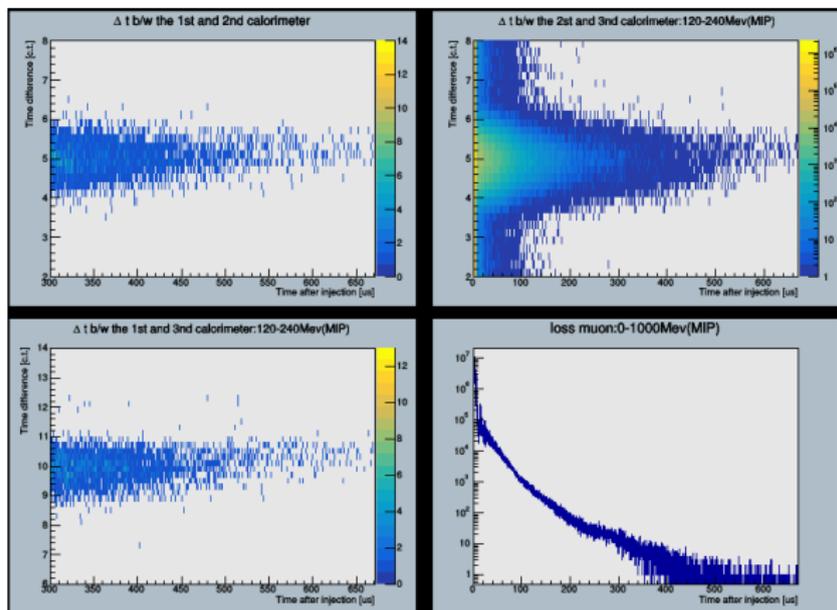We change the MIP energy selection range to 120-240 Mev.

Figure: MIP energy selection range:120-240 Mev

Optimize MIP energy cut selection

Table: Lost muons uncertainty for differents MIP energy cut selections on Endgmame datasets

MIP energy cut selection	R[ppm]	$\sigma R[[ppm]$	$\Delta R[ppb]$
120~240Mev	-6.20179	0.6269	0
0~infinite Mev	-6.19332	0.6269	+8.47

Conclusion and Prospects

- We study the protons and deuterons contamination in the lost muons construction.
- Eliminate the effect by optimizing the MIP energy cut selection.
- The dominant sources of the lost muon systematics comes from the phase population ,which needs to do more simulations or beam dynamics study.