(small) modifications to the Drell-Yan setup

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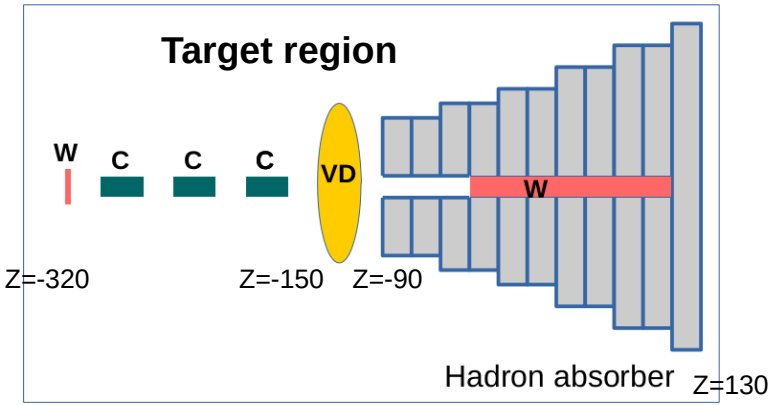
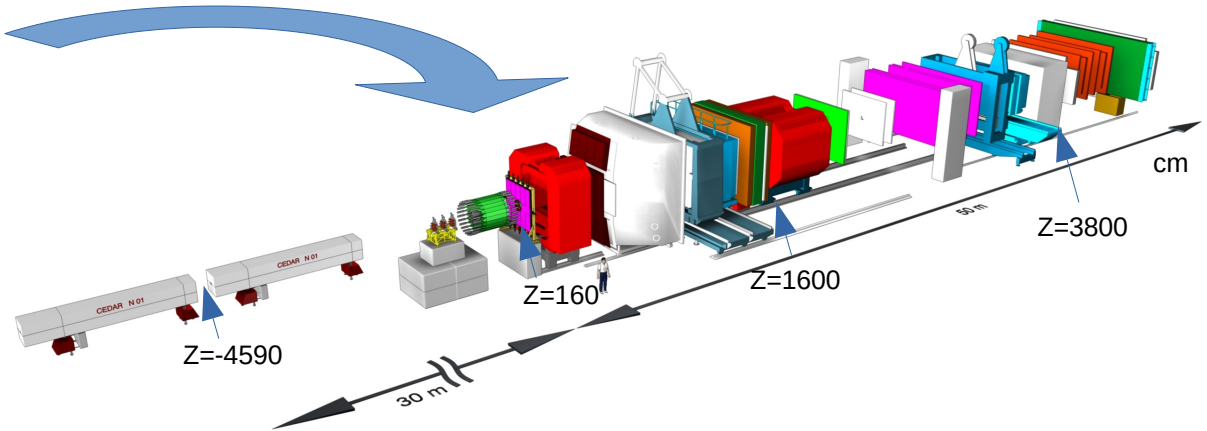
A typical setup for Drell-Yan (à la COMPASS)





Identified muons: X/X0>30 in spectrometer

MF1: 34 X0	ECAL2: 16 X0
MF2: 21 X0	HCAL2: 50 X0
MF3: 57 X0	
ECAL1: ~20 X0	Hadron absorber: 57 X0
HCAL1: 46 X0	Beam plug: 365 X0

Study impact of (removing) MW2

A sample of 150K Drell-Yan events, generated with Pythia8
In the mass range $3.5 < M_{\mu\mu} < 11$ GeV/c^2

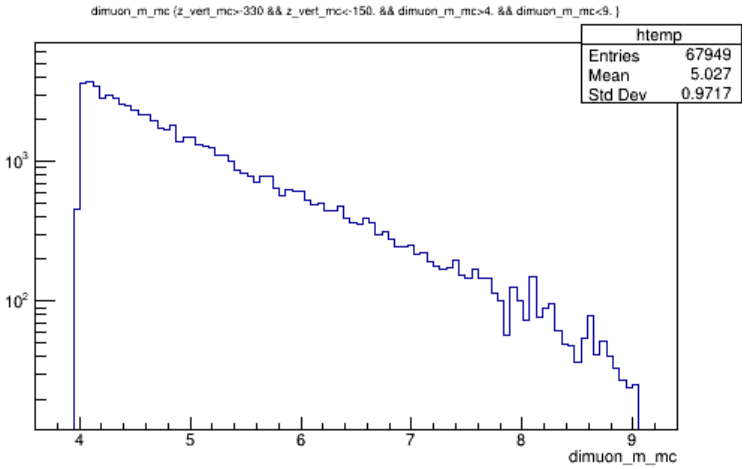
Full MC chain TGEANT+CORAL+PHAST

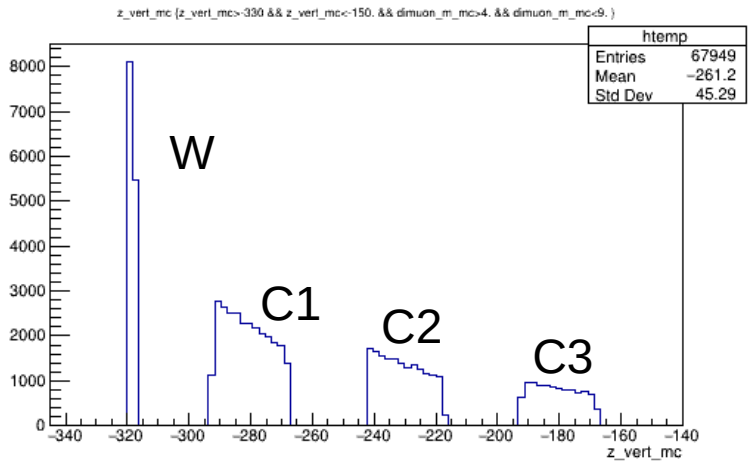
A special setup:

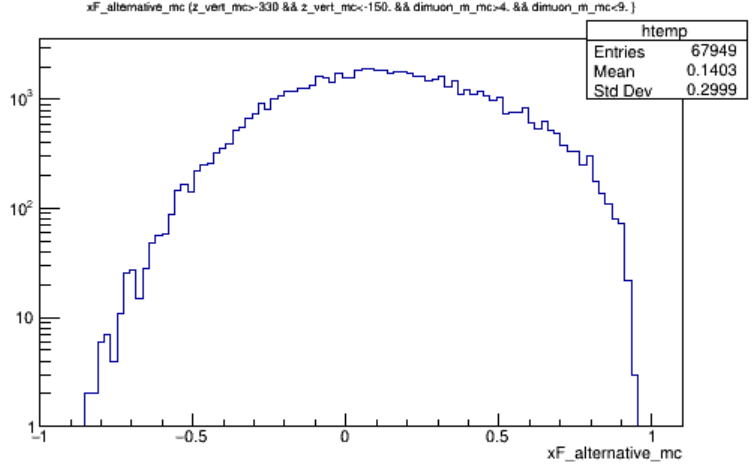
- The **Muon Filter 2** (MF2: 2.4 meters of concrete, centered at Z=3800 cm) had its central hole fully filled with concrete.

- The Muon Wall 2 detector (MB) was removed from the setup

Consider only events generated in $4 < M_{\mu\mu}$ (gen) < 9 GeV/c² and $-330 < Z_{vertex}$ (gen) < -150 cm







Pair selection	# events	Acc %
Generated	67949	
Reconstructed	27019	39.8
X/X0>30 (muons)	21160	31.1
Zlast>1500 & Zfirst<300	20368	30.0
$4 < M_{\mu\mu}$ (rec)< 9 GeV/c^2	19059	28.0

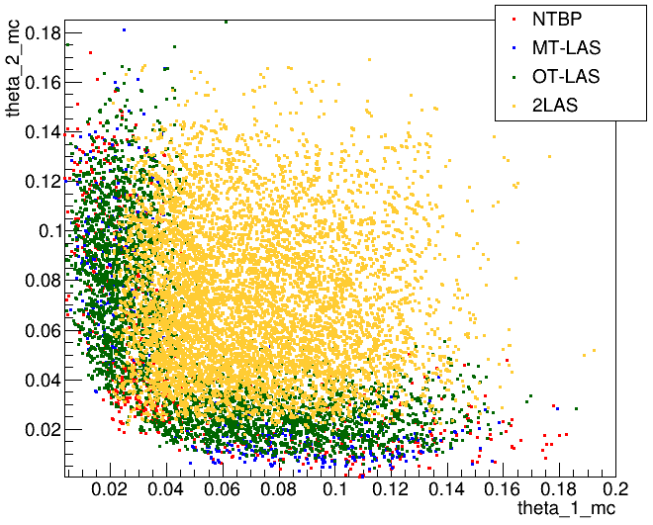
Dimuon triggers:

2LAS: Two large hodoscopes with big central hole (HG01 and HG02), and MF1 in between. It covers large angles.
OT-LAS: one muon at large angle (LAS) and one at smaller angle (in SAS: HO03 and HO04, central holes).
MT-LAS: one muon at large angle (LAS) and one at even smaller angle (in SAS: HM04 and HM05, central holes).

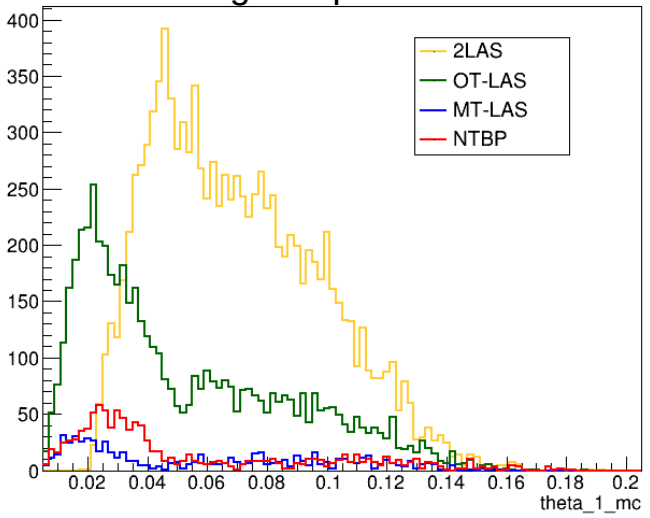
Pair selection	# events	Acc %	δp/p %
2LAS	10885	16.0	2.2
OT-LAS	5485	8.1	0.8
MT-LAS	641	0.9	0.3
No trigger, but possible	1049	1.5	0.4
total		26.5	

Zlast1>3800 || Zlast2>3800

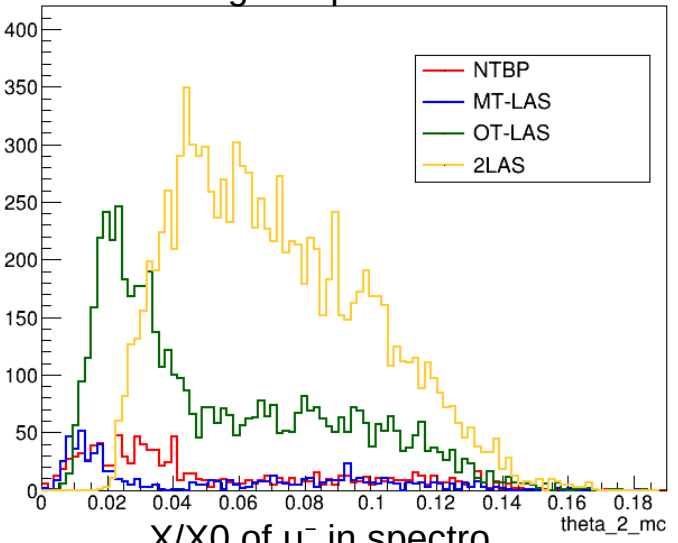
Acc (C): 27.3% Acc (W): 23.8%



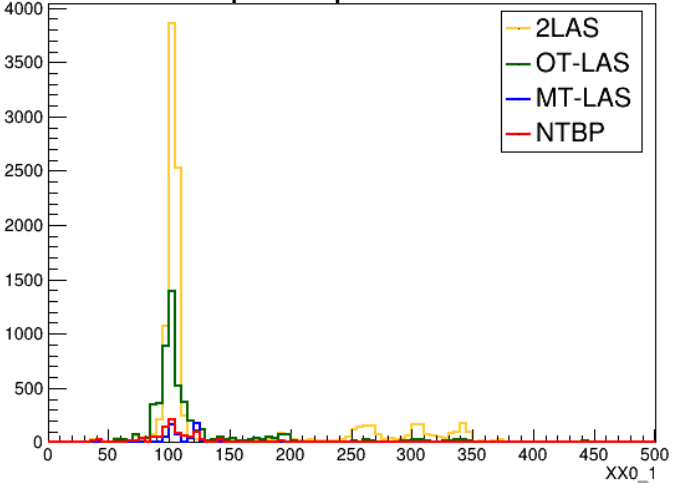
Polar angle of μ⁺ in lab frame



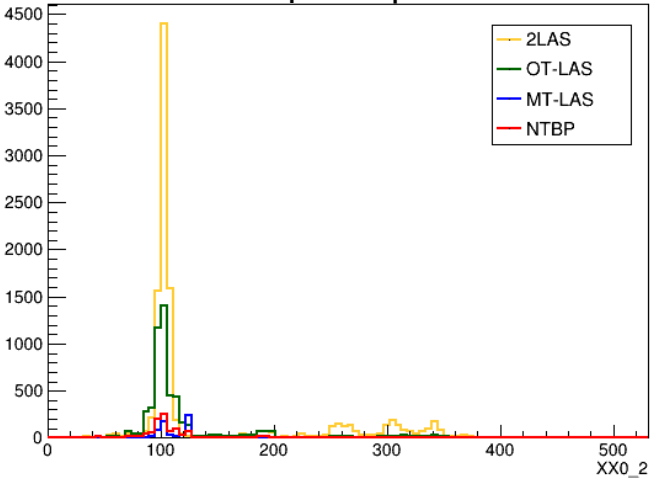
Polar angle of μ⁻ in lab frame

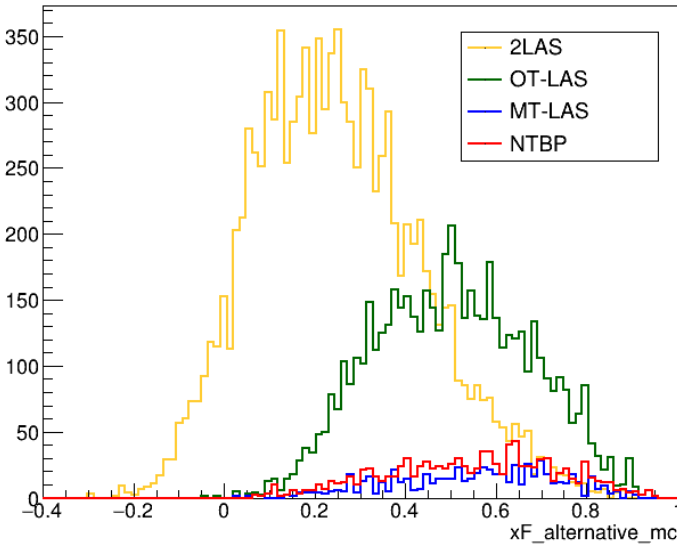


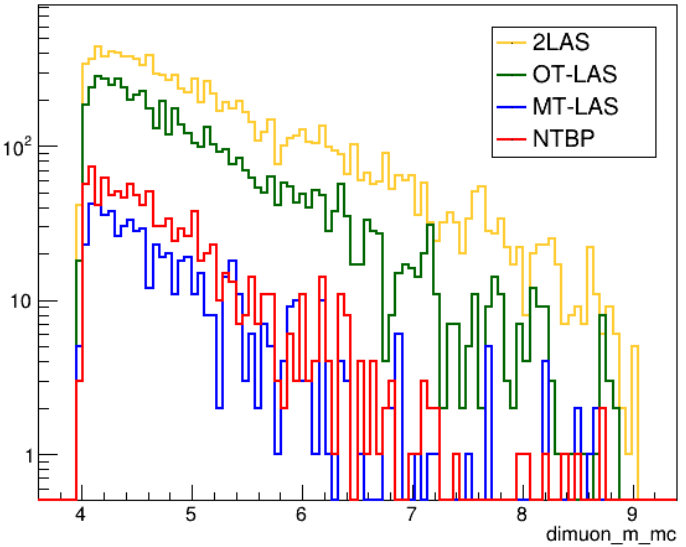
X/X0 of μ⁺ in spectro

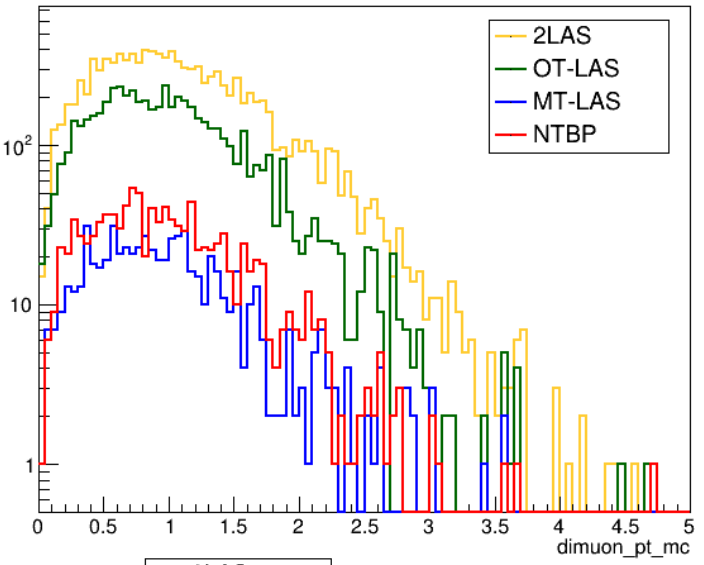


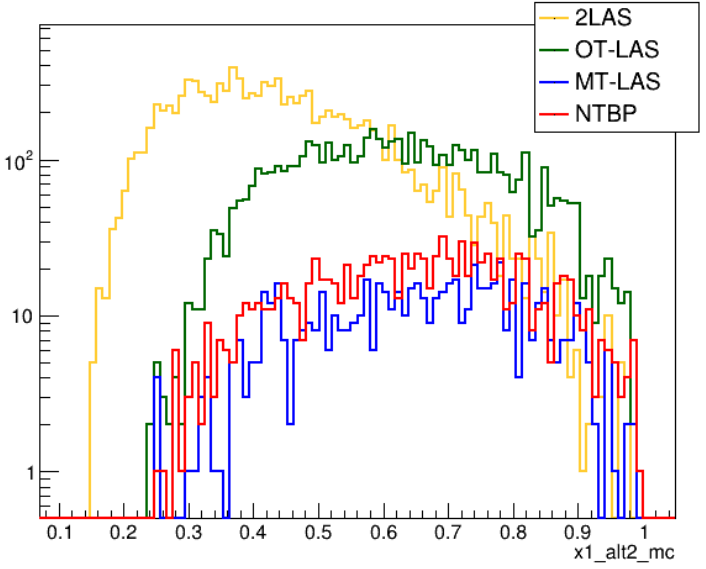
X/X0 of μ⁻ in spectro

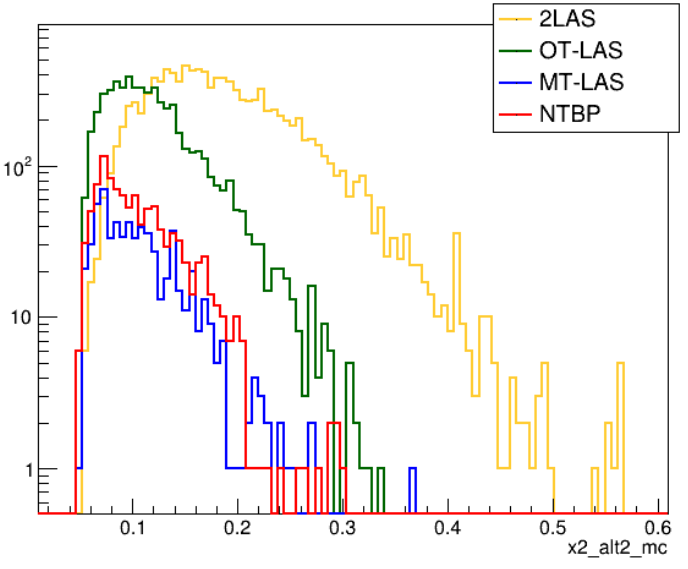


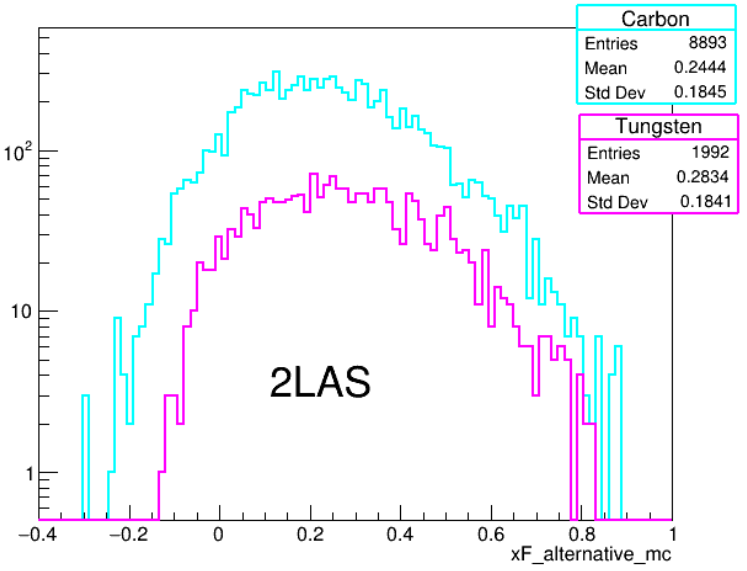

2LAS
OT-LAS
MT-LAS
NTBP
xF_alternative_mc

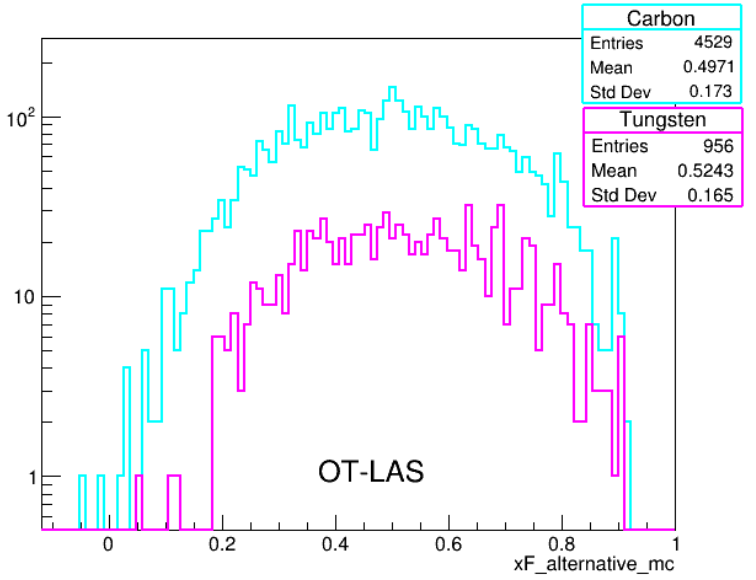

2LAS
OT-LAS
MT-LAS
NTBP
dimuon_m_mc

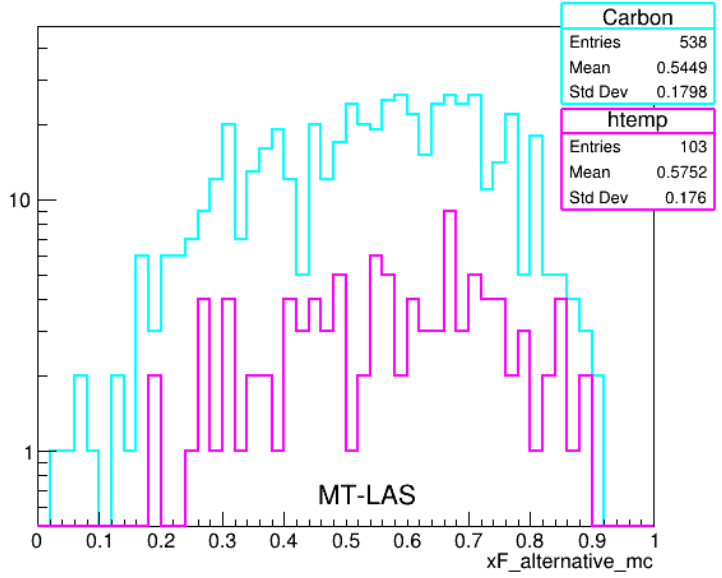

2LAS
OT-LAS
MT-LAS
NTBP
dimuon_pt_mc

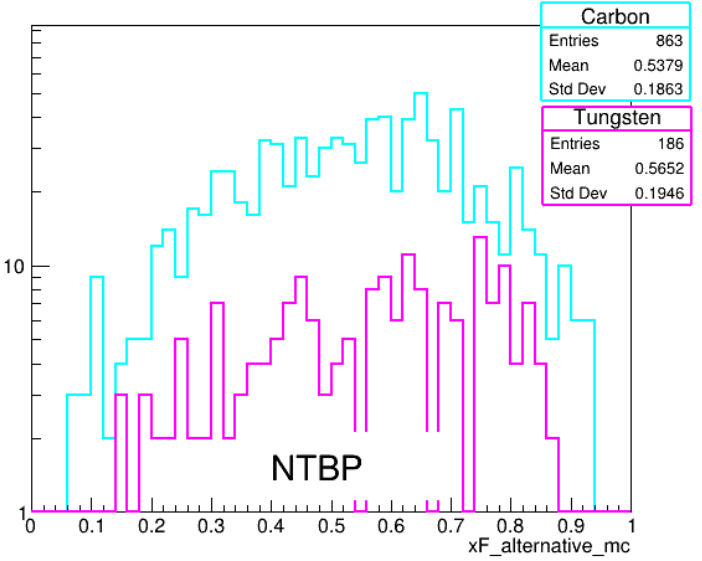

2LAS
OT-LAS
MT-LAS
NTBP
x1_alt2_mc


2LAS
OT-LAS
MT-LAS
NTBP
x2_alt2_mc


Carbon
Entries 8893
Mean 0.2444
Std Dev 0.1845
Tungsten
Entries 1992
Mean 0.2834
Std Dev 0.1841
2LAS
xF_alternative_mc


Carbon
Entries 4529
Mean 0.4971
Std Dev 0.173
Tungsten
Entries 956
Mean 0.5243
Std Dev 0.165
OT-LAS
xF_alternative_mc


Carbon
Entries 538
Mean 0.5449
Std Dev 0.1798
htemp
Entries 103
Mean 0.5752
Std Dev 0.176
MT-LAS
xF_alternative_mc


Carbon
Entries 863
Mean 0.5379
Std Dev 0.1863
Tungsten
Entries 186
Mean 0.5652
Std Dev 0.1946
NTBP
xF_alternative_mc

While with default setup, we had:

Pair selection	# events	Acc %
Generated	68588	
Reconstructed	26531	38.7
X/X0>30 (muons)	21022	30.6
Zlast>1500 & Zfirst<300	20210	29.5
$4 < M_{\mu\mu}$ (rec)< 9 GeV/c²	18948	27.6

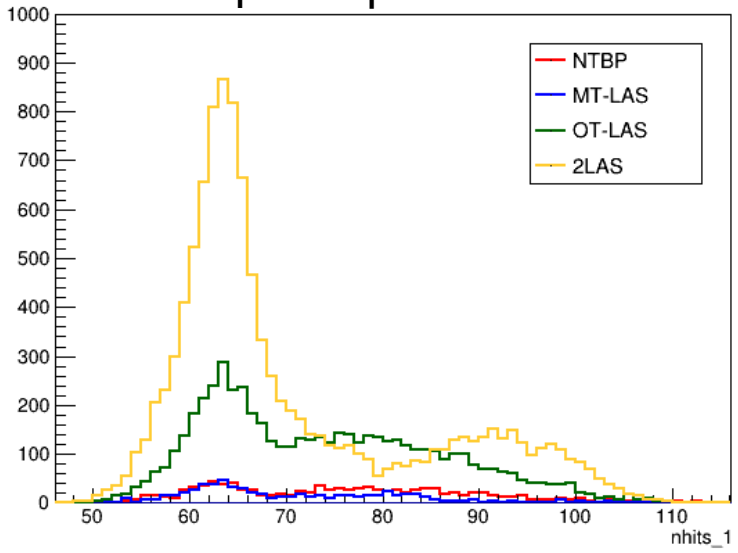
Same as before, within errors

Pair selection	# events	Acc %	δp/p %
2LAS	10743	15.7	2.2
OT-LAS	5270	7.7	0.8
MT-LAS	655	1.0	0.3
No trigger, but possible	1224	1.8	0.4
total		26.2	

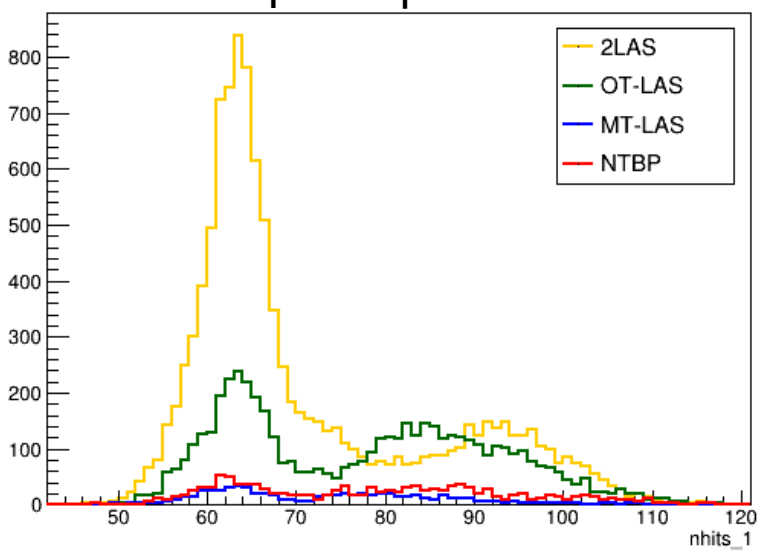
Zlast1>3800 || Zlast2>3800

Acc (C): 26.7% Acc (W): 23.7%

#hits of μ^+ in spectro – NoMW2



#hits of μ^+ in spectro – MW2



A difference is visible for OT-LAS, where the muon track going into OT has less hits associated for the NoMW2 setup.

That does not affect the muon identification (given by X/X0>30).
The muons in OT tend to have one single measured point after MF2, in HO04 (but X/X0>70).

~11% of the 2LAS events are seen and validated also in OT-LAS.

Conclusions

Removing the MW2 while filling the hole of MF2 we obtain a setup that presents still same performance for dimuons reconstruction.

The is no impact in the momentum resolution of muons, when removing MW2.

A dimuon identification based on X/X0>30 + multiplicity>=2 (trigger level 1) would still work, leading to identical or better acceptance.

Hodoscopes are still relevant for a future setup, poviding a precise timing (~1 ns) and correct X/X0 for muon identification.