Preliminary analysis of the dead time measurements

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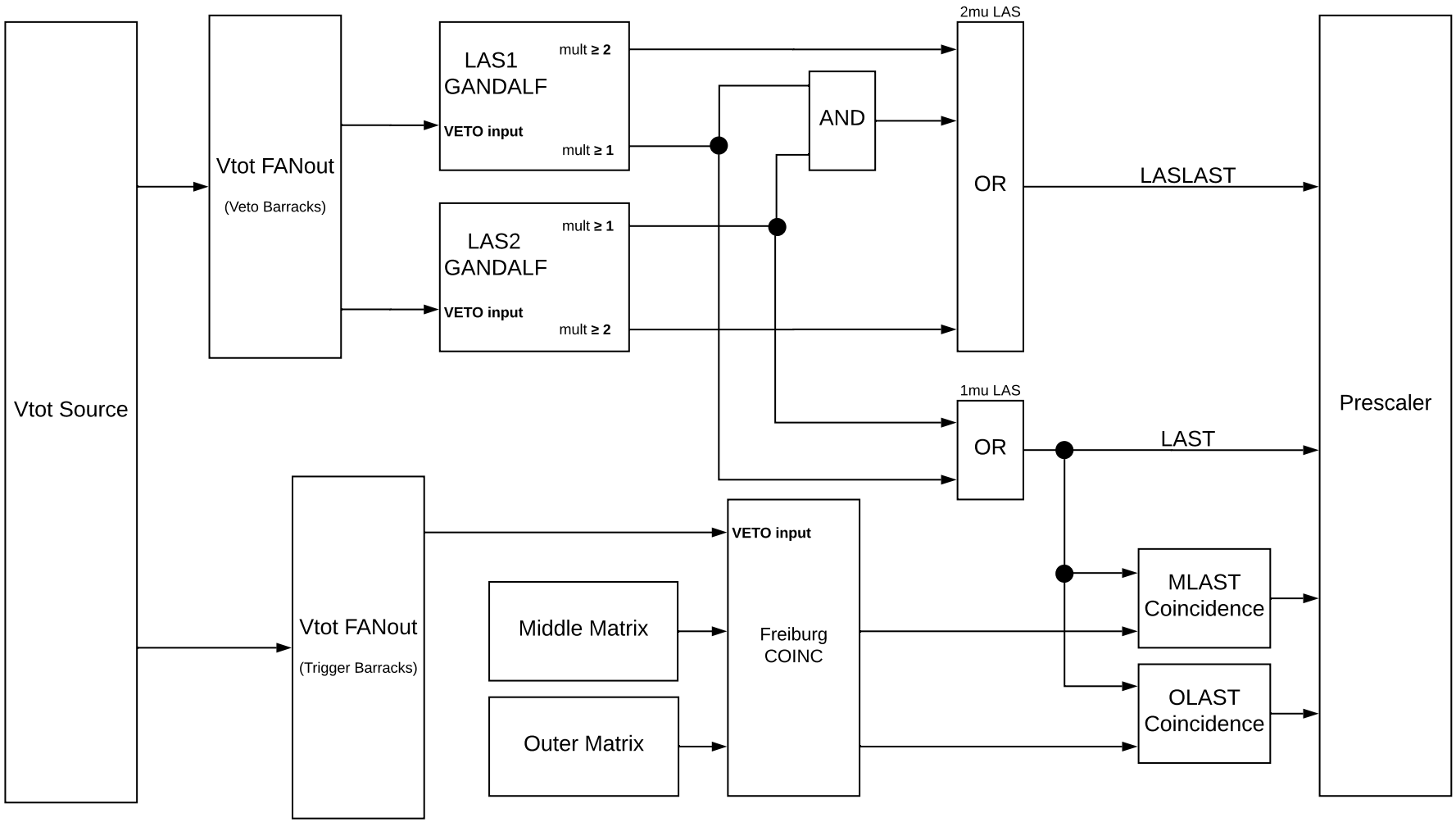
Setup of the Di-Muon Triggers (simplified)



Method of dead time measurement

Method for determine the veto dead time out of the rates:

$$T_{dead} = 1 - \frac{R_{\text{veto\_delayed}}}{R_{\text{veto\_off}}}$$

(detailed description COMPASS Note 2010-8)

Problems:

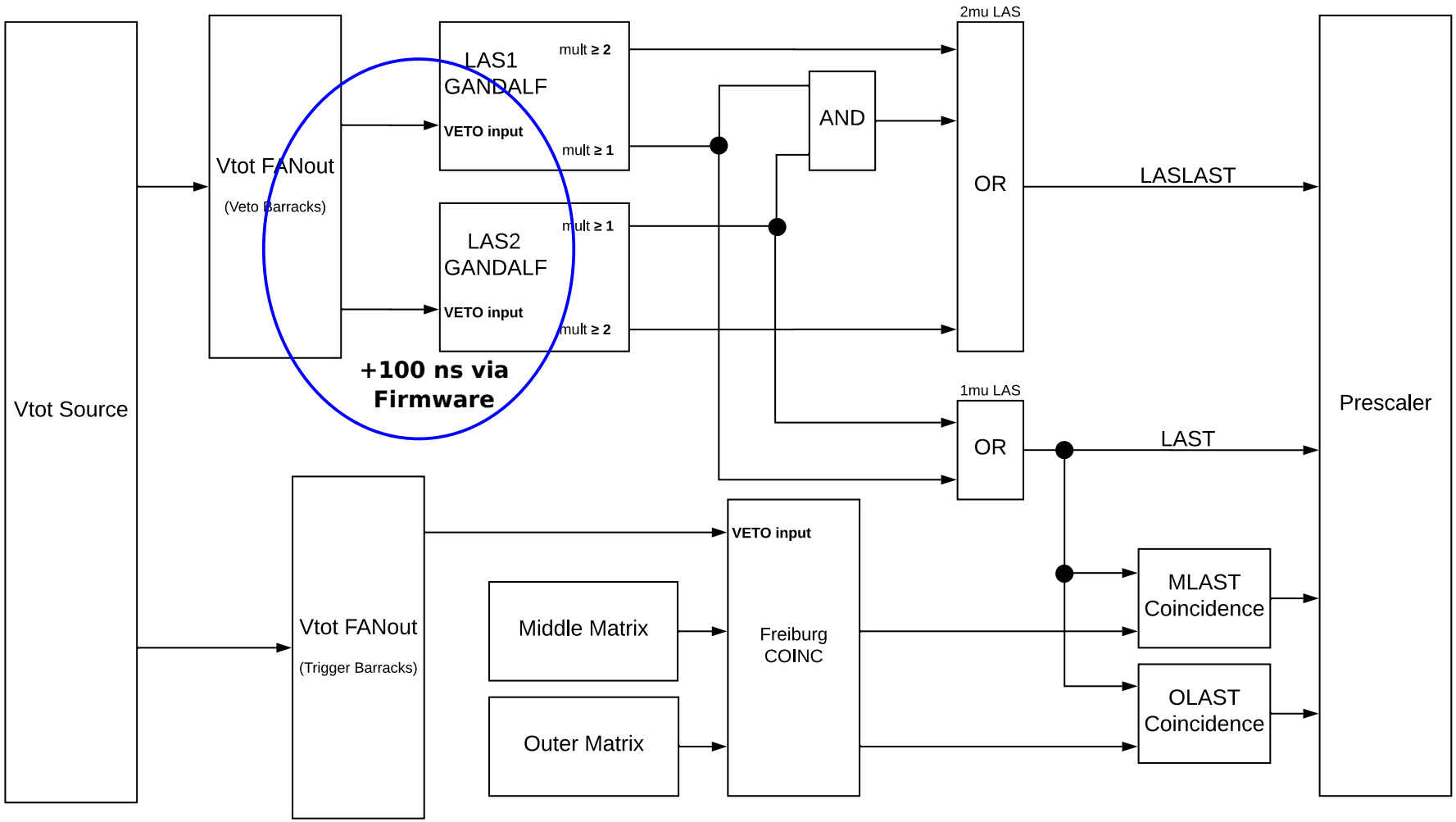
- Only middle and outer (single-muon) can be monitored in real time.
- For Di-muon trigger we have to manual measurements of consecutive spills with different settings of delayed veto and without veto.

$\rightarrow$ Afterwards we have to match similar spills!

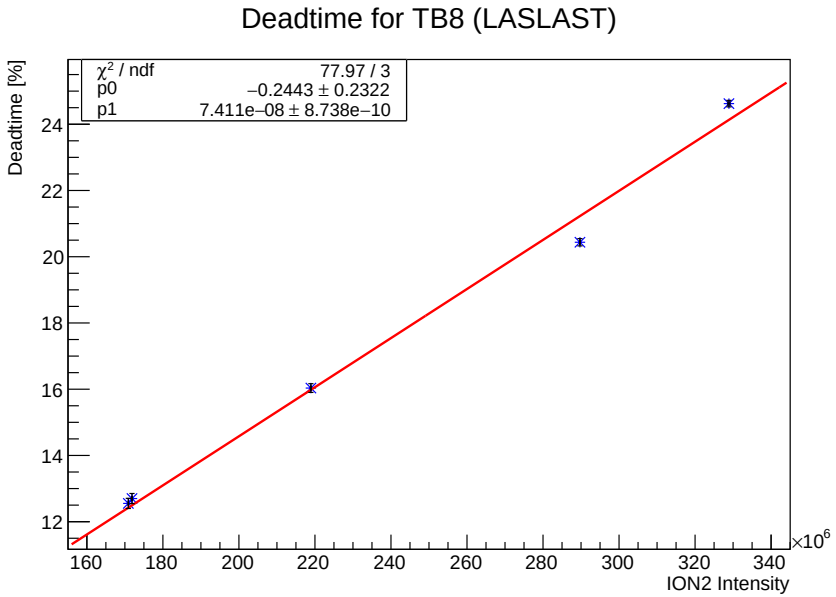
Requirement at the moment:

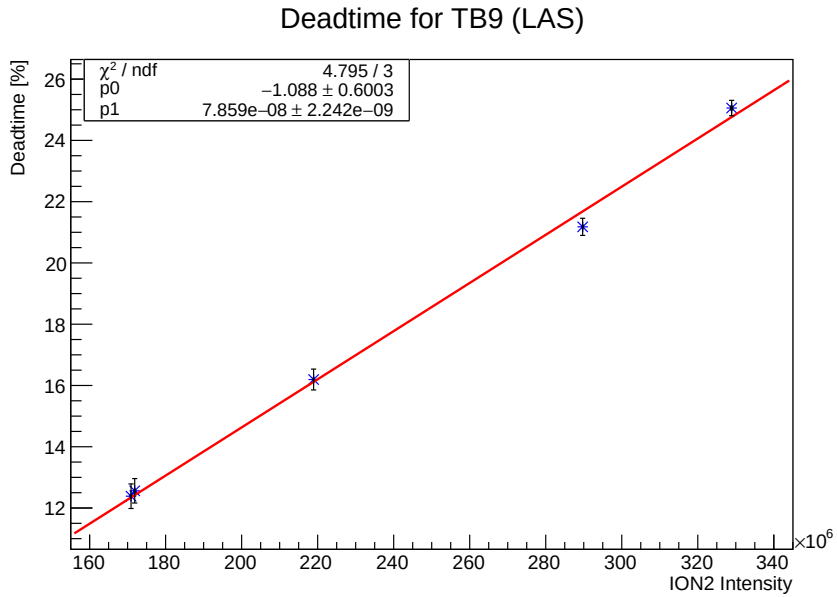
Difference in ION2 intensity is less then 0.1%

Measurement of LAST and LASLAST via Gandalf delay



Results for different intensities for LAS and LASLAST

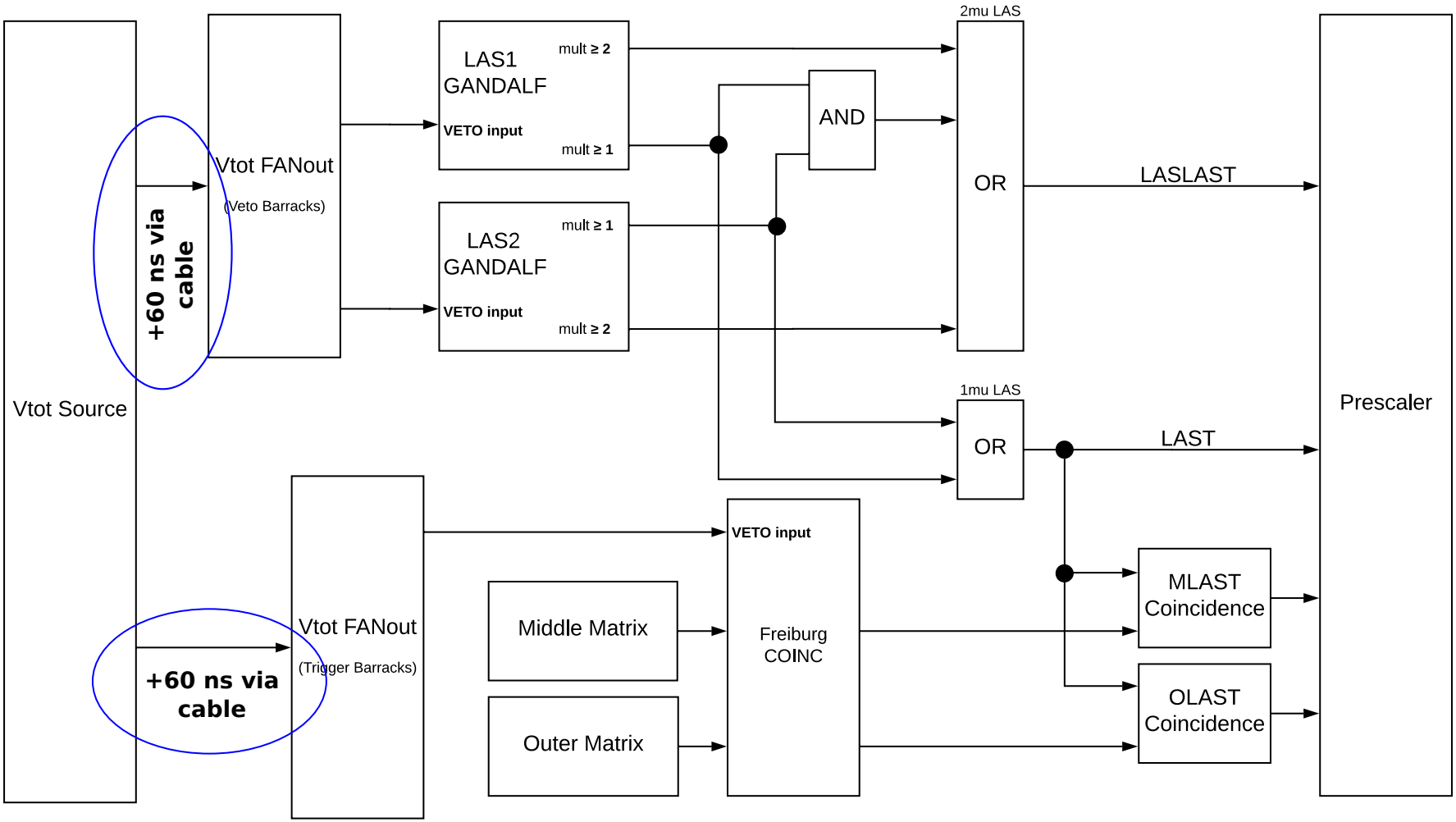




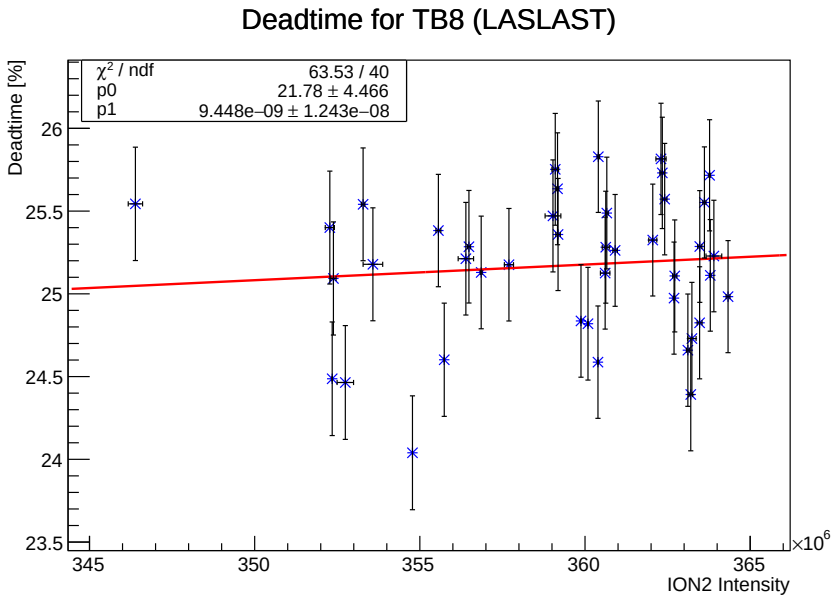
Different beam intensities produced through different collimator settings (col1-4 but for the future better only 2 and 4 [J. Bernhard])

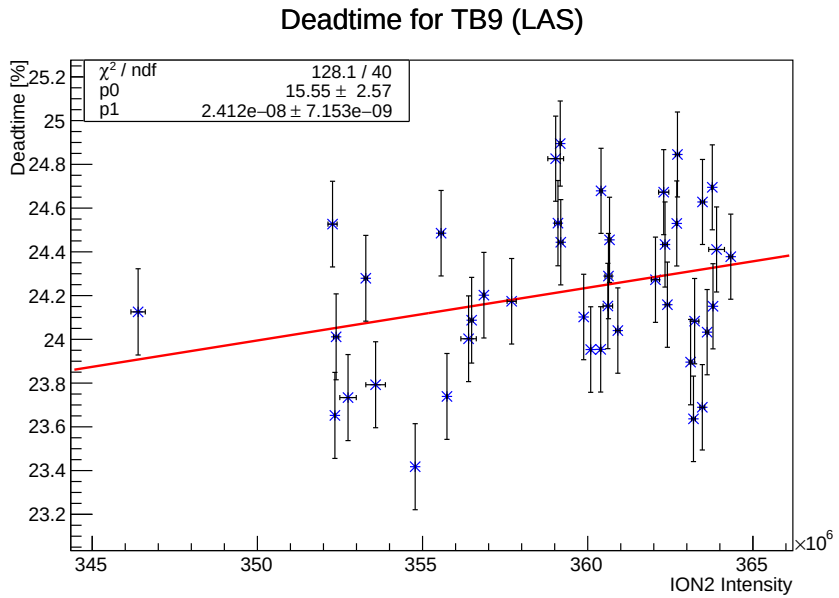
5 Spill combinations out of 6 measurements with each five spills for veto delayed and off fulfilled the condition of $\Delta\text{ION2} < 0.1\%$

Measurement of all Triggers via cable delay



Results for LAS and LASLAST

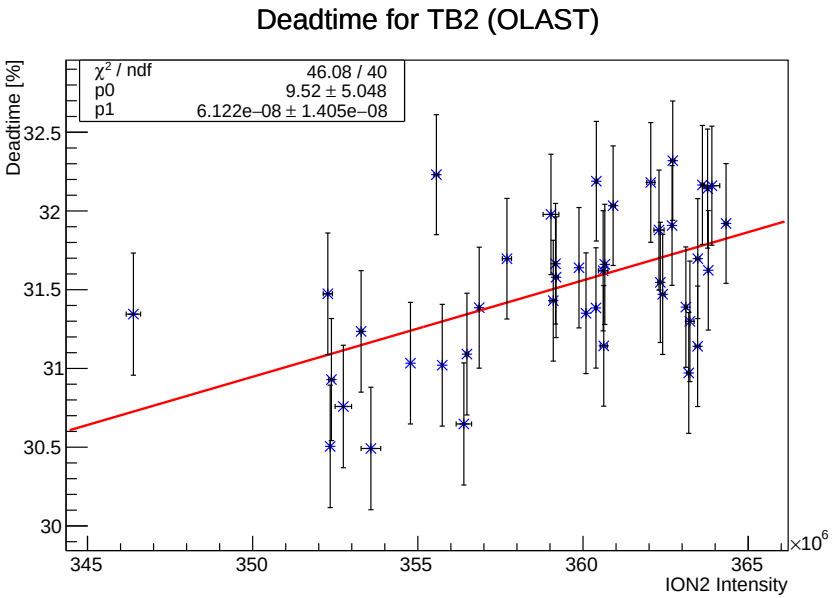


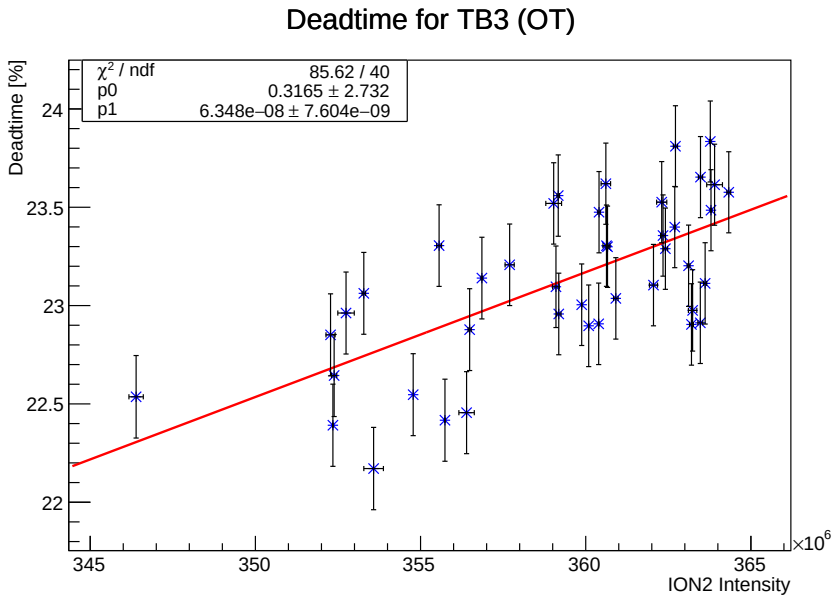


Measurement of this Wednesday performed with different collimator settings.

LAS and LASLAS dead time are in the same order of magnitude.

Results for OT and OLAST

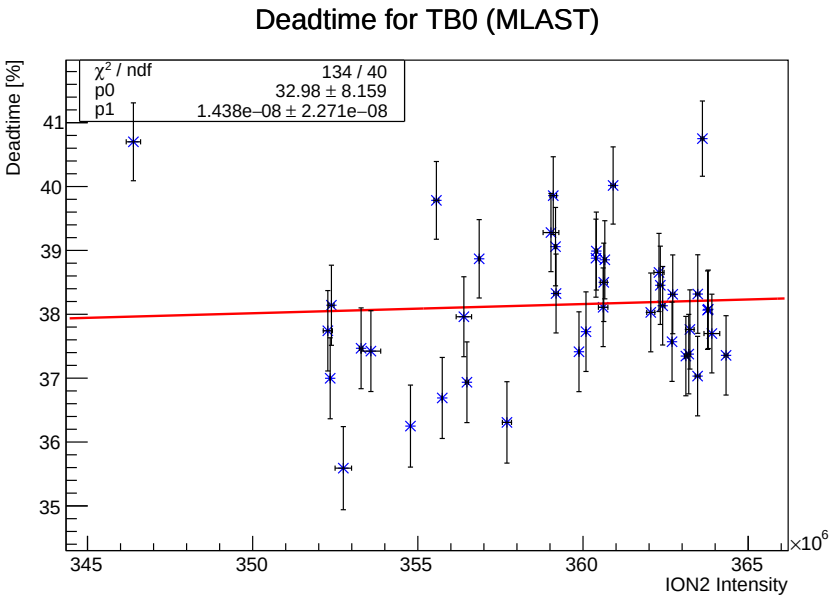


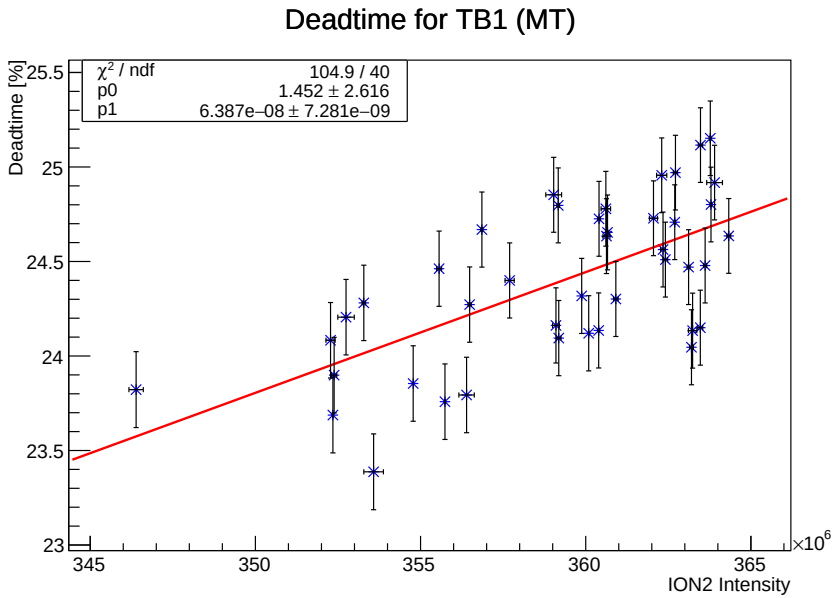


Measurement of this Wednesday performed with different collimator settings.

Di muon trigger dead time significantly higher than single muon dead time.

Results for MT and MLAST



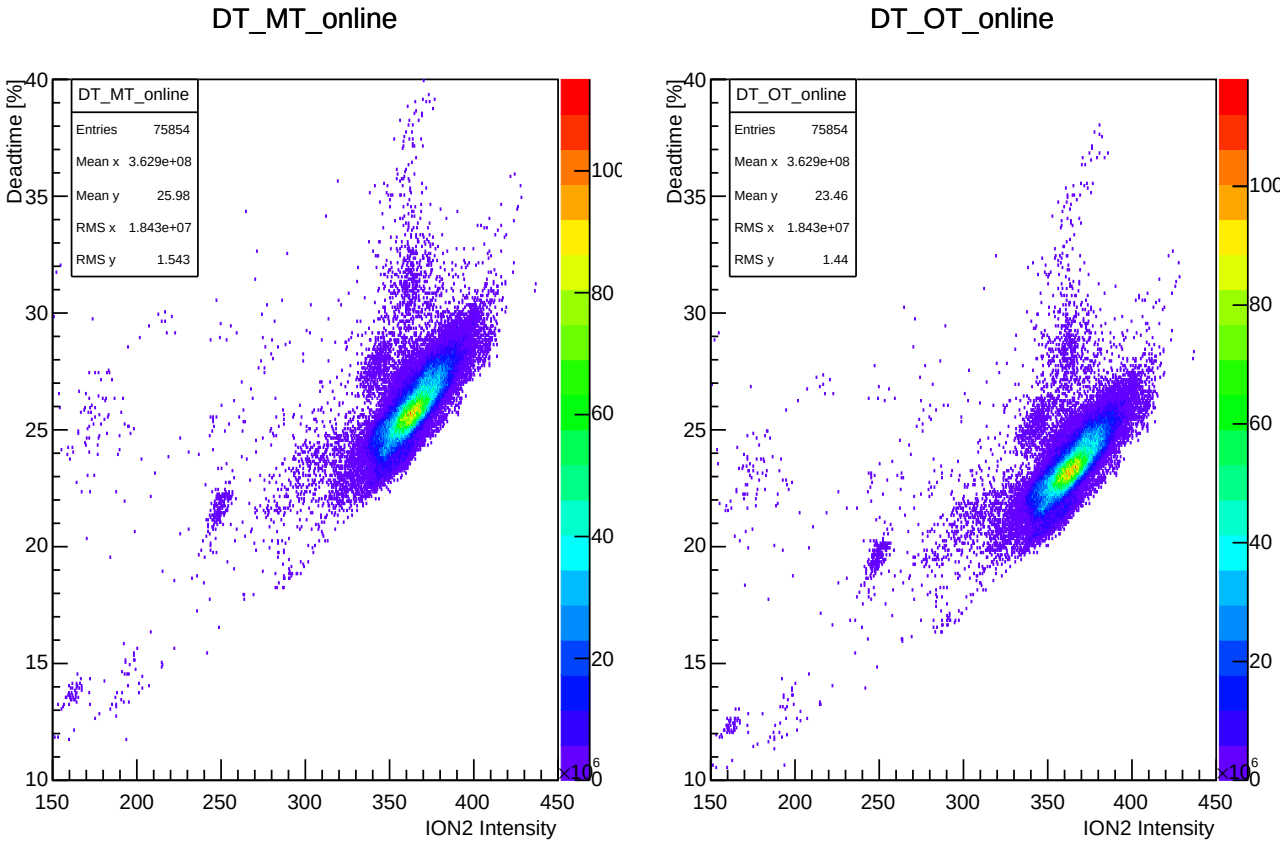


Measurement of this Wednesday performed with different collimator settings.

Di muon trigger dead time significantly higher than single muon dead time.

Analysis of the online measurements of MT and OT

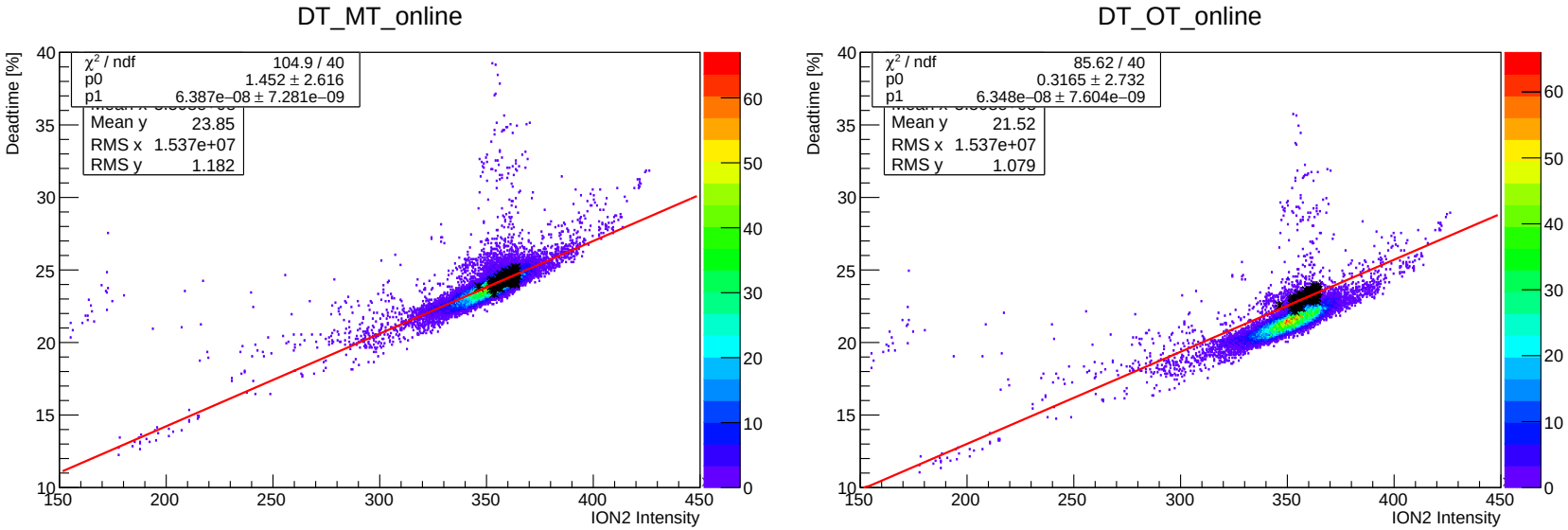
Online dead time measurements spill by spill from MySQL Database:



Data of the last month (1.7.2018-2.8.2018).
Only Runs which are marked as Drell-Yan Physics.

Comparison of wire delay and online Method

DY data from this period (02.08.2018 - 09.08.2018):



Middle online dead time is in good agreement with wire delay method.

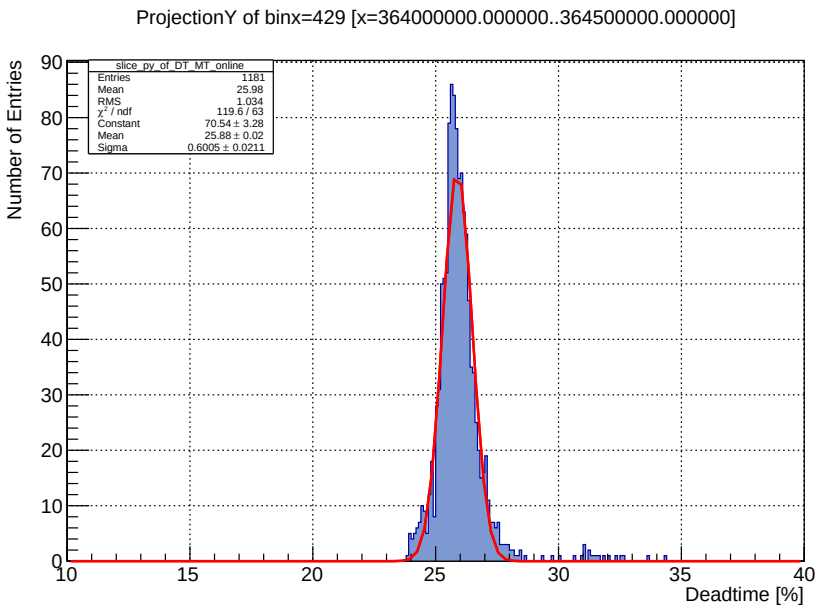
Outer online dead time is slightly higher for the wire delay method.

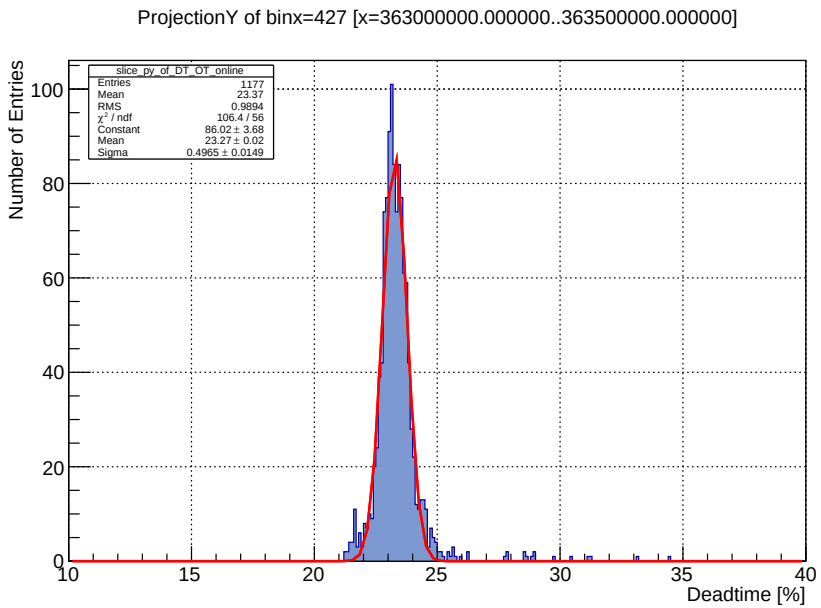
Reason under investigation!

$\rightarrow$ most probably different points where the measurement is taken.

Accuracy of the online Measurement

Projection of one central bin in the distribution for Middle and Outer:

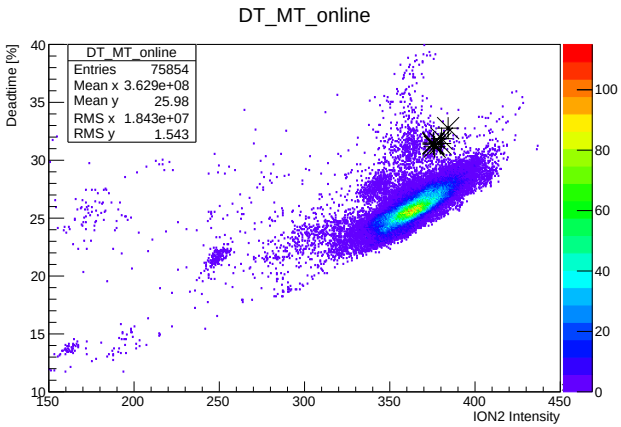


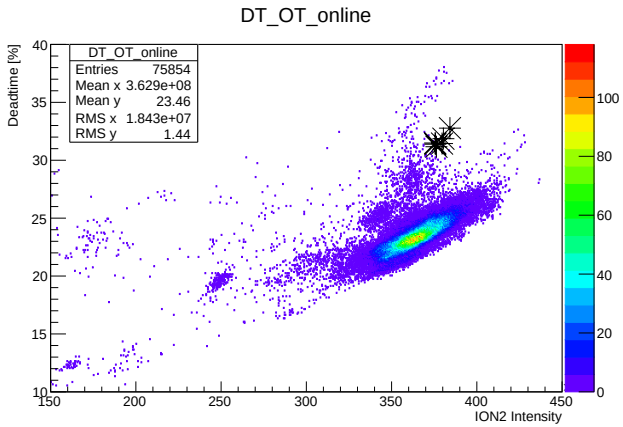


$\sigma_{\text{middle}} = 0.6\%$

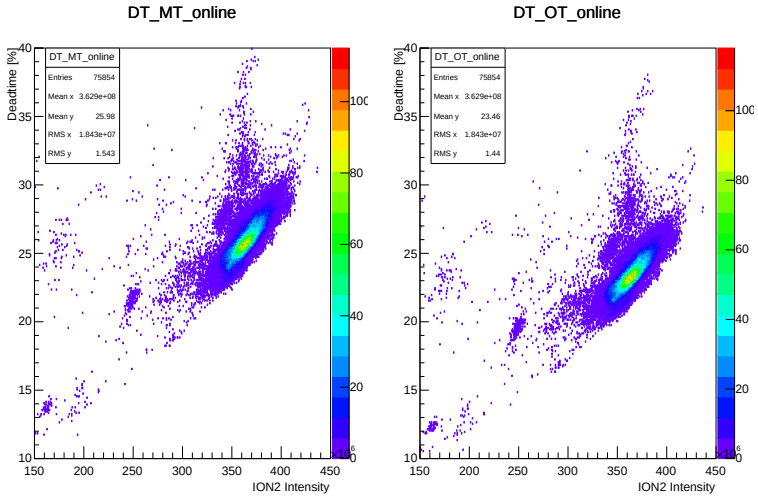
$\sigma_{\text{outer}} = 0.5\%$

Remarks on last dead time measurement

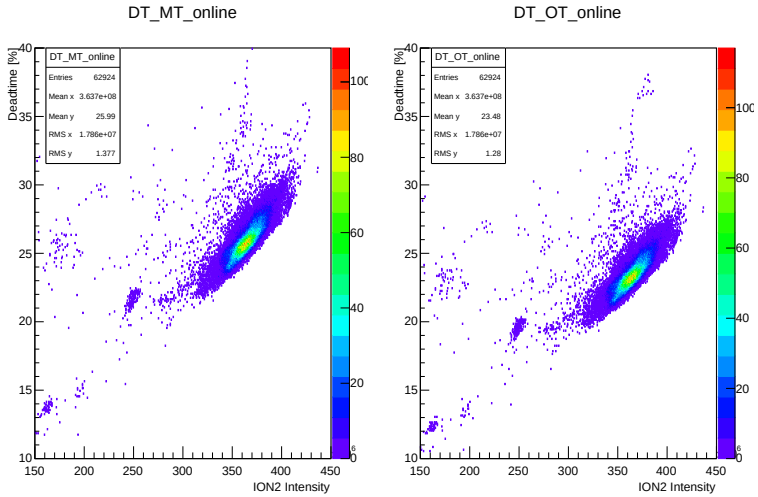




02.07 - 31.07:

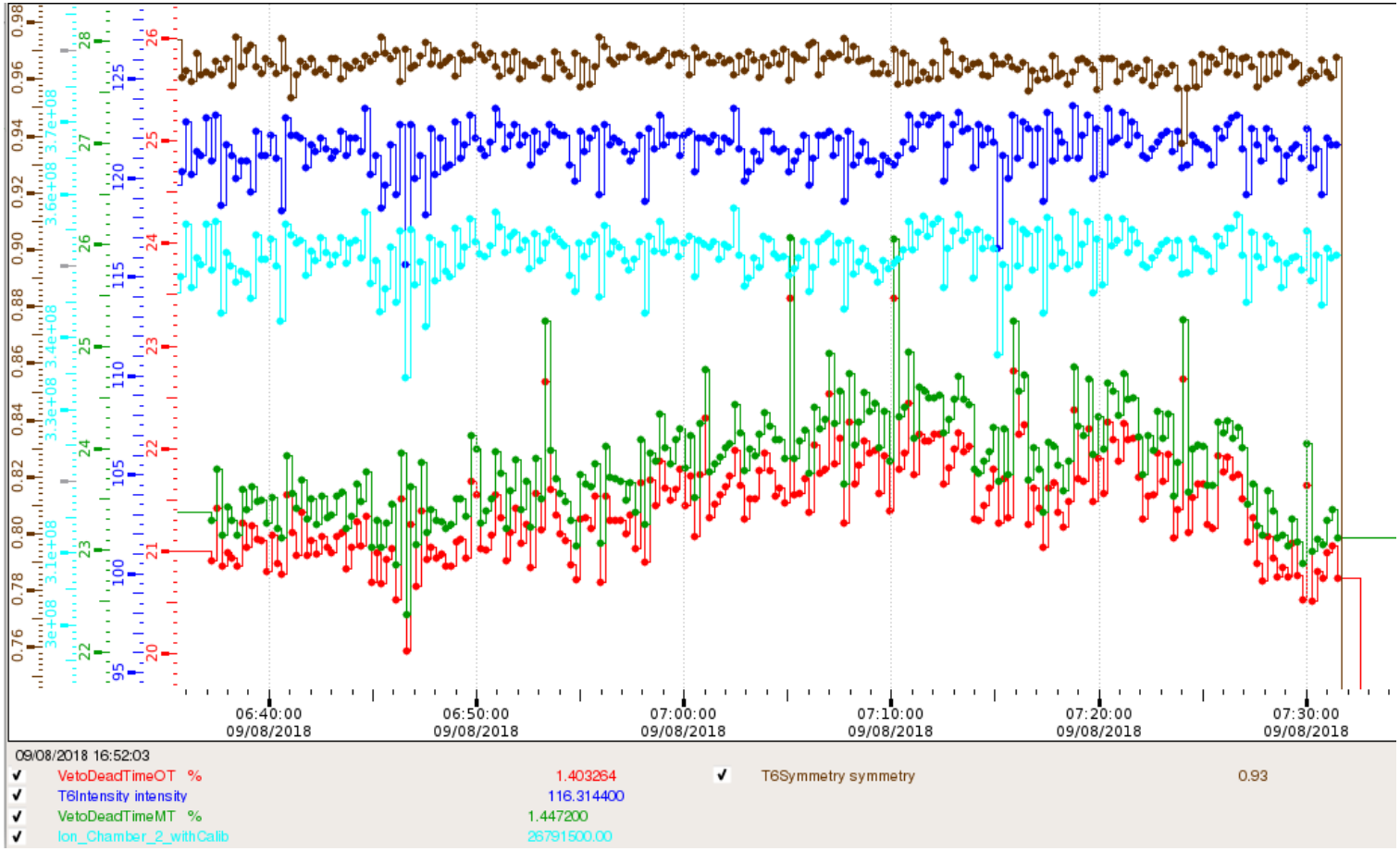


02.07 - 30.07:



Cutting on dead times is a good way to exclude bad spills from the data analysis.

Sudden changes of dead time



Sudden change in dead time ($\approx 1\%$) on Thursday morning between 6:55 and 7:30 ...

$\rightarrow$ No changes visible in ION2, T6, or symmetry, ...

Solution for lowering MLAST and OLAST dead time?

Remove the veto signal on middle and outer (single muon) triggers !

$\rightarrow$ Only LAS is still vetoed in the coincidence for di muon.

A short test run was done (284939,285047,285048):

Prescaler setup for run 284939

Trigger element	Short name	Division factor	In rate (1st spill)	Out rate (1st spill)
Dimuon Trigger (Middle and LAS)	MLAST	1	11922	11922
One muon Middle Trigger	MT	0	1339938	0
Dimuon Trigger (Outer and LAS)	OLAST	1	15241	15241
One muon Outer Trigger	OT	0	1138066	0
Calorimeter Trigger	CT	240	4929542	20540
Inner Veto	VI	0	15415695	0
Halo Trigger (H2 AND H4Outer)	Halo	0	1477054	0
Beam Trigger	BT	0	58225487	0
Dimuon Trigger LAS	LASLAST	1	109407	109407
One muon Trigger LAS	LAST	0	748021	0
True Random	TRand	1	21680	21680
Noise Random	NRand	0	434039	0

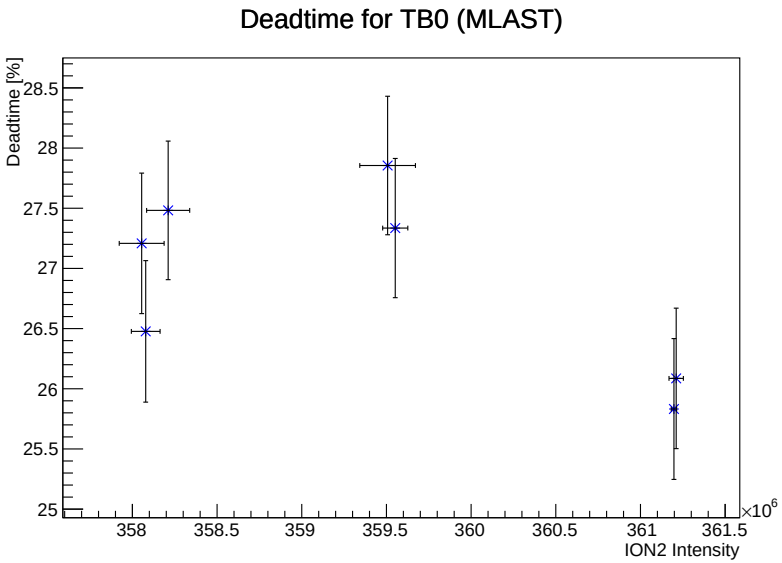
Prescaler setup for run 284941

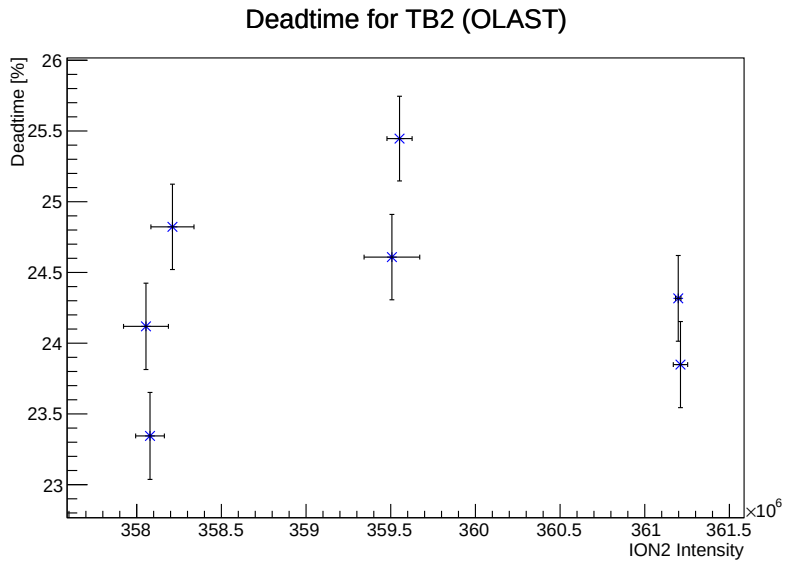
Trigger element	Short name	Division factor	In rate (1st spill)	Out rate (1st spill)
Dimuon Trigger (Middle and LAS)	MLAST	1	2952	2952
One muon Middle Trigger	MT	5	194023	38805
Dimuon Trigger (Outer and LAS)	OLAST	1	6985	6985
One muon Outer Trigger	OT	5	178837	35768
Calorimeter Trigger	CT	240	2321969	9675
Inner Veto	VI	0	15779897	0
Halo Trigger (H2 AND H4Outer)	Halo	0	1524591	0
Beam Trigger	BT	0	58839601	0
Dimuon Trigger LAS	LASLAST	5	112960	22592
One muon Trigger LAS	LAST	20	769762	38489
True Random	TRand	1	21663	21663
Noise Random	NRand	0	433924	0

MLAST rate increased by a factor of ≈ 4

OLAST rate increased by a factor of ≈ 2

General observations for new settings



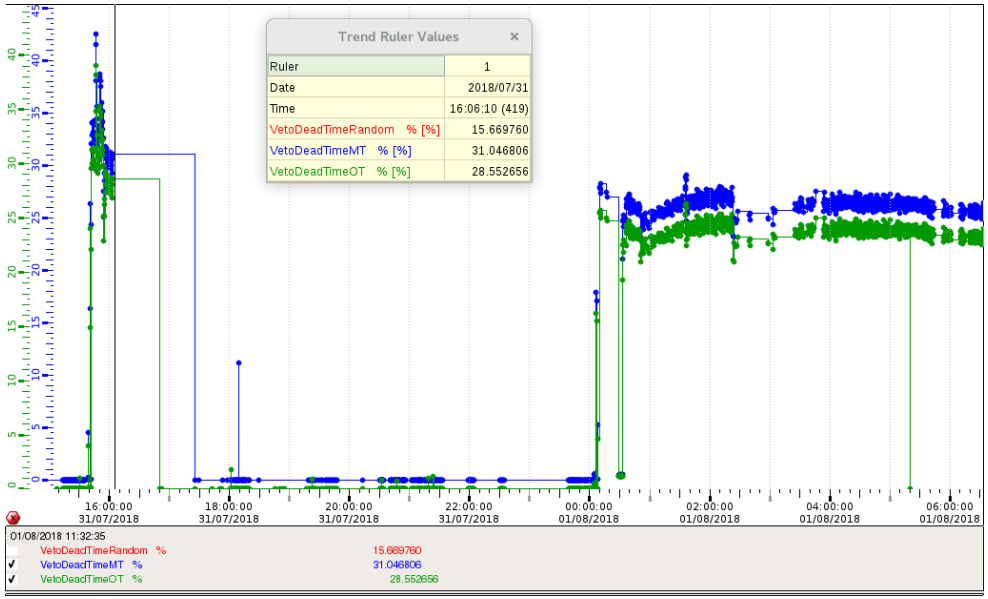


MLAST dead time reduced from ≈38.5% → ≈27.5%
OLAST dead time reduced from ≈31.5% → ≈24.5%
Total Trigger rate increased from 161k/spill → 175k/spill (+9%)
→ DAQ dead time increased from 13% → 15%
No online dead time measurement for MT and OT possible (they are 0)

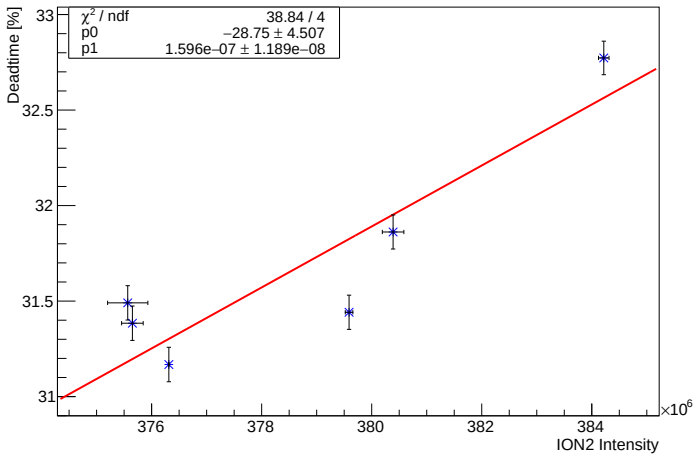
Further investigation needed and ongoing ...
(trigger timing check, veto timing check, check of numbers of Ypsi,...)

Backup Slides

Bad Beam Conditions during Measurement



Deadtime for TB1 (MT)



Deadtime for TB3 (OT)