



COMPASS NOTE

TRIGGER MODIFICATION FOR DRELL-YAN

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September 24, 2015

1 Introduction

The Drell-Yan process is examined by a negative pion beam on a polarized ammonia target (NH_3). The final state consists of two muons and a hadronic state, which is absorbed by the hadron absorber behind the target. For the data taking in 2014/2015, the Middle and Outer Trigger systems have been modified to match the acceptance of these dimuons.

The Outer Trigger consists of two hodoscopes with horizontal strips: the HO03, directly behind the SM1 magnet and HO04 behind the Muon Filter 2.

The Middle Trigger consists of two subsystems, namely HM04 and HM05. Each of these subsystems is composed of one vertical ($\text{HM0}^*\text{X}$) and one horizontal hodoscope ($\text{HM0}^*\text{Y}$). The hodoscope HM04 is located behind the HO04 and HM05 is behind the Muon Wall 2. For the data taking, only the target pointing hodoscopes with horizontal strips are used. The single muon triggers (MT and OT) are used in coincidence with the Large Angle Spectrometer Trigger (LAST) to obtain a dimuon trigger. The LAST electronics on the FPGA was modified to trigger on single muon and dimuon events.

For the DY measurement, the trigger hodoscopes should to be symmetric around the zero beam line. This was not fully archived, due to limitations of the beam onto which the Outer hodoscopes were. The Outer hodoscopes were not shifted in position and a symmetrical hole was introduced, resulting a similar but not equal acceptance for positive and negative muons. The Middle hodoscopes were shifted to cover the hole of the outer hodoscopes.

2 Dimuon Trigger for Drell-Yan

For DY, three dimuon trigger are introduced. They consist of MT and LAST (Triggerbit 0), OT and LAST (Triggerbit 2) and LAST/LAST (Triggerbit 8). All used Trigger are shown in Table 1.

Trigger Bit	Short-Name	Trigger-Elements
0	MT+LAST	Dimuon Trigger (Middle and LAS)
1	MT	One muon Middle Trigger
2	OT+LAST	Dimuon Trigger (Outer and LAS)
3	OT	One muon Outer Trigger
4	CT	Calorimeter Trigger
5	VI	Inner Veto
6	Halo	Halo Trigger (Veto Outer AND HO4)
7	BT	Beam Trigger
8	LAST 2mu	Dimuon Trigger LAS
9	LAST 1mu	One muon Trigger LAS
10	TRand	True Random
11	NRand	Noise Random

Table 1: List of used triggers in 2014.

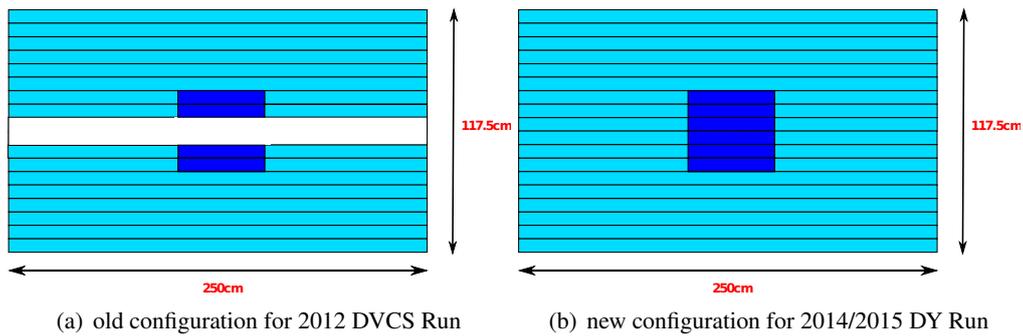


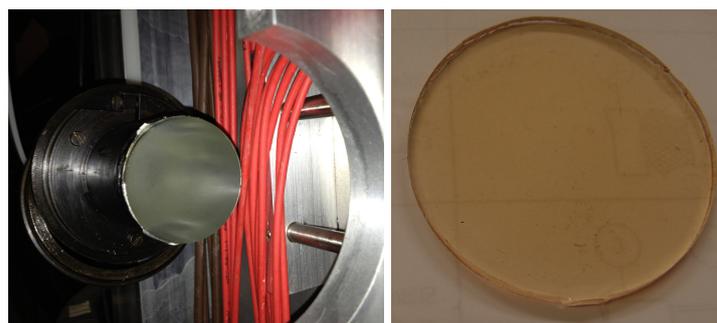
Figure 1: Modification on HO03 (blue area is acrylic glass)

3 HO03 Modification

Prior to 2014, the HO03 consists of 16 slabs with a central hole of 40x42 cm , as seen in Figure 1(a). In addition, two slabs in the center were left out. The corresponding part in the HO04 were inactive. All H03 strips are 250 cm long and are read out by photomultipliers of type EMI 9813KB[2] on both sides. Two new slabs with a central inactive part made of PMMA were added to ensure a larger acceptance (Figure 1(b)). Each new strip are made out of two 1050x70x10 mm BC408[3] scintillator pieces with a 400x70x10 mm block acrylic glass in the center to fit the hole. On both ends, a light guide is glued with a transparent super glue on a cyanate basis (Henkel Loctite 406[1]) to the scintillator to makes the transition between the rectangular flat front to the round photo multiplier read-out cathode.

3.1 HO03 Cleaning and Removing Cookies

During the preparation for the modification of HO03, we discover that the round ends of the light guide were opaque 2(a) and the silicon cookies between the light guide and the PMT showed a discoloration (Figure 2(b)).



(a) Opacity of the HO3 light guides

(b) Discoloration of Cookies

Figure 2

All existing light guides of HO3 were checked .The result of the inspection is shown in Table 2. In addition, a transmission analysis was performed on the discolored cookies. The result is shown in Figure 3. At the scintillator output wave length, the transmission is only 80 %. It was decided to remove all cookies. The opaque light guides were polished to re-obtain the necessary transparency.

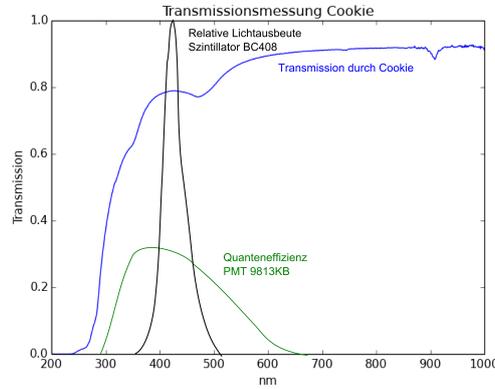


Figure 3: Transmission of old Cookies

4 HO04 Modification

For Drell-Yan, the hole section of the two hodoscope HO04 saleve and HO04 jura were modified. The "old" configuration is shown in 4(a). To obtain a symmetrical central hole, six slabs in the center on each hodoscope half were exchanged. The new strips form a rectangular hole with dimensions of 110 cm x 83 cm in the center of the detector. 4(b) shows this configuration of HO04 for the DY set-up. This modification was achieved by producing 12 strips with an active area of $(185 \times 15) \text{ cm}^2$ and a adiabatic light guide on each end. The thickness of each HO04 slab is 2 cm. The strips are read out by photo-multipliers of type EMI 9813KB[2] on both ends. For this new slabs, active high rate voltage dividers are used. The glueing of the new strips was performed in Mainz with a transparent curing super glue on cyanate basis (Henkel Loctite406[1]). A new aluminum support is used to hold the slabs in position.

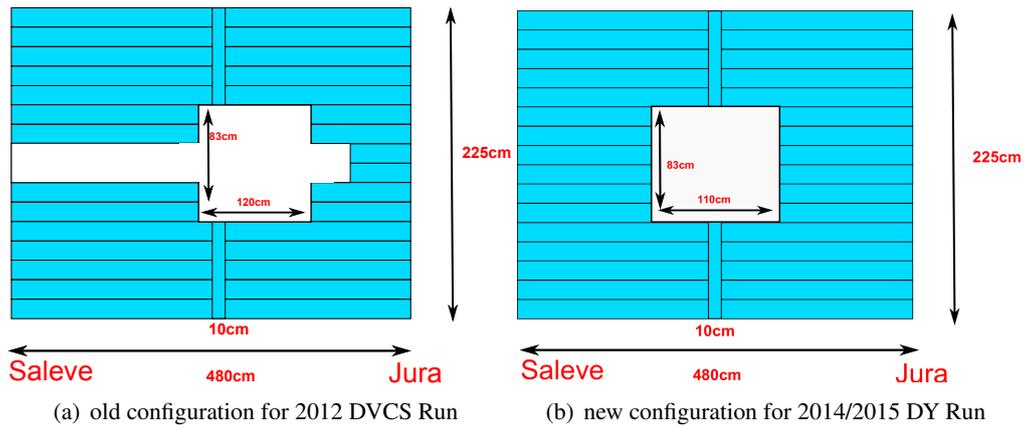


Figure 4: Modifikation on HO04

5 Middle Trigger Modifications

Only the horizontal hodoscopes of MT are active. They were shifted to cover the hole of the outer trigger. HM04Y is now centered at $X=15.0$ cm in the hall (was $X=58.5$ cm during DVCS run of 2012). HM05Y is now centered at $X=20$ cm in the hall (was $X=74.5$ cm during DVCS run of 2012). The old position were marked on the floor. The positions were controlled with a lead.

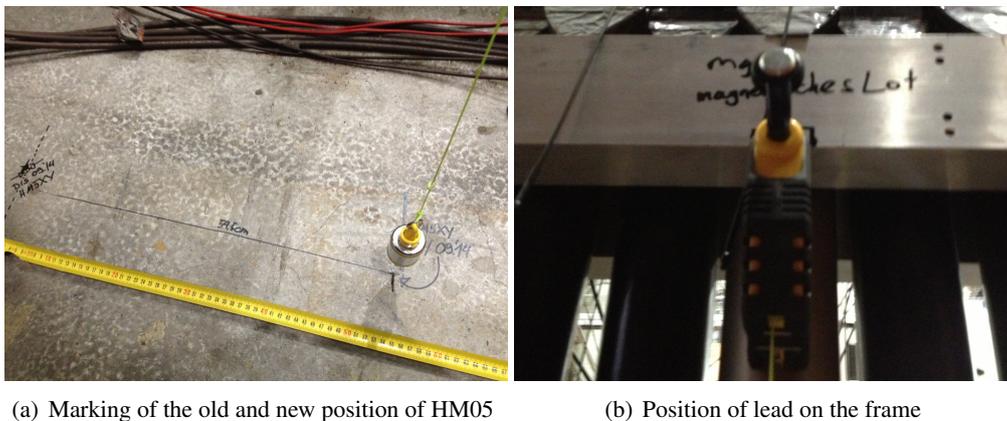


Figure 5: Shifting of HM05

6 Summary

According to the request from the Drell-Yan group, the MT and the OT systems were modified (position and/or structure) for the detection of muon pairs. In detail, 12 slabs and PMTs were

installed in the HO04 to get the rectangular hole in the center. For HO03, two new strips in the center section with a dead zone of 40 cm were added. Also, a full cleaning of the light guides of HO03 was performed. The vertical part of the Middle Trigger is switched off and the horizontal parts were shifted to cover the hole of the Outer Trigger.

7 Appendix

State of the HO03 in Summer 2014:

Nr	PMT Side	PMT Serial	HV Cable	Signal Cable	Comment
1	Saleve	11030	1	1	clean
2	Saleve	11164	2	2	clean
3	Saleve	11161	3	3	clean
4	Saleve	11249	4	4	clean
5	Saleve	10851	5	5	opaque
6	Saleve	11167	6	6	opaque
7	Saleve	11113	7	7	clean
8	Saleve	11103	8	8	clean
9	Saleve	11230	9	9	clean
10	Saleve	10764	10	10	clean
11	Saleve	11193	11	11	opaque
12	Saleve	11210	12	12	clean
13	Saleve	11208	13	13	clean
14	Saleve	11105	14	14	opaque
15	Saleve	11142	15	15	opaque
16	Saleve	11279	16	16	clean
17	Jura	-	36	17	clean
18	Jura	1103	18	18	clean
19	Jura	10791	20	19	clean
20	Jura	10763	19	20	clean
21	Jura	-	21	21	clean
22	Jura	10750	22	22	clean
23	Jura	9306	23	23	clean, scratches
24	Jura	10280	24	24	clean, scratches
25	Jura	11012	25	25	opaque
26	Jura	11256	26	26	opaque
27	Jura	11274	27	27	opaque
28	Jura	-	28	28	opaque
29	Jura	11190	29	29	opaque
30	Jura	11140	30	30	opaque
31	Jura	10975	31	31	clean, scratches
32	Jura	11214	32	32	opaque

Table 2: List of checked HO03 slabs

References

- [1] Datasheet Henkel Loctite 406, <http://tds.loctite.com/tds5/docs/406-2012NEW-EN.PDF>
- [2] Datasheet EMI 9813kb, <http://my.et-enterprises.com/pdf/9813B.pdf>
- [3] Datasheet BC 408, http://www.phys.ufl.edu/courses/phy4803L/group_I/muon/bicron_bc400-416.pdf