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SAMUS data samples: RUN I

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1 Introduction

All information about data obtained with SAMUS during RUN-I is summarized in this Note. All events with muons detected in SAMUS are written to tapes and described below.

In the Note there is also information about simulated muons in SAMUS. These data are described and written to tapes also.

Section two gives general information about *RUN I* data, section three describes RUN-Ia data, RUN-Ib data are given in section four. Section five describes the 630 GeV data and section six describes dimuon data. Section seven containes information about other data connected with SAMUS.

2 RUN I description

RUN I for SAMUS data consists of 5 large parts. The first part of the RUN I is called as *RUN Ia*. There were no global triggers for SAMUS except *mu_2_jet*. But there have been collected Special Runs.

Next part of the RUN I is called *RUN Ib*. These data are devided into two samples due to different L1.5 trigger tables used. The first sample of these data is called here "*OLD*" data (obtained with the old L1.5 trigger tables). "*NEW*" data are collected with the new L1.5 trigger tables.

The third part of the RUN I is called *RUN Ic*, where one part containes data for the high energy interaction (1800 GeV) and another part containes data for low energy interactions (630 GeV) (called here "630").

In Table 1 there are run numbers and the corresponding integrated luminosities for samples collected with some SAMUS triggers.

Table 1: Run numbers for each RUN I part with the corresponding integrated luminosity for some SAMUS triggers.

Part	Global Runs	MU_1_LO_JET (nb^{-1})	MU_2_LOW_Y4 (nb^{-1})	MU_1_LOW (nb^{-1})
RUN Ia	50002-65981	-	-	-
OLD	75321-89329	15988	9153	943
NEW	89329-94789	2695	2260	69
RUN Ic	95491-97004	-	1775	79
630	94874-95389	-	-	566

Events with muons in SAMUS are selected by special triggers. There are 4 trigger levels: L0, L1, L1.5 and L2. The corresponding trigger names are given below.

After event reconstruction (D0RECO) there are 3 output formats: -STA- , -DST-, -μDST-.

Besides there is also "streaming" for each physics topic with the aim to facilitate the event analisys.

We are using BSM (SAMUS) stream.

According to the BSM-stream definition all events with any number of muons in SAMUS (greater than zero) are written to tapes. Events are written in DST and STA formats.

All such events were written for *RUN Ia*, because number of events with SAMUS tracks was small enough: about 2 tapes total (30k events).

For *RUN Ib* number of events is considerably large. It was decided to introduce some cuts for the streaming to clean output events:

- P(muon) $>$ 5 GeV

This cut was used for about 7 month in 1994 (January - October), it corresponds to the trigger lists v8.2-v9.2. With the aim to further diminish the number of streamed events additional cuts have been introduced:

- E(hadron cal.) $>$ 1.5 GeV
- N(hits) $\geq$ 14
- P(muon) $>$ 5 GeV

One can compare this with the definition of the *gold* muons [2]:

- $E_{had} \;>\;$ 2 GeV (1NN algorithm);
- $N_{hit} \;>\;$ 15 ;
- $P \;>\;$ 6 GeV/c .

Data samples status is given in Tables 2 and 3,

Table 2: Types of SAMUS data for Global Runs

Data Types	**OLD**	**NEW**	**630**	**RUN Ic**
STA	DB	DB	DB	DB
DST	DB,EXA	DB,EXA	DB,EXA	DB,EXA
μDST	DB	DB	DB	DB
Ntuple	EXA	EXA	EXA	EXA
MC (DST)	No	No	EXA	No
MC (Ntuple)	No	No	EXA	No

where DB means the data which one can extract through the FATMEN facility; EXA means that the data are written into the exabyte tapes (existing in the SAMUS group office).

For all Runs there are Run's catalogs with the information about 'bad' Runs. Partly this information has been taken from LOGBOOK-data list, but the main information is taken from D0-Notes [3],[4]. This information is placed into Run's catalogs and in the Ntuple code.

All information about SAMUS data is collected at:

$$ALPHA :: PRJ\$ROOT335 : [MUB\_1.BABINTSEV.DATA]$$

Table 3: Types of SAMUS data for Special Runs

Data Types	**OLD**	**NEW**	**630**	**RUN-Ic**
STA	DB	DB	DB	DB
DST	DB,EXA	DB,EXA	DB,EXA	DB,EXA
μDST	No	No	No	No
Ntuple	EXA	EXA	No	No
MC (DST)	No	No	No	No
MC (Ntuple)	No	No	No	No

and codes are stored in the SAMUS library

$$D0FNAL :: SSC1 : [TMP50.SAMUS].$$

With the aim to facilitate SAMUS data analysis common NTUPLEs have been created. Using the DST files a corresponding Ntuples have been written according to the B-group format [6]. Some words were added to this format with muon track information in the FDC system. The overall format description of the Ntuple can be found in:

$$D0FNAL :: SSC1 : [TMP50.SAMUS.NTUPLE]$$

According to the news from the Luminosity Group [5] luminosity data are fixed and one can use the following luminosity errors:

- The Run 1A luminosity error is 5.4%.
- The Run 1B/1C(1800) luminosity error is 5.3%.
- The Run 1C(630) luminosity error is 3.1%.
- One no longer need to make any corrections to the luminosity numbers obtained from the PDB unless one have triggers with an MIFLAG=1 term or triggers without L0.

3 RUN Ia SAMUS data description

After BSM stream around $\approx 30k$ events have been written to tapes.

There are μDST data for $RUN\ 1a$.

The $RUN\ Ia$ catalog is in:

$$DST\_STRM\_SUMMARY\_IA.list$$

and all other Ia information is stored in:

$$ALPHA :: PRJ\$ROOT335 : [MUB\_1.BABINTSEV.DATA.RUN1A]$$

Small part of the data has been collected with the SAMUS trigger: MU_2_JET.

4 RUN Ib SAMUS data description

As it was mensioned there are two samples in the RUN I data: "OLD" and "NEW" ones. Efficiency of muon detection with old L1.5 trigger tables is less than that with the new L1.5 trigger tables. NEW trigger tables have a factor of 1.7 [3] higher efficiency.

4.1 "OLD" data sample

All information about "OLD" data is stored in:

$$ALPHA :: PRJ\$ROOT335 : [MUB\_1.BABINTSEV.DATA.OLD]$$

RUN Ib started from Run 72847, 'normal' muon data are started from Run 75321.

Triggers selecting events with muons in SAMUS are listed in Table 4. Some triggers are different only by the conditions of muon tracking procedure.

A lot of parameters are valuable for WAMUS only. In the case of SAMUS, some triggers are similar, nevertheless all of them are written below (and in trigger tables).

Trigger tables contain the most important information for SAMUS:

- N_μ means the requirement of one or more muons at the trigger level;
- *Vertex* means the requarement on the number of vertex at L0;
- *Cal.* means the requirement on calorimeter confirmation at L2;
- P_T means the requirement on P_T value of muon at L2

Trigger names correspond to names of triggers (L1) and filters (L2):
left-shifted names correspond to $L1\&L2$-names and right-shifted names are filter names only. The full trigger description can be found in

$$ALPHA :: PRJ\$ROOT335 : [MUB\_1.BABINTSEV.DATA.HISTORY]$$

During events selection event repetion occured due to the presence of different versions of reconstruction program. It is neccessary to check the presence of event dublication during data analysis.

Information about tapes and data is presented in the file

$$PRJ\$ROOT335 : [MUB\_1.BABINTSEV.DATA.CKLAD]ARCHIVES.LIST$$

The luminosity tables were created only for the latest version of the reconstruction program. For example, the RECO version 12.10 was deleted entirely. If a Run-list contained files with different RECO versions the oldest versions were cut off at all.

In Table 5 the integrated luminosity for each trigger is presented. Integrated luminosity for each run is in the files:

$$ALPHA :: PRJ\$ROOT335 : [MUB\_1.BABINTSEV.DATA.OLD]TRIG * .LIST$$

Table 4: The list of global SAMUS triggers

Version (trig.list)	Trigger name (L1) & (L2)	N_μ (L1.5)	N_μ (L2)	Vertex	Cal.	$P_T(L2)$ (GEV)
8.5	mu_1_em_jet	1	1	1	no	10.0
	mu_1_lo_jet	1	1	1	no	3.0
	dimu_lo_jet	1	2	1	no	3.0
	junk_1_lo_jet	1	1	1	no	1.0E6
	mu_2_lo_jet	1	2	1	no	3.0
	junk_2_lo_jet	2	2	1	no	1.0E6
	mu_1_jet_mon	2	2	no	no	3.0
8.6	mu_1_lo_jet	1	1	1	yes	3.0
	dimu_lo_jet	1	2	1	yes	3.0
	junk_1_lo_jet	1	1	1	yes	1.0E6
	mu_2_lo_jet	1	2	1	yes	3.0
	junk_2_lo_jet	2	2	1	yes	1.0E6
	mu_1_jet_mon	1	1	no	no	3.0
8.7	mu_1_lo_jet	1	1	no	yes	3.0
	dimu_lo_jet	1	2	no	yes	3.0
	mu_2_lo_y4	1	2	no	yes	3.0
	mu_1_low	1	1	no	no	3.0
9.0	mu_1_lo_jet	1	1	1	yes	3.0
9.1	dimu_lo_jet	1	2	1	yes	3.0
	mu_2_lo_y4	1	2	1	yes	3.0
	mu_1_low	1	1	no	no	3.0
9.2	mu_1_lo_jet	1	1	1	yes	3.0
	dimu_lo_jet	1	2	1	yes	3.0
	mu_2_lo_y4	1	2	1	yes	3.0
	mu_1_low	1	1	no	yes	1.0
	mu_1_nocal_low	1	1	no	no	1.0
10.0	mu_1_lo_jet	1	1	1	yes	1.0
10.1	dimu_lo_jet	1	2	1	yes	1.0
10.2	mu_2_lo_y4	1	2	1	yes	1.0
	mu_1_low	1	1	1	yes	3.0
	mu_1_low_noscint	1	1	1	yes	3.0
	mu_1_low_nocal	1	1	1	no	3.0
	mu_1_low_good	1	1	1	yes	3.0
	mu_1_low_trkall	1	1	1	yes	3.0

Table 5: Integrated luminosity (nb^{-1}) per trigger

L2 trigger name	Version 8.5	Version 8.6	Version 8.7, 9.0, 9.1	Version 9.2	Version 10.0, 10.1, 10.2
$MU\_1\_EM\_JET$	761.7	-	-	-	-
$MU\_1\_LO\_JET$	689.9	454.8	4886.2	594.8	5458.4
$DIMU\_LO\_JET$	689.9	454.8	4886.2	1189.6	5517.8
$JUNK\_1\_LO\_JET$	689.9	454.8	-	-	-
$MU\_2\_LO\_JET$	732.2	465.3	-	-	-
$JUNK\_2\_LO\_JET$	732.2	465.3	-	-	-
$MU\_1\_JET\_MON$	29.2	16.0	-	-	-
$MU\_2\_LOW\_Y4$	-	-	2688.1	546.6	4196.2
MU_1_LOW	-	-	373.6	137.6	257.2
$MU\_1\_NOCAL\_LOW$	-	-	-	27.5	-
$MU\_1\_LOW\_NOSCINT$	-	-	-	27.5	12.9
$MU\_1\_LOW\_NOCAL$	-	-	-	27.5	12.9
$MU\_1\_LOW\_GOOD$	-	-	-	27.5	12.9
$MU\_1\_LOW\_TRKALL$	-	-	-	27.5	2.6

4.2 NEW data sample

Information about "NEW" data is stored in:

$$ALPHA :: PRJ\$ROOT335 : [MUB\_1.BABINTSEV.DATA.NEW]$$

This part of muon data starts from Run 89329 and contains two samples of high energy data: *RUN Ib* and *RUN Ic*.

Triggers selecting events with muons for *RUN Ib* in SAMUS are listed in Table 6. Trigger names correspond to names of triggers (L1) and filters (L2):
left-shifted names correspond to $L1\&L2$-names and right-shifted names are filter names only. The full trigger description can be found in

$$ALPHA :: PRJ\$ROOT335 : [MUB\_1.BABINTSEV.DATA.HISTORY]$$

Table 6: The list of the global SAMUS triggers (RUN Ib)

Version *(trig.list)*	Trigger name (L1) & (L2)	N_μ (L1.5)	N_μ (L2)	Vertex	Cal.	$P_T(L2)$ (GeV)
10.2	mu_1_lo_jet	1	1	1	yes	1.0
10.4	dimu_lo_jet	1	2	1	yes	1.0
	mu_2_lo_y4	1	2	1	yes	1.0
	mu_1_low	1	1	1	yes	3.0
	mu_1_low_noscint	1	1	1	yes	3.0
	mu_1_low_nocal	1	1	1	no	3.0
	mu_1_low_good	1	1	1	yes	3.0
	mu_1_low_trkall	1	1	1	yes	3.0
10.5	mu_1_lo_jet	1	1	1	yes	1.0
	dimu_lo_jet	1	2	1	yes	1.0
	mu_2_lo_y4	1	2	1	yes	1.0
10.6	mu_1_lo_jet	1	1	1	yes	1.0
	dimu_lo_jet	1	2	1	yes	1.0
	mu_2_lo_y4	1	2	1	yes	1.0
	mu_1_low	1	1	1	yes	3.0
	mu_1_low_noscint	1	1	1	yes	3.0
	mu_1_low_nocal	1	1	1	no	3.0
	mu_1_low_good	1	1	1	yes	3.0
	mu_1_low_trkall	1	1	1	yes	3.0

The triggers for the *RUN Ic* data are presented in Table.7

All events for *RUN Ic* were selected from data-base as DST files without any quality cuts and whithout using BSM stream. The luminosity tables are given taking into account all information about the Runs. For example, for all 'bad' Runs the integrated luminosity equals to zero.

Table 7: The list of the global SAMUS triggers (RUN-Ic)

Version (trig.list)	Trigger name (L1) & (L2)	N_μ (L1.5)	N_μ (L2)	Vertex	Cal.	$P_T(L2)$ (GeV)
10.6	mu_1_lo_jet	1	1	1	yes	1.0
	dimu_lo_jet	1	1	1	yes	1.0
	mu_2_low_y4	1	2	1	no	3.0
	mu_1_low	1	1	1	yes	3.0
	mu_1_low_noscint	1	1	1	yes	3.0
	mu_1_low_nocal	1	1	1	no	3.0
	mu_1_low_good	1	1	1	yes	3.0
	mu_1_low_trkall	1	1	1	yes	3.0
11.0	mu_2_low_y4	1	2	1	yes	1.0
11.1	mu_1_low	1	1	1	yes	1.0
11.2	mu_1_low_noscint	1	1	1	yes	1.0
	mu_1_low_nocal	1	1	1	no	1.0
	mu_1_low_good	1	1	1	yes	1.0
	mu_1_low_trkall	1	1	1	yes	1.0

Table 8: Integrated luminosity (nb^{-1}) per trigger

Trigger name	Version 10.2-10.4	Version 10.5	Version 10.6	Version 11.0-11.2
MU_1_LO_JET	1339.9	1063.4	291.8	-
DIMU_LO_JET	1341.7	1063.4	291.8	-
MU_2_LOW_Y4	1330.5	720.3	209.3	1755.4
MU_1_LOW	59.7	-	9.3	79.4
MU_1_LOW_NOSCINT	3.0	-	0.5	4.0
MU_1_LOW_NOCAL	3.0	-	0.5	4.0
MU_1_LOW_GOOD	3.0	-	0.5	4.0
MU_1_LOW_TRKALL	0.6	-	0.1	0.8

5 Low energy SAMUS data sample (630 GeV)

Information about SAMUS low energy data is stored in:

$$ALPHA :: PRJ\$ROOT335 : [MUB\_1.BABINTSEV.DATA.LOW]$$

This part of muon data includes Runs from 94874 untill 95389.
Triggers selecting events with muons in SAMUS are listed in Table 9.

Table 9: The list of the global SAMUS triggers (630 GeV)

Version (trig.list)	Trigger name (L1) & (L2)	N_μ (L1.5)	N_μ (L2)	Cal.	$P_T(L2)$ (GeV)
L10.0	mu_1_samn-lnr	1	1	yes	1.0
L20.0	mu_1_samn-lnr	1	1	yes	1.0
L30.0	mu_1_samn-lnr	1	1	yes	1.0
L30.1	mu_1_sams-lnr	1	1	yes	1.0

All events for this part of data were selected from data-base as DST files without any quality cuts for muons in SAMUS. That is why the Ntuples contain all recontsructed muons in SAMUS. All 'bad' Runs are not written to the Ntuple. Information about 'bad' Runs is spred in the catalog list and in the selecting code of the Ntuple program.

The integrated luminosity for each of two SAMUS triggers for this part of data taking equals to 566 nb^{-1}.

Monte Carlo simulation and comparison with real muon data for low energy interaction one can be found in [8].

The initial muon distribution is described as follows:

$$f(\mu) = A1 * exp(b1 * P_T^\mu) + A2 * exp(b2 * P_T^\mu)$$

where $A1, A2, b1, b2$ parameters are tuned to the data.

These muons have been passed through 'standart' simulation procedure. They were passed through the GEANT simulation, then they were mixed with MINIBIAS events (seperately for the North and South arms with the corresponding MB events) to take into account the background hits in muon detectors. Mixed events passed trigger simulation (L1-L15-L2) procedure and reconstructed.

Simulated events are written into NTUPLEs files. Format of these files is described in the above mensioned area.

6 Dimuon SAMUS data sample

With the aim to study events with two muons (J/ψ analysis) these events were selected as a separate data sample. This sample contains only data from *RUN Ib*.

Information about two-muon data can be found in:

$$ALPHA :: PRJ\$ROOT335 : [MUB\_1.BABINTSEV.DATA.DIMU]$$

All events with two or more SAMUS tracks from *RUN Ib* have been extracted and written to tapes. The corresponding trigger names and the integrated luminosity is presented in table 10 [9].

Table 10: Dimuon Integrated Luminosity

Trigger	Trigger name	Level 1.5 tables	P_T cut at L2 GeV/c	$\int Ldt, pb^{-1}$
Single muon	mu_1_low	"OLD"	3.0	0.70
Single muon	mu_1_low	"NEW"	3.0	0.07
Dimuon	mu_2_low_y4	"OLD"	3.0	2.90
Dimuon	mu_2_low_y4	"OLD"	1.0	3.90
Dimuon	mu_2_low_y4	"NEW"	1.0	2.23

There are Ntuples for all selected dimuon events and for selected J/ψ events:

$$ALPHA :: PRJ\$ROOT335 : [MUB\_1.BABINTSEV.DATA.CKLAD]$$

Efficiency has been calculated using simulated J/ψ events. The original J/ψ distribution was simulated in the momentum range of (1-1000) GeV with the exponential distribution

$$EXP(-0.2 * P_T^{J/\psi})$$

and uniformly distributed along ϕ and η variables.

These simulated events have been reconstructed according to the standart procedure: they passed GEANT simulation, MIXed with MiniBias events, passed trigger simulation and RECOnstructed. Monte Carlo results have been written to DST and Ntuples (see DIMU area).

7 Miscellaneous.

SAMUS library contains also additional information usefull for physics analysis:

$$ALPHA :: PRJ\$ROOT335 : [MUB\_1.BABINTSEV.DATA.CKLAD]$$

These data contain information about MB events, "Mark and Pass" events and simulated events.

In "Mark and Pass" Runs events have been sent to tape regardless of the calculated L2 result (to check Level 2 efficiency).

Using Ntuple data one can select and analalize muon-unbiased events, i.e. events selected by triggers without muon trigger system. Using these data one can define SAMUS trigger efficiency.

References

[1] H.T.Diehl, D0 Note 1887 (1993), "Level 2 muon filter in RUN-1A"

[2] A.Kozelov, D0 Note 2768 (1995), "SAMUS muon background"

[3] P.Z.Quintas,D.Vititoe, D0 Note 2680 (1995), "History of muon trigger L1 and L1.5 hardware and L2 code and status of offline simulations for RUN 1B"

[4] P.Z.Quintas, M.Fortner, R.Markeloff, D0 Note 2555 (1995), "Changes to muon L2 in Spring 1995"

[5] " News 5178 in D0.GENERAL", 31-JUL-1997

[6] " News 302 in D0.B-PHYSICS ", 28-SEP-1996

[7] P.Z.Quintas, M.Fortner, R.Markeloff, D0 Note 2251 (1994), "What's new in L2: changes in muon code with version 7"

[8] V.Babintsev, A.Kozelov, D0 Note 3300 (1997), "SAMUS performance in background environments"

[9] S.Chekulaev, D.Denisov, O.Eroshin et al., D0 Note 3205 (1997), "Correction of SAMUS multiplicity cut efficiency"