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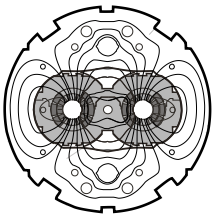

Large Hadron Collider

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LHC Data Exchange

DATA EXCHANGE BETWEEN THE EXPERIMENTS AND THE LHC - DATA EXCHANGE FOR REPORTING EXPERIMENTAL CONDITIONS

Abstract

This document describes the data to be exchanged for the purpose using in the fixed displays on Experimental Conditions

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History of Changes

Rev. No.	*Date*	*Pages*	*Description of Changes*
1	***8/2/2011***	***15***	**- This document replaces EDMS document 1026129, and is updated for the 2011 run.**
1.1	***9/2/2011***	***15***	**- Corrected typo for Ions Lumi publication and removed duplicate publication of the Luminous region**
1.2	***10/2/2011***	***15***	**- Created a separated publication for the bunch arrays of the Luminous Region, as this simplifies the publication within PVSS** **- Corrected the definition of the WrongBucketArray description; it is a fixed length array**

Table of Contents

1. INTRODUCTION

This document is to specify the details of the data exchange from the Experiments to the Experimental Conditions Fixed Display.

2. DATA STRUCTURE AND NAMING CONVENTIONS

2.1 DATA STRUCTURE WITHIN DIP

Data should be published to a specific folder structure within DIP. For the data made available by the Experiments, the data in the LHC sub-folder is considered as validated and released for use outside the experiment. Within the this DIP directory structure, the following subdirectory structure is imposed:

dip/*EXPT*/LHC
- ./ExptStatus
- ./BKGD
- ./IntensitiesPerBunch
- ./Luminosity
- ./LumiPerBunch
- ./LumiScanN (N = 0,1,2,3,...)
- ./FillLumi
- ./FillSummary
- ./LuminousRegion
- ./AbortGap
- ./Handshake/*EXPT*_INJECTION
- ./Handshake/*EXPT*_ADJUST
- ./Handshake/*EXPT*_BEAMDUMP
- ./Timing

In addition, data that is specific to an individual experiment can be published in the following directory (again *EXPT* is the experiment in question)

dip/*EXPT*/LHC/Specific

2.1.1 DATA STRUCTURE OF DATA PUBLISHED

All data published by the experiments should adhere to a set ofrequirements, so that the data can be correctly understood and logged. For each publication, the following should be defined:

- Data values: type and format
- Acquisition Time stamp: All data should have a corresponding time stamp. For this time stamp there are two possibilities:
  - **No user defined time stamp [Default case]:** In this case, a timestamp is assigned that corresponds to the DIP publishing time for the data. The resolution on this time stamp is at the millisecond level.
  - **User defined Time Stamp:** The user defines an explicit time stamp that is published in conjunction with the publishing of a data value. This timestamp is then at the accuracy and precision set by the user, and is normally used only for data where the time stamping is critical.

- If data *ITEM* within a publication has a specific timestamp, this should be tagged as *ITEM*_Timestamp.

- Units: Text field: String that gives a description of data.

In addition, when supplying new publications, the documentation should also include:

- If the data is a text field, all possible values should be enumerated
- The update policy: either on change or a fixed refresh rate. It is assumed that the maximum refresh rate is 1 Hz (ie the standard DIP publishing rate)

2.1.2 DIP QUALITY FLAG FOR DATA

DIP publications have an associated quality flag, which is used to represent the state of availability and correctness of the data source. Be aware that whenever a publication has a data quality flag = BAD, the republishing of the data to the controls middleware created an exception that is written to a log file. As such, it is recommended that the DIP quality flag = BAD is only used when there is a problem with the data source.

3. STANDARD DATA STRUCTURE - ALL EXPERIMENTS

For all experiments, the operation is expecting a "standard set of data to be published to DIP. This will then be republished to CMW for use by the LHC Operations applications. All data that is republished to CMW will be logged into the LHC logging data base.

For the format of the standard data that the experiments should publish, the following tables outline the format. Note that the lines in grey are the DIP items in the DIP/EXPT/LHC sub-domain, and the lines in white are the values associated with the item.

For Luminosity related publications, there are different publication streams defined for the different particle types (Lumi Epochs). At present there is foreseen a different set of luminosity publications for protons and for Ions

For clarity, please note the following conversion factors for Luminosity units:

1 $x10^{30}xcm^{-2}s^{-1}$ = 1 Hz/ub
1 $x10^{24}xcm^{-2}s^{-1}$ = 1 Hz/b
1 $x10^{33}xcm^{-2}$ = 1 nb^{-1}
1 $x10^{36}xcm^{-2}$ = 1 pb^{-1}

3.1 LUMINOSITY DATA - PROTONS

Name	Format	Description	Units	Refresh
dip/*EXPT*/LHC/Luminosity				
Lumi_TotInst	Float	Total instantaneous luminosity summed over all bunches	Hz/ub	Hz
Source	string	Details on source, coincidence mode etc	None	On Change
CollRate	double	collision rate (if possible published at 1Hz as for the BRAN)	Hz	To be clarified
CollRateErr	double	error on the acquisition	Hz	To be clarified

CollRateIntTime	double	integration time per acquisition in seconds (used to derive dN/dt).	s	On Change
CollRateSource	String	Description of the source (monitor name)	None	On Change
dip/*EXPT*/LHC/LumiPerBunch				
Lumi_BunchInst	Float [3564]	Array of floats of calibrated instantaneous bunch by bunch luminosity measurements Note that a bunch in bucket 1 would be entered as the first entry in the array (array index =0)	Hz/ub	Interval 1 per minute
Source	string	Details on source, coincidence mode etc		On Change

3.2 LUMINOSITY DATA - IONS

Name	Format	Description	Units	Refresh
dip/*EXPT*/LHC/LuminosityIons				
Lumi_TotInst	Float	Total instantaneous luminosity summed over all bunches	Hz/b	Hz
Source	string	Details on source, coincidence mode etc	None	On Change
CollRate	double	collision rate (if possible published at 1Hz as for the BRAN)	Hz	To be clarified
CollRateErr	double	error on the acquisition	Hz	To be clarified
CollRateIntTime	double	integration time per acquisition in seconds (used to derive dN/dt).	s	On Change
CollRateSource	String	Description of the source (monitor name)	None	On Change
dip/*EXPT*/LHC/LumiPerBunchIons				
Lumi_BunchInst	Float [3564]	Array of floats of calibrated instantaneous bunch by bunch luminosity measurements Note that a bunch in bucket 1 would be entered as the first entry in the array (array index =0)	Hz/b	Interval 1 per minute
Source	string	Details on source, coincidence mode etc		On Change

3.3 LUMINOUS REGION

Name	Format	Description	Units	Refresh
dip/*EXPT*/LHC/LuminousRegion				
Size	Float[3]	Horizontal, Vertical and logitudinal size of luminous region	um,um,mm	Interval
Centroid	Float[3]	Centroid of luminous region	um,um,mm	Interval
Tilt	Float[2]	horizontal (dx/dz) & vertical (dy/dz) luminous tilt angles	urad	Interval
dip/*EXPT*/LHC/LuminousRegionPerBunch				
BunchSize_X	Float[3564]	Bunch array of size of luminous region	um	Interval
BunchCentroid_X	Float[3564]	Bunch array of X Centroid of luminous region	um	Interval
BunchSize_Y	Float[3564]	Bunch array of Y size of luminous region	um	Interval
BunchCentroid_Y	Float[3564]	Bunch array of Y Centroid of luminous region	um	Interval
BunchSize_Z	Float[3564]	Bunch array of Z size of luminous region	mm	Interval
BunchCentroid_Z	Float[3564]	Bunch array of Z Centroid of luminous region	mm	Interval

3.4 LUMINOSITY SCAN DATA

dip/*EXPT*/LHC/LumiScan# (# if several sources)

CollRate	double	collision rate (if possible published at 1Hz as for the BRAN)	Hz	To be clarified
CollRateErr	double	error on the acquisition	Hz	To be clarified
IntTime	double	integration time per acquisition in seconds (used to derive dN/dt).	s	On Change
Source	String	Description of the source (monitor name)	None	On Change
Preferred	Boolean	If several sources, flag to tag which measurement we should rely on for optimization	None	On Change

3.5 BACKGROUNDS DATA

dip/*EXPT*/LHC/BKGD				
BKGD1	double	Primary Bkgd indicator . Nominal range: 0-100	None	1Hz
BKGD1_Source	String	Description of data source	None	On Change
BKGD2	double	Secondary Bkgd indicator. Nominal range: 0-100	None	1Hz
BKGD2_Source	String	Description of data source	None	On Change
BKGD3	double	Fraction of abort thershold. Nominal range: 0-100	None	1Hz
BKGD3_Source	double	Description and limits of abort threshold	None	On Change

3.6 EXPERIMENT STATUS AND HANDSHAKES

dip/*EXPT*/LHC/ExptStatus				
Status	String	State of Experiment. Values: OFF, CALIBRATION, NOT READY, STANDBY, PHYSICS.	None	On Change
dip/*EXPT*/LHC/Handshake/EXPT_INJECTION				
__DIP_DEFAULT__	String	Values: VETO, PREPARE, READY, PROBLEM	None	On Change
dip/*EXPT*/LHC/Handshake/EXPT_ADJUST				
__DIP_DEFAULT__	String	Values: VETO, PREPARE, READY, PROBLEM	None	On Change
dip/*EXPT*/LHC/Handshake/EXPT_BEAMDUMP				
__DIP_DEFAULT__	String	Values: VETO, PREPARE, READY, PROBLEM	None	On Change

3.7 BEAM PROPERTIES AS MEASURED BY THE EXPERIMENTS

dip/*EXPT*/LHC/IntensitiesPerBunch				
Beam1	Float [3564]	Bunch intensities.Note that a bunch in RF bucket 1 would be entered as the first entry in the array (array index =0)	None	Interval
Beam2	Float [3564]	Bunch intensities. Note that a bunch in RF bucket 1 would be entered as the first entry in the array (array index =0)	None	Interval

3.8 DELIVERED LUMINOSITY AND SUMMARY DATA - PROTONS

dip/*EXPT*/LHC/FillLumi

IntLumi_Delivered_StableBeams	Float	IntLum_DeliveredTotal_StableBeams: accumulates only while stable-beam flag is on; not dead-time corrected, and independent of DAQ state. Summed over all bunch pairs that collide at IP.	nb^{-1}	Interval
IntLumi_Recorded	Float	IntLumi_Recorded: accumulates when *EXPT* is taking data and is a dead-time corrected value. Contributions to this quantity are restricted to those bunch crossing IDs that the EXPT triggers on.	nb^{-1}	Interval
dip/*EXPT*/LHC/FillSummary				
FillNumber	Int	This field is only updated once per fill, and the update occurs when the fill number is changed, and the value published is the fill number of the fill that has just been completed	None	On Change - Once per fill
Delivered_Lumi	Float	Delivered Lumi for the fill defined by FillNumber. This field is only updated once per fill, and the update is triggered by the setting of the Beammode to BEAMDUMP.	nb^{-1}	On Change - Once per fill
Recorded_Lumi	Float	Recorded Lumi for the fill defined by FillNumber. This field is only updated once per fill, and the update is triggered by the setting of the Beammode to BEAMDUMP.	nb^{-1}	On Change - Once per fill
Peak_Inst_Lumi	Float	Peak Instantaneous Luminosity during STABLE BEAMS for the fill defined by FillNumber. This is essentially the maximum value of Lumi_TotInst during the course of the fill. This field is only updated once per fill, and the update is triggered by the setting of the Beammode to BEAMDUMP.	Hz/ub	On Change - Once per fill
FS_TimeStamp		Time stamp for the setting of the fill number for the fill which the summary data is represents. The time stamp is as published by the LHC over DIP. This field is only updated once per fill, and the update is triggered by the setting of the Beammode to BEAMDUMP.		

3.9 DELIVERED LUMINOSITY AND SUMMARY DATA - IONS

dip/*EXPT*/LHC/FillLumiIons				
IntLumi_Delivered_StableBeams	Float	IntLum_DeliveredTotal_StableBeams: accumulates only while stable-beam flag is on; not dead-time corrected, and independent of DAQ state. Summed over all bunch pairs that collide at IP.	mb^{-1}	Interval
IntLumi_Recorded	Float	IntLumi_Recorded: accumulates when *EXPT* is taking data and is a dead-time corrected value. Contributions to this quantity are restricted to those bunch crossing IDs that the EXPT triggers on.	mb^{-1}	Interval
dip/*EXPT*/LHC/FillSummaryIons				
FillNumber	Int	This field is only updated once per fill, and the update occurs when the fill number is changed, and the value published is the fill number of the fill that has just been completed	None	On Change - Once per fill
Delivered_Lumi	Float	Delivered Lumi for the fill defined by FillNumber. This field is only updated once per fill, and the update is triggered by the setting of the Beammode to BEAMDUMP.	mb^{-1}	On Change - Once per fill
Recorded_Lumi	Float	Recorded Lumi for the fill defined by FillNumber. This field is only updated once per fill, and the update is triggered by the setting of the Beammode to BEAMDUMP.	mb^{-1}	On Change - Once per fill
Peak_Inst_Lumi	Float	Peak Instantaneous Luminosity during STABLE BEAMS for the fill defined by FillNumber. This is essentially the maximum value of Lumi_TotInst during the course of the fill. This field is only updated once per fill, and the update is triggered by the setting of the Beammode to BEAMDUMP.	Hz/b	On Change - Once per fill
FS_TimeStamp		Time stamp for the setting of the fill number for the fill which the summary data is represents. The time stamp is as published by the LHC over DIP. This field is only updated once per fill, and the update is triggered by the setting of the Beammode to BEAMDUMP.		On Change - Once per fill

3.10 ABORT GAP MONITORING

dip/*EXPT*/LHC/AbortGap/Beam1				
Population	Float	Number of protons in the abort gap (in units of 10^8). The abort gap is defined as runnning from RF bucket 34440 to 35640	None	Interval
Warning	Boolean	Flag to indicate the Expt sees a problem with particles in the abort gap	None	On Change
dip/*EXPT*/LHC/AbortGap/Beam2				
Population	Float	Number of protons in the abort gap (in units of 10^8). The abort gap is defined as runnning from RF bucket 34440 to 35640	None	Interval
Warning	Boolean	Flag to indicate the Expt sees a problem with particles in the abort gap	None	On Change

3.11 TIMING DATA DATA

dip/*EXPT*/LHC/Timing/BPTX1

Phase	Float	Time difference of time(BPTX1) - time(BCmain) + offset. BCmain is definded as the clock that each experiment decides to use to run its electronics. Offset is set at the start of running	ns	0.1- 0.3 Hz
PhaseErr	Float	The RMS on the measurement of Phase	ns	0.1- 0.3 Hz
wrongBucketFlag	Boolean	Flag indicating if the observed bunch pattern is not as expected. wrongBucketFlag = True means that the bunch pattern was not what was expected.	None	On Change
wrongBucketArray	Int[3564]	Inetger array of RF bucket numbers for all locations where the bunch configuration is not as expected. A positive entry in the array idicates that a bunch was observed at the given RF bucket when none was expected, and a negative entry in the array idicates that a bunch was missing at the given RF bucket when one was expected. If there are no irregularities, the wrongBucketArray should be an array of 3564 zeros.	None	On Change
dip/*EXPT*/LHC/Timing/BPTX2				
Phase	Float	Time difference of time(BPTX2) - time(BCmain) + offset. BCmain is definded as the clock that each experiment decides to use to run its electronics. Offset is set at the start of running	ns	0.1- 0.3 Hz
PhaseErr	Float	The RMS on the measurement of Phase	ns	0.1- 0.3 Hz
wrongBucketFlag	Boolean	Flag indicating if the observed bunch pattern is not as expected. wrongBucketFlag = True means that the bunch pattern was not what was expected.	None	On Change
wrongBucketArray	Int[3564]	Inetger array of RF bucket numbers for all locations where the bunch configuration is not as expected. A positive entry in the array idicates that a bunch was observed at the given RF bucket when none was expected, and a negative entry in the array idicates that a bunch was missing at the given RF bucket when one was expected. If there are no irregularities, the wrongBucketArray should be an array of 3564 zeros.	None	On Change
dip/*EXPT*/LHC/Timing/BPTX				
deltaT	Float	time(BPTX1) - time(BPTX2). The value published is is an average over all bunch pairs that are supposed to collide at the given IP.	ns	0.1-0.31Hz
deltaTErr	Float	The RMS on the measurement of deltaT	ns	0.1- 0.3 Hz

4. DETAILS ON DATA FROM THE MACHINE

4.1 LUMINOSITY FROM THE MACHINE

The LHC provides measurement of the luminosity via the BRAN system. The value of the absolute luminosity for the 4 interaction points are quite different. This means that the number of particles arriving on the BRAN detectors will be very different. At ATLAS and CMS the detector will be a fast ionization chamber, and at ALICE and LHC-B the detector will be based on solid state polycrystalline Cadmium-Telluride (CdTe) sensors.

For the luminosity measurements the the data reported from the BRANs is the luminosity per 1 second interval. All luminosity numbers are calibrated and corrected.
FESA properties available for OP:

Acquisition [notified at 1 Hz – synchronized with all devices] :

meanLuminosity: luminosity counter (in coincidence mode or not) * scalingfactor
meanCrossingAngle : not implemented yet, always returning 0.
acqMode : Type of acquisition (coincidence mode or not)

BunchByBunchAcquisition [notified at 0.1 Hz – synchronized with all devices] :
bunchByBunchLuminosity: array of luminosity counter (in coincidence mode or not) * scalingfactor per bunch [size = 3564]
acqMode : Type of acquisition (coincidence mode or not)

Settings
factorLuminosityNoCoinc: conversion between counter and luminosity [no coincidence]
factorLuminosityCoinc: conversion between counter and luminosity [coincidence]

4.1.1 BRASCLHC- THE CDTE SENSORS

These devices are located at Pts 2 and 8 and the following details are relevant

Pt 2: Device : LHC.BRANB.4L2
Device : LHC.BRANB.4R2
Pt 8: Device : LHC.BRANB.4L8
Device : LHC.BRANB.4R8

4.1.2 BRASGLHC: THE FAST IONIZATION CHAMBER

These devices were located at Pts 1 and 5 and the following details are relevant:

Pt1: Device : LHC.BRANA.4L1
Device : LHC.BRANA.4R1
Pt 5: Device : LHC.BRANA.4L5
Device : LHC.BRANA.4R5

4.1.3 BRASPMLHC: THE PHOTOMULTIPLIER READOUT

These devices were located at Pts 1 and 5 and were used for the 2010 run. The devices are:

Pt 1: Device : LHC.BRANP.4L1
Device : LHC.BRANP.4R1
Pt 5: Device : LHC.BRANP.4L5
Device : LHC.BRANP.4R5

These have been removed in the 2010-2011 technical stop and are not longer available.

4.2 VACUUM PRESSURE READINGS

The vacuum pressure readings in the straight sections around the IRs are available in TIMBER, but as requested by ATLAS a set of pressure readings are published to DIP. The published pressure readings are:

4.3 OTHER SIGNALS

The RFRX data is published to DIP by the timing system and so does not need to be republished by the experiments. The details of the RFRX data will be added to this document.

Machine quantities such as Energy, beam intensities etc will be read directly from the LHC systems. Please check the following DIP directory

dip/acc/LHC

The experiment inputs into the Beam Interlock system (including the Injection inhibit) are read directly from the Beam Interlock System, and so do not need to be published via DIP.

4.4 SIGNALS TO BE ADDED

Pileup indicator: The experiments have been asked to see if a pileup indicator can published. Agreement on what is to be published is still to be reached.

To be investigated: publication of data on LHCb's beam gas for individual beam positions and angles. This still has to be discussed with LHCb.

5. DETAILS ON ADDITIONAL DATA FROM THE EXPERIMENTS

5.1 BACKGROUNDS

All background numbers published by the experiments should be normalised, with the expected normalised data range to be a loose percentage (ie 0 to 100), where 100% is equivalent to unacceptable conditions/beam dump threshold. The range should be open ended at the top to allow for overshoots on the signals. For no reading a value of -1 should be assigned.

Due to differences between the experiments, the meaning of the background numbers cannot be exactly the same for each experiment. However it is requested that the 3 BKGD numbers from each experiment follow the general outline given below:

BKGD1: Background (+collision products) from the inner detector region

BKGD2: Halo related background

BKGD3: Percentage of Experiment input to the BIS, wrt to the dump threshold

All experiments are expected to publish a minimum of 3 background signals, but may also provide additional signals to the fixed displays. These additional signals should also be published in the dip/EXPT/LHC/Beam/Backgrounds folder, and should follow the naming scheme and format as BKGD1

dip/EXPT/LHC/BKGD/BKGD4

dip/EXPT/LHC/BKGD/BKGD5

dip/EXPT/LHC/BKGD/BKGD6

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dip/EXPT/LHC/BKGD/BKGDN

5.2 LUMINOSITY SCANS

Data from from luminosity scans is to be published/stored elsewhere, but once the format of the data is defined, summary results can be made available in CMW for use in the fixed displays. These summary scan results wold not be logged as part of the Fixed display logging

6. ADDITIONAL DATA FROM ATLAS

Nothing yet

7. ADDITIONAL DATA FROM ALICE

dip/ALICE/LHC/Specific/Target_InstLumi				
Target	Float	Desired target instantaneous luminosity	$(ub.s)^{-1}$	On Change
dip/ALICE/LHC/Handshake/ALICE_TI2_SETUP				
__DIP_DEFAULT__	String	Values: VETO, PREPARE, READY, PROBLEM	None	On Change

8. ADDITIONAL DATA FROM CMS

dip/*EXPT*/LHC/BKGD				
BKGD4	double	Bkgd indicator	None	1Hz
BKGD4_Source	String	Description of data source	None	On Change
BKGD5	double	Bkgd indicator	None	1Hz
BKGD5_Source	String	Description of data source	None	On Change
BKGD6	double	Bkgd indicator	None	1Hz
BKGD6_Source	double	Description of data source	None	On Change
BKGD7	double	Bkgd indicator	None	1Hz
BKGD7_Source	String	Description of data source	None	On Change
BKGD8	double	Bkgd indicator	None	1Hz
BKGD8_Source	String	Description of data source	None	On Change
BKGD9	double	Bkgd indicator	None	1Hz
BKGD9_Source	double	Description of data source	None	On Change
BKGD10	double	Bkgd indicator	None	1Hz
BKGD10_Source	double	Description of data source	None	On Change

9. ADDITIONAL DATA FROM LHCB

dip/LHCB/LHC/Specific/Velo				
Gap	Float	Gap size	mm	On Change
Position	String	Position of the VELO	ns	On Change
dip/LHCB/LHC/Handshake/LHCB_TI8_SETUP				
__DIP_DEFAULT__	String	Values: VETO, PREPARE, READY, PROBLEM	None	On Change

10. ADDITIONAL DATA FROM TOTEM

Nothing yet

11. ADDITIONAL DATA FROM LHCF

See EDMS document # 969919 [1] for the definition of what data was defined for LHCf. The Experiment is no longer active, and so no data is received over DIP.

12. NAMES OF VARIABLES IN MEASUREMENT DATABASE

dip/*EXPT*/LHC/*EXPT*/ExptStatus	*EXPT*:EXPT_STATUS
dip/*EXPT*/LHC/*EXPT*/Luminosity/Lumi_Tot_Inst	*EXPT*:LUMI_TOT_INST
dip/*EXPT*/LHC/*EXPT*/Luminosity/Lumi_Vertex_Count	*EXPT*:LUMI_VERTEX_COUNT
dip/*EXPT*/LHC/*EXPT*/Luminosity/Lumi_Collision_Rate	*EXPT*:LUMI_COLLISION_RATE
dip/*EXPT*/LHC/*EXPT*/Luminosity/Lumi_Collision_Rate_Err	*EXPT*:LUMI_COLLISION_RATE_ERR
dip/*EXPT*/LHC/*EXPT*/BKGD/BKGD1	*EXPT*:BKGD1
dip/*EXPT*/LHC/*EXPT*/BKGD/BKGD2	*EXPT*:BKGD2
dip/*EXPT*/LHC/*EXPT*/BKGD/BKGD3	*EXPT*:BKGD3
dip/*EXPT*/LHC/FillLumi/IntLumi_Delivered_StableBeams	*EXPT*:INTLUMI_DELIVERED_STABLEBEAMS
dip/*EXPT*/LHC/FillLumi IntLumi_Recorded	*EXPT*:INTLUMI_RECORDED
dip/*EXPT*/LHC/LuminousRegion/Size[0]	*EXPT*:LUMI_REGION_SIZE_X
dip/*EXPT*/LHC/LuminousRegion/Centroid[0]	*EXPT*:LUMI_REGION_CENTROID_X
dip/*EXPT*/LHC/LuminousRegion/Size[1]	*EXPT*:LUMI_REGION_SIZE_Y
dip/*EXPT*/LHC/LuminousRegion/Centroid[1]	*EXPT*:LUMI_REGION_CENTROID_Y
dip/*EXPT*/LHC/LuminousRegion/Size[2]	*EXPT*:LUMI_REGION_SIZE_Z
dip/*EXPT*/LHC/LuminousRegion/Centroid[2]	*EXPT*:LUMI_REGION_CENTROID_Z
dip/EXPT/LHC/Timing/BPTX/deltat	*EXPT*:BPTX_DELTA_T
dip/EXPT/LHC/Timing/BPTX/deltaT_Err	*EXPT*:BPTX_DELTA_T_ERR

13. REFERENCES

[1] LHCf data over DIP. D. Macina.
https://edms.cern.ch/document/969919

[2] Luminosity scans data storage requirements. S White.
https://edms.cern.ch/document/970037

[3] LHC Fixed Displays
https://edms.cern.ch/document/997019