# Problems of
# Luminosity measurements
# 2002 - 2003

DQ-Meeting, 20.03.03

N.Gogitidze

- Reminder
- LUMO bank errors
  - Memory shift (-3 words)
  - Overwriting problem
- Some statistics
- Next steps
  - Repair of DB banks 2002-2003
  - Hardware repair ????

# Reminder

- The Integrated Luminosity information is registered in H1 Event data, every 10 sec., in KEEP bank LUMO (in earlier years in LRTL, LUMM).
- At Run-End the TCL-job writes DB banks:
  - LH1R:
    Integrated lumi summary bank
  - LH1T:
    Combined information of Integrated lumi and of HV-bits
    $\Rightarrow$ new Table-Row every 10 sec.
    $\Rightarrow$ corresponding to LUMO banks
- Input to TCL-job are RUNDATA files (TCL.C02000xx, TCL.C03000xx)
  Records contain KEEP data,
  e.g. LUMO bank every 10 sec.

# LUMO keep bank

```
---------------------------------------------------------------------------
 TABLE  LUMO     B32           ! LUmi_Measurements_with_Online_tools
                               ! (non-event bank at KEEP-environment)
                               ! Replaces LUMM bank at HERA-II
 !   ATTributes:
 !   -----------
 !COL ATT-name FMT Min    Max   !Comments
 !
 1    PDRT001   I -INF    +INF  ! Rate of Photon Detector Energy Trigger(PDy)
                                ! in bunch 0-219, in 0.1 Hz units
                                ! (averaged over the last ~10 sec.)
! ...
 220  PDRT220   I -INF    +INF  !             " " "
 221  PDRTTOT   I   0     +INF  ! Total Photon Detector Energy Trigger Rate
                                ! in 0.1 Hz units
                                ! (averaged over the last ~10 sec.)
 222  LLTLUMO1  I   -INF  +INF  ! TimeStamp1 - unix time at aplumi02 (sec tick)
                                ! at Luminosity measurement moment
 223  LLTLUMO2  I   -INF  +INF  ! TimeStamp2 (nsec tick)
                                ! at Luminosity measurement moment
                                ! RealTime  = TimeStamp1+0.000000001*TimeStamp2
 224  INSTLUMI  I   -INF  +INF  !   (10**25 cm-2s-1)
                                !          Instantaneous Luminosity
 225  SPLUMI    I   -INF  +INF  !   (10**25 cm-2s-1mA-2)
                                !          Specific Luminosity
 !---------- Int. Lumi:  values accumulated for current H1Run -----------------
 226  H1RUN_L   I   -INF  +INF  !   (10**27 cm-2 = 1.0 mb-1)
 227  H1DATA_L  I   -INF  +INF  !   (10**27 cm-2 = 1.0 mb-1)
 !---------- Int. Lumi:  values accumulated for current Lumi Fill -------------
 228  HERAPR_A  I   -INF  +INF  !   (10**27 cm-2 = 1.0 mb-1)
                                !          HERA Produced
 229  H1RUN_A   I   -INF  +INF  !   (10**27 cm-2 = 1.0 mb-1)
                                !          H1 RUN Gated
 230  H1DATA_A  I   -INF  +INF  !   (10**27 cm-2 = 1.0 mb-1)
                                !          H1 Data Taken
 231  ACC       I      0  +INF  !   (at 0.001 units) 0.975 now -> 975
                                !          Acceptance Correction
 232  LUFILL    I   -INF  +INF  !          Lumi Fill Number
 233  SP233     I   -INF  +INF  !          Spare Words
 !...................................
 239  SP234     I   -INF  +INF  !          Spare Words
 END TABLE
----------------------------------------------------------------------------
```

# Example of good LUMO bank

## Run 337378, from 20.01.03

```
Run and Event:  337378 2523
LUMO:  Length, table header   241      239     1
  PD Energy Trigger bunch Rates, 0.1 Hz, last 10s average
  1- 10:      3324     4754     4367     4058     4329     4251     3981     3942     3014     4213
 11- 20:       231     3826     4367     3362     3517     3671     3594     4251     4676     4213
 21- 30:      4406      154     4213     4174     3440     4019     4599     3324     3903     4483
 31- 40:      4831     3440      115     3826     4019     4251     4058     4599     4599     3826
 41- 50:      3362     3826     4290      309     4676     4406     4213     4058     4908     5179
 51- 60:      4908     4754     5140     5256        0     5256     4754     5681     5063     5449
 61- 70:      4676     4947     4986        0        0        0        0        0        0       38
 71- 80:      4174     4986     4135     4135     5024     4792     4599     4097     3749     4676
 81- 90:       270     4251     4560     4754     4367     4947     4638     4251     4213     4947
 91-100:      4986      154     4444     5295     4097     4367     4483     4792     5217     5836
101-110:      4444     5333      154     4174     4947     3942     4522     3826     3903     4251
111-120:      4483     3517     4251      231     3671     4715     4522     4599     4483     4715
121-130:      4754     4947     4329     3710       77     3749     4097     3981     5333     4792
131-140:      4444     3555     3942       38        0        0        0        0        0        0
141-150:      3362     3942     3981     3787     3903     4367     3826     3092     3826     3633
151-160:       115     2860     3826     4947     3710     4444     3787     4135     4483     4367
161-170:      4213       38     4444     4715     4870     4638     3903     4019     3981     4715
171-180:      5102     4444      115     3826     4522     4483     4290     4908     3671     4174
181-190:      5604     5256     5140      154     3633     4831     5102     4792     5179     4367
191-200:      4638     4831     4367     4638      193     4947     4406     5102     4367     4908
201-210:      5952     4676     4870        0        0        0        0        0        0        0
211-220:         0        0        0        0       38       38        0        0        0        0
  Word 221: Total PD Rate, same unit and average          166896 hex.     28BF0
 Words 222-223, Time stamps      1043075500        293862212
 Words 224-225, Luminosity           99274           143988
 Words 226-227, Int. Luminosity          641309           635089
 Words 228-230, Int. Luminosity      -2147483648      -2147483648      -2147483648
 Words 228-230, Int. Luminosity, hex.  80000000  80000000  80000000
 Words 231-232, Accept, L-Fill             975             2921
              Words 234-239, spares
Spares:       0        0        0        0        0        0      260
```

# LUMO Problems
# in 2002 - 2003

## 1. Memory shift

## 2. Overwriting

# Memory shift (-3 words) in LUMO bank

## Run 337330, from 20.01.03

```
Run and Event:  337330 201
LUMO:  Length, table header   241       239      1
  PD Energy Trigger bunch Rates, 0.1 Hz, last 10s average
  1- 10:     12716    11324    11170    10629     8889    10745    11904      386     9933     9083
 11- 20:     12098     9005     9701    10977     9662    11672    12136    12329      502    10088
 21- 30:     11093     9972    11904    11866    11634    12832    12987    10938    12175      386
 31- 40:     10358    11982    11286    12136    14069    11440    11711    12059    10590    12677
 41- 50:       154    11750    12871    11363    12059    11982    12987    12755    11750    14301
 51- 60:     14223      850    13953    14996    15383    15035    14494    13760    14146    13760
 61- 70:         0        0        0        0        0        0       38    12677    13528    11672
 71- 80:     12755    11711    12175    12291    10474    12561    14185      386    13412    12291
 81- 90:     15112    12484    11943    12175    12832    13064    14417    15035      270    11479
 91-100:     14069    11518    13334    13296    13102    14069    12252    10513    13450      386
101-110:     10822    11634    11209    11518    12020    11131    12368    11440    11402    12716
111-120:       425    11324    12407    13257    12716    12677    12136    13412    12445    11286
121-130:     11247      309    11402    10861    11209    12407    11324    11247    11479    12716
131-140:         0        0        0        0        0        0        0     6106     9972    10204
141-150:     11170    11054    11866    10822    10513     9044    11286      425     7962    11556
151-160:     11363    12252    12252    11982    10513    11402    10320    13373      386    11943
161-170:     12871    11634    11440    11131    12252    13257    13605    11788    12600      386
171-180:     10822    12291    13141    10822    13296    14649    12600    13876    13760    14687
181-190:       502    11015    13644    14880    14958    14107    13644    12639    13605    13837
191-200:     13914      231    13141     9624    13334    11131    12329    13566    14185    13373
201-210:         0        0        0        0        0        0        0        0        0        0
211-220:         0        0        0        0        0       38        0 ******* ******* *******
  Word 221: Total PD Rate, same unit and average          276018 hex.     43632
 Words 222-223, Time stamps          140687             22202
 Words 224-225, Luminosity            20753         171439520
 Words 226-227, Int. Luminosity        166729392         162865856
 Words 228-230, Int. Luminosity              975              2921                0
 Words 231-232, Accept, L-Fill                 0                 0
              Words 234-239, spares
Spares:       0        0        0        0        0        0      260
```

# Memory shift
# Why does it happen?

- **Hardware error on the RIO2 board:**
  - **Shift of the VME Addresses versus Data by 3 units, at random times.**
  - **This causes the data to be written wrongly into the Dual Port Memory .**
    **⇒ Correct BOS structure (no BSE!) but -3 words data shift.**

- **To recover:**
  - **Shift happens at random times, is stable after the shift**
    **⇒ does not jump back**
    **⇒ RIO2 board had to be rebooted**
  - **Recently found (by I. Sheviakov): VME bus error clears the shift. Possible way to avoid a reboot of the RIO2 and of the crate - to provoke VME bus error. Tests are underway.**

# Effect of Memory shift

**If whole run is affected**

**$\Rightarrow$ Int. Lumi in LH1R is 0**

**If only part of run is affected**

**$\Rightarrow$ Int. Lumi in LH1R is reduced**

**H1EP: Runs are so far Poor**

**Recovery ?**

**see later**

# Overwriting in LUMO bank

## Run 339037, from 3.02.03

```
Run and Event:  339037 663
LUMO:  Length, table header   241      239     1
  PD Energy Trigger bunch Rates, 0.1 Hz, last 10s average
  1- 10:      3942     6377     7614     8812     9894     8039     6300     7034     6416     8000
  1- 10:       F66     18E9     1DBE     226C     26A6     1F67     189C     1B7A     1910     1F40

 11- 20:       425     5643     8039     8387     6802     8348     7073     7846     9778     8851
 11- 20:       1A9     160B     1F67     20C3     1A92     209C     1BA1     1EA6     2632     2293

 21- 30:      8232      154     9199     7691     7305     9121     7227     7653     8155     8542
 21- 30:      2028       9A     23EF     1E0B     1C89     23A1     1C3B     1DE5     1FDB     215E

 31- 40:      8928     9315      425     6377     8310     8503     7498     8928     7498     9044
 31- 40:      22E0     2463      1A9     18E9     2076     2137     1D4A     22E0     1D4A     2354

 41- 50:      8812     9701    10165      231     6184     8271     8000     7227     8271     8773
 41- 50:      226C     25E5     27B5       E7     1828     204F     1F40     1C3B     204F     2245

 51- 60:      7498     9083     8426     9121      231     9121     7498     9431     8889     9199
 51- 60:      1D4A     237B     20EA     23A1       E7     23A1     1D4A     24D7     22B9     23EF

 61- 70:      7691     8464     8426       38        0        0        0       38        0        0
 61- 70:      1E0B     2110     20EA       26        0        0        0       26        0        0

 71- 80:      6609     9044     7730     9624    10590     6764     8542     7150     7575     7073
 71- 80:      19D1     2354     1E32     2598     295E     1A6C     215E     1BEE     1D97     1BA1

 81- 90:       309     7111     8039     9121     6493 *******       12        0        1      663
 81- 90:       135     1BC7     1F67     23A1     195D 53444151        C        0        1      297
                                                         S D A Q

 91-100:  ******* *******        0      164      663 *******   120354        0   169751  1245184
 91-100: 53494645 C020917        0       A4      297 C3FC0013    1D622        0    29717   130000
          S I F E
```

```
101-110:       96 *******     614     255    1024 1048576 1114112 1179648 1245184 1310720
101-110:       60 C0DEBF41    266      FF     400  100000  110000  120000  130000  140000

111-120:  1376257 ******* 1441792 1507328 *******  118851       0  169751 1245184      96
111-120:   150001 1DCA6800 160000 170000 C3FC401D   1D043       0   29717  130000      60

121-130:  *******     606     255    1024 1048576 1114112 1179655 ******* 8401759 6318944
121-130:  C0DEBF41    25E      FF     400  100000  110000  120007  A32B5E  80335F  606B60

131-140:  ******* ******* ******* ******* 1245188 ******* 6388547 6388547 8377156 1310720
131-140:   A2F3A2  E093A3  E0DC61  A25462  130004  DFC342  617B43  617B43  7FD344  140000

141-150:  1376256 1441792 1507328 *******  118619       0  169751 1245184      96 *******
141-150:   150000  160000  170000 C3FC8012  1CF5B       0   29717  130000      60 C0DEBF41

151-160:      605     255    1024 1048576 1114112 1179648 1245184 1310720 1376256 1441792
151-160:      25D      FF     400  100000  110000  120000  130000  140000  150000  160000

161-170:  1507328 *******  118639       0  169751 1245184      96 *******     631     255
161-170:   170000 C3FCC013  1CF6F       0   29717  130000      60 C0DEBF41    277      FF

171-180:     1024 1048576 1114113 8467700 1179648 1245184 1310720 1376256 1441792 1507328
171-180:      400  100000  110001  8134F4  120000  130000  140000  150000  160000  170000

181-190:  *******  118379       0  169751 1245184      96 *******     631     255    1024
181-190:  C3FD0012  1CE6B       0   29717  130000      60 C0DEBF41    277      FF     400

191-200:  1048576 1114112 1179648 1245184 1310720 1376256 1441792 1507328 *******  119362
191-200:   100000  110000  120000  130000  140000  150000  160000  170000 C3FD4012  1D242

201-210:        0  169751 1245184      96 *******     625     255    1024 1048576 1114112
201-210:        0   29717  130000      60 C0DEBF41    271      FF     400  100000  110000

211-220:  1179648 1245184 1310720 1376256 1441792 1507328 *******  118596       0  169751
211-220:   120000  130000  140000  150000  160000  170000 C3FD8012  1CF44       0   29717

  Word 221: Total PD Rate, same unit and average         1245184 hex.    130000
 Words 222-223, Time stamps             96       -1059143871
 Words 224-225, Luminosity             618               255
 Words 226-227, Int. Luminosity            1024          1048576
 Words 228-230, Int. Luminosity         1114112          1179648          1245184
 Words 228-230, Int. Luminosity, hex.    110000    120000    130000
 Words 231-232, Accept, L-Fill         1310720          1376256
```

# Effect of Overwriting

Data now completely random

$\Rightarrow$ Int. Lumi in LH1R is

0 or nonsense.

H1EP: Runs are Poor

Recovery ?

Not with standard methods.

LUMO data is lost.

# Overwriting

**Overwriting $\longrightarrow$ BSE error!**

**event is discarded by CDAQ**

**Started to happen very often since 08.02.03**

**(connected with**
**introduction of $\rho^\circ$ - trigger?**
**high rates? )**

**Alan introduced recovery in CDAQ:**

**overwrite bank length in LUMO**

**241 $\longrightarrow$ smaller value (usually 87),**

**corresponding to position of SDAQ bank.**

**Active: Run 340375 - Run 342776**
**10.02.03 03.03.03**
**(end of data taking)**

# Overwriting changed length in LUMO bank

## Run 340969, from 14.02.03

```
Run and Event:  340969 544
LUMO:  Length, table header    87      239     1
Error:  Bank lenght
  PD Energy Trigger bunch Rates, 0.1 Hz, last 10s average
  1- 10:      8889   10551   10667   11711   14687   14069   13682   12832   12407   14146
  1- 10:      22B9    2937    29AB    2DBF    395F    36F5    3572    3220    3077    3742

 11- 20:       347   14030   11750   12909   14107   14262   14185   13605   13025   11634
 11- 20:       15B    36CE    2DE6    326D    371B    37B6    3769    3525    32E1    2D72

 21- 30:     13218     231   14764   15576   14417   18011   14842   14880   13760   15653
 21- 30:      33A2      E7    39AC    3CD8    3851    465B    39FA    3A20    35C0    3D25

 31- 40:     11634   14417     270   14764   15963   15924   13025   16311   14455   14030
 31- 40:      2D72    3851     10E    39AC    3E5B    3E34    32E1    3FB7    3877    36CE

 41- 50:     14069   16040   14223     270   13218   17277   15383   14378   15924   15692
 41- 50:      36F5    3EA8    378F     10E    33A2    437D    3C17    382A    3E34    3D4C

 51- 60:     14687   14571   14455   14958     309   14262   14880   13450   13682   14185
 51- 60:      395F    38EB    3877    3A6E     135    37B6    3A20    348A    3572    3769

 61- 70:     12948   15499   13218       0       0       0       0       0       0      77
 61- 70:      3294    3C8B    33A2       0       0       0       0       0       0      4D

 71- 80:     11479   15692   13450   14610   15267   15692   13102   14455   13102   13450
 71- 80:      2CD7    3D4C    348A    3912    3BA3    3D4C    332E    3877    332E    348A

 81- 90:       309   13682   17354   17316   14262 ******* ******* ******* ******* *******
 81- 90:       135    3572    43CA    43A4    37B6 3F20D171 3F79F0B4 3987402C B7BF873D 36F11D6D

 91-100:  ******* ******* ******* ******* ******* ******* ******* ******* ******* *******
 91-100:  438C0000 3F2B5237 3F7DB6C6 3A396A09 38AB3AD1 374DB85F 43908000 3F2B0B89 3F7DFE4A 39B094AC
```

**Standard print, from TCL tape (silicon data on H1RAWD tape!)**

# Some statistics

1. Memory shift

   ⇒ feature of RIO2 board

   present in all HERA-II running

2. Overwriting ⇒ reason so far unknown

   seem to be connected with high rate

   present in all HERA-II running

   (at very low level)

   Real problem in February 2003

3. What data is affected?

   Today: 2003 data

# 2003 data

1. **Memory shift**

   **happened in 6 lumi fills out of 40**
   **57 H1 Runs out of 1357**
   **In H1EP all these runs are Poor**

2. **Overwriting**

   - **at very low level ($<$ 1% of LUMO banks)**
     **happened in 23 lumi fills out of 40**
     **80 H1 Runs out of 1357**
     **In H1EP all these runs are G, M, P**
     **(No problem with luminosity calculation)**
   - **at high level ($>$ 80% of LUMO banks)**
     **happened in 4 lumi fills out of 40**
     **118 H1 Runs out of 1357**
     **In H1EP all these runs are Poor:**
   - **fill 2969 (340427-340582) $\Rightarrow$ 83.08 $nb^{-1}$**
   - **fill 2970 (340618-340733) $\Rightarrow$ 225.30 $nb^{-1}$**
   - **fill 2972 (340811-340885) $\Rightarrow$ 133.40 $nb^{-1}$**
   - **fill 2973 (340897-340975) $\Rightarrow$ 141.10 $nb^{-1}$**

# Recovery

## 1. Memory shift

**shift LUMO content +3 words**

**first 3 bunch rates are lost**

**replace with**

**average over bunches of same type**

**(either colliding, or empty, or pilot)**

## LH1R, LH1T can be restored.

## Software already exist

## Will be done soon

# Recovery

## 2. Overwriting

**LUMO content is lost unrecoverable**

**But: Int. Lumi data stored also in Igor's Lumi Server (diskfiles)**

## Can LH1R, LH1T be recovered

## from these data ??

## Currently being investigated

**(more longterm project, if at all)**

# Hardware repair:

## 1. Memory shift

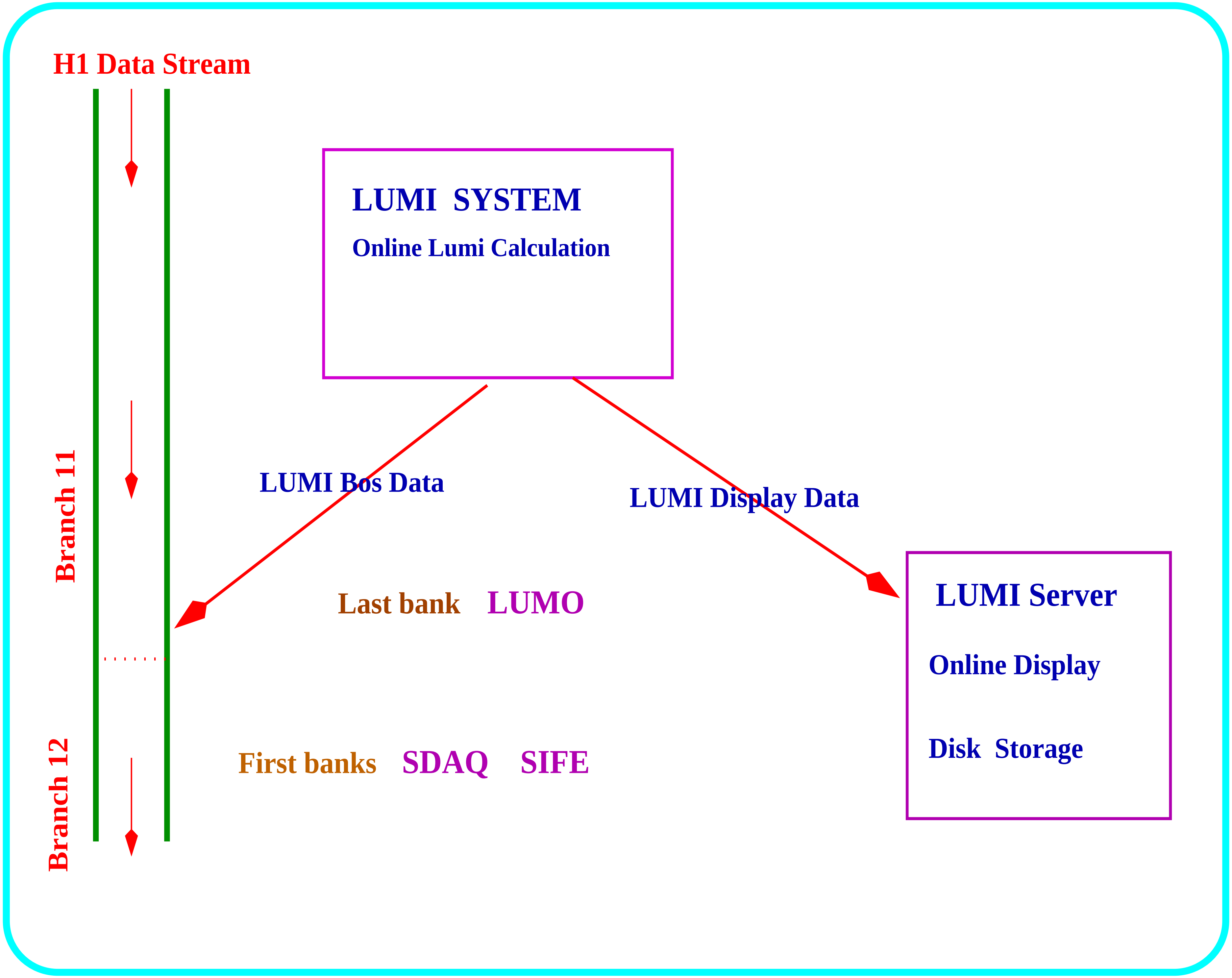
- Replace RIO2 (talks with manufacturer?)
- Meanwhile
  - BBL3 alarm
  - Emergency solution:
    artificial VME Bus Error
    → auto recovery

## 2. Overwriting

- Reason is being investigated by Igor
- Possible solutions:
  - Lumi readout in separate Branch (?)
  - ???

# Summary

- **2 types of LUMO errors**
  - **Memory shift** **easy to recover**
  - **Overwriting** **difficult to recover (if at all)**
- **Relatively small part of data affected**
  **(but big part of "$\rho^\circ$-data")**
- **To do:**
  - **Update 'Memory shift" runs**
  - **Investigate "Overwritten" runs: can they be recovered from Lumi Server?**
  - **H1EP classification will change for many runs**
  - **Hardware actions ?**



H1 Data Stream
LUMI SYSTEM
Online Lumi Calculation
LUMI Bos Data
LUMI Display Data
Branch 11
Last bank LUMO
LUMI Server
Online Display
Disk Storage
Branch 12
First banks SDAQ SIFE