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Proposal for DC3 Samples

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Introduction

This proposal is a short summary of the subdetectors' calibration requirements; all the information is extracted from the responses of the different subdetectors communities to a calibration questionnaire circulated last March.

The main items of this questionnaire are: the status of the calibration (in particular the implementation of the calibration algorithms in ATHENA), the planning for the immediate (Release 11) and long future (next year) and the requirements for the DC3 production, in particular which type and number of events are required with or/and without the simulation of realistic mis calibration and misalignment.

An important aspect of the DC3 project will be the calibration and alignment test: the possibility to simulate a detector with realistic miscalibration and misalignment, then to reconstruct events, perform calibration and feed the results back for improved reconstruction in a 'closed loop' test. Coupled to this, defining the necessary conditions database infrastructure for handling and distributing the associated calibration data.

Calibration parameters

In the table below the calibration parameters for each subdetector, and their exercise during the Combined TestBeam, are briefly reported (note that calibration also implicitly includes alignment).

There are no differences between the parameters and the levels of calibration in which they are involved, all the calibrations steps: ROD level, HLT calibration, calibration before prompt reconstruction and offline calibration are considered together.

SUBDETECTOR	CALIBRATION PARAMETERS	CALIBRATION PARAMETERS IN CTB
SCT/Pixel	Module alignment Module distortions Dead/noisy channels Pixel calibration parameters	Module alignment Dead/noisy channels
TRT	Module Transforms Wire shifts, sagitta T0 RT function Propagation velocity TR hit efficiency Spatial Resolution	Module Transforms Wire shifts, T0 RT function Spatial Resolution Bad channel

	Bad channel	
LAr	Electronic calibration parameters HV Cluster level correction, dead material Misalignment	Electronic calibration parameters (using NOVA) HV algorithms
TILE	CIS calibration factor (2500 channels) Cesium calibration factor (500 cells) Optimal filter coefficients	Same parameters on 6 modules (2 order of magnitude less)
HEC		First studies on the energy/eta parameterization (not yet available)
MDT	T0, space-time relation, RT function Corrections for temperature, field, wire sag, space charge effects Alignment corrections	T0, space-time relation, RT function No corrections for temperature, field, wire sag, space charge effects Alignment corrections from sensors measurements
RPC	Dead strip map Inefficiencies map Trigger time and trigger coincidence window calculation from LVL1 Pressure & temperature Threshold on front end readout HV, LV supply channel Current driven by each gas gap gas system controls	Pressure & temperature Threshold on front end readout HV, LV supply channel Current driven by each gas gap gas system controls
CSC	3 constants for ADC to strip charge calibration 3 numbers for the corrections of mis-alignment chamber	ADC to charge parameters
TGC	Alignment exercise: positions of the chambers (line A in AMDBSIMERC)	Timing calibration of delay Efficiencies

Table 1: Calibration Parameters

The samples needed to exercise the calibration algorithms and the possibilities to have samples simulated with mis-calibration are reported in the following sections. In detail for each subdetector:

- HEC subdetector required samples of single particle and jet simulation covering all eta regions and energy range; at the moment the number of events has not been specified. Many events of DC2 could be used directly.
  In addition, the calibration algorithm will be tested via a comparison of testbeam data with simulations.
  The mis-calibration is not the immediate issue, rather variation using

different MC versions or parameterisation might be more relevant.

- Tile subdetector needs single muon, pion and jet samples, samples very similar to those generated in DC2.
  In the case of mis-calibrated sample, the mis-calibration procedure is done at the digitisation step, so all the samples are "perfect ones" as regards simulation. Therefore Rome samples could be used. These events will directly compared with those produced in DC3, where there will be a new and different Tile Detector Description.
- LAr subdetector uses calibration data from test beam and commissioning for the electronic calibration.
  For the cluster level calibration, MC single particles are needed to derive the appropriate corrections and should be produced first.
  While to exercise in situ EM calibration a sample of Z-> e+e- will be used, with typical statistics corresponding to few months of data taking, then of the order of magnitude of 50k events. The miscalibration exercise could be done with ESD samples; some W->eν could be probably useful to look at track-cluster association.
- For TRT subdetector events of type W or Z into muons should be used.
  During the last testbeam, 25000 events were used to align about 260 straws to 10-14mu. Scaling that up would take to 30M events. But the resolution is dominated by systematic effects (a tenth of the data yields the same placement precision), reducing the requirement to 3M events.
  Among the existing samples, the Rome production should be useful to exercise module transforms and the T0.
  About the misalignment samples, the R-t function, propagation and wire sags should be varied via the CondDB in simulation and not at readout level.
  The rest can be mis-aligned at the reconstruction readout level avoiding volume clashes.
- For RPC subdetector the calibration required samples are mainly single muons of about 6M of events and Z boson into two muons to study the di-muon rate (for the muon special calibration streams).
  In this case the calibrations study are focused on the efficiencies map, the trigger time calculations and trigger coincidence windows calculations, and the samples can be simulated as "perfect".
- The samples needed for the calibration of TGC are single muons. The required numbers of events, for both nominal and mis-aligned layouts, are not yet defined.
- For the CSC subdetector the samples needed are single muons to check the alignment and pulser system (at ROD level).
  There are no particular requirements for miscalibrated samples, in principal perfect/nominal samples should be good.
- The MDT subdetector needs O(1M) single muon events with low Pt threshold (6 GeV/c) to calibrate. Dimuons samples should be used for validation and to study of the effect of wrong calibration constants reconstruction.

The effect of wrong geometry in reconstruction, and the effect of the alignment corrections on samples simulated with displaced chambers, will be studied mainly using Z to 2 muons samples, but also other channels with muons, for example MSSM Higgs to 2 muons.

To align with straight tracks in the barrel samples of single muon events, Pt spectrum from b and W decays ($b \rightarrow \mu$, $W \rightarrow \mu$), with the displaced chambers, toroid off and solenoid on, in a restricted (eta,phi) region are needed:

500K muons in sectors 1-2 of A side with phi between -15 and 32 degrees, eta between 0 and 2.7 and Pt>6 GeV.

At the beginning nominal samples will be use to test the calibration machinery (autocalibration convergence, access to DB, validation). After that, some degree of mis-calibration (adding essentially the wire-sag effect) would be very interesting, but has lower priority.

At the moment some single muons generated with 9.0.4 are useful for first studies, but a new production will probably be necessary.

For the alignment, existing dimuon samples could be used to study the effect of using the wrong geometry in reconstruction, but dimuon samples with modified geometry in the simulation and toroid off single muons samples are not available with the required statistics.

- For the SCT alignment, mis-aligned samples should be used to test the calibration algorithms. The number of events required corresponds to 1 day of low-luminosity running, which is enough to reach a statistical precision of a few microns for the alignment of SCT and pixel.

  Typically samples of muons in the final state should be fine.

  Moreover, samples with mis-aligned geometry will be compared with nominal samples to test individual module misalignment.

  A substantial number of cosmic ray samples will be simulated for standalone alignment challenge.

An effort is also going on to gather information on ATLAS global misalignments, for example between the ID and the calorimeters, between the different calorimeters, and different parts of the ID. Misalignment of the magnetic axes (e.g. between solenoid and toroid) are also being considered. The intention is to put some of these effects into the simulation, for use in the 'mis-calibrated' samples produced for DC3.

Required samples

The perfect Nominal Samples required, specifying type and the number of events (where defined), are:

- ***<u>e/ gamma samples</u>***

  - $Z \rightarrow ee$ 50 K events LAr

- ***<u>Pions, jets and hadrons</u>***

- B→μ jet 0(10M) events SCT

- Jet and pions 0(10M) events / DC2 — Tile and HEC

- ***Muons***

  - Single muons 0(1M) with Pt >6GeV; 500k with Pt >6GeV in the 1-2 A side with 0<η<2.7 and -15<φ<32 — MDT
    50k in 2.0<η<2.7 CSC
    0(1M) with Pt >6GeV TGC
    0(6M) events RPC

  - Z →μμ number of events not defined MDT & RPC
    1.5M events TRT
  - W →μν 1M events SCT
    1.5M events TRT
  - h →μμ number of events not defined MDT

While the Miscalibrated Samples are:

- ***e/ gamma samples***

  - W →eν ESD samples LAr

- ***Pions, jets and hadrons***

  - Nominal samples for the calorimetry community

- ***Muons***

  - Single muons
  - Z →μμ
    nominal sample, ESD level, and with geometry wrong at the simualtion level
  - Single muons with misalignment for TGC
  - W →μν 1M events SCT

In many cases, the samples are generated and simulated as "nominal" ones and then miscalibrated after at the digitisation or ESD step.

- Single muons are used as nominal samples for all the muon chambers except the TCG who required misaligned sample at not specified level.
- $Z \rightarrow \mu\mu$: for the RPCs without any miscalibation, while the MDTs required dimuons samples with miscalibration at ESD level (studying wrong geometry effects at reconstruction level) and samples simulated directly with modified geometry and toroid system switched on and off.
  For the TRT, the module trasformation and the T0 calculations could be done via Rome Samples, while RT functions, propagation and wire sag should be varied via CondDB at the simulation level and the rest at reconstruction level.
- $W \rightarrow \mu\nu$: for the TRT the required are the same of the samples $Z \rightarrow \mu\mu$, while the usage for the SCT required misaligned samples (wrong geometry).
- $W \rightarrow e\nu$: required only by LAr subdetector as perfect sample to study the track-cluster association.
- $B \rightarrow \mu$ jet: only perfect samples.
- Hadrons and jets: in principal the samples simulated for DC2 should be fine, all the miscalibrations take place at the digitisations step, all the DC2 samples could be used to compare the new Detector Descriptions of DC3 with that of DC2.

At the beginning, some DC2 samples could be used for the calibration procedures, varying parameters at the reconstruction or digitisation level.
The DC2 samples required by the calibration group are reported below.

- **E/gamma sample**
  Electrons, positrons and photons:
  $-2.5<\eta<2.5$
  E_T = 5, 10, 20, 25, 50, 75, 100, 200, 500, 1000
  With pileup low and without pileup
  5k, 10k, 20k, 40k, 100k, 200k,400k events for each combination
  photons with $-2.5<\eta<2.5$ E_T = 50
  and no pileup 200k events
  electrons, positrons with $-2.5<\eta<2.5$ E_T = 5
  and no pileup 200k events
  electrons with $-2.5<\eta<2.5$ E_T = 25
  and no pileup 5k events
- **Pions, hadrons and jets**
  Pions at: fixed E_T = 1, 6, 20, 200, 1000
  $\eta<5.0$ 20k events x 5
  fixed E_T = 1, 3, 9, 10, 20, 50, 100, 200, 500, 1000
  $\eta<5.0$ 40k events x 10

Di-Jets : with P_T in different ranges
20k events x 6 and 10k events x 2
Forward Jets: in different eta range
10k events x 4
Jets at fixed eta and energy: 320k events
QCD di-jets with: E_T (hard)= 55 GeV

- **Muons**

  Single muons (for release 8.0.5)
  fixed P_T = 3, 10, 30, 50, 100, 300
  $-3.2<\eta<3.2$ with energy E = 3, 30, 300
  1000 events x 20 files = 20000 events
  $Z \rightarrow \mu\mu$ (for release 8.0.5)
  250 events x 20 files = 5000 events

Appendix

Available Calibration samples for JetEtmiss group (from previous productions).

```
   http://atlfarm003.mi.infn.it/~negri/dataset.htm

  Sample J1-J8: dijets in pt bins
  ------------------------------

evgen+simul:
Dataset                         Files   Ev per file   Ev done
dc2.003034.evgen.J1_Pt_17_35   2       10000   20000
dc2.003034.simul.J1_Pt_17_35   400     50      20000
dc2.003035.evgen.J2_Pt_35_70   2       10000   20000
dc2.003035.simul.J2_Pt_35_70   400     50      20000
dc2.003036.evgen.J3_Pt_70_140  2       10000   20000
dc2.003036.simul.J3_Pt_70_140  400     50      20000
dc2.003037.evgen.J4_Pt_140_280         2       10000   20000
dc2.003037.simul.J4_Pt_140_280         400     50      20000
dc2.003038.evgen.J5_Pt_280_560         2       10000   20000
dc2.003038.simul.J5_Pt_280_560         400     50      20000
dc2.003039.evgen.J6_Pt_560_1120        2       10000   20000
dc2.003039.simul.J6_Pt_560_1120 400    50      20000
dc2.003040.evgen.J7_Pt_1120_2240       1       10000   10000
dc2.003040.simul.J7_Pt_1120_2240       200     50      9950
dc2.003041.evgen.J8_Pt_2240    1       10000   10000
dc2.003041.simul.J8_Pt_2240    200     50      9950

digitisation nonoise:
  J1: done, 399 digi files in:
/castor/cern.ch/user/c/costanzo/validation/data/J1_digi
  J2: done, 400 digi files in:
/castor/cern.ch/user/c/costanzo/validation/data/J2_digi
  J3: done, 400 digi files in:
/castor/cern.ch/user/c/costanzo/validation/data/J3_digi
  J4: done, 399 digi files in:
/castor/cern.ch/user/c/costanzo/validation/data/J4_digi
  J5: done, 399 digi files in:
/castor/cern.ch/user/c/costanzo/validation/data/J5_digi
  J6: done, 399 digi files in:
/castor/cern.ch/user/c/costanzo/validation/data/J6_digi

digitisation noise
/castor/cern.ch/grid/atlas/datafiles/dc2/digit/
dc2.003034.digit.J1_Pt_17_35    400 files
dc2.003035.digit.J2_Pt_35_70    400
dc2.003036.digit.J3_Pt_70_140   400
dc2.003037.digit.J4_Pt_140_280  400
dc2.003038.digit.J5_Pt_280_560  400
dc2.003039.digit.J6_Pt_560_1120 398 files
dc2.003040.digit.J7_Pt_1120_2240 200 files
dc2.003041.digit.J8_Pt_2240 200 files

      pi+/- at fixed pT
      -----------------

evgen+simul:
Dataset         Done    To be done     Ev per file    Ev done
dc2.003056.simul.P1_pi_pt1_eta5       20      0       1000    20000
dc2.003066.simul.P2_pi_pt6_eta5       20      0       1000    20000
dc2.003067.simul.P3_pi_pt20_eta5      40      0       500     20000
```

```
dc2.003068.simul.P4_pi_pt200_eta5     200     0       100     20000

      pi+/- at fixed energy
      ---------------------
evgen+simul:
Dataset        Done    To be done     Ev per file    Ev done
dc2.003069.simul.P1P_pi_e1_eta5       40      0       1000    40000
dc2.003070.simul.P2P_pi_e3_eta5       40      0       1000    40000
dc2.003071.simul.P3P_pi_e9_eta5       40      0       1000    40000
dc2.003072.simul.P4P_pi_e10_eta5      40      0       1000    40000
dc2.003073.simul.P5P_pi_e20_eta5      40      0       1000    40000
dc2.003074.simul.P6P_pi_e50_eta5      40      0       1000    40000
dc2.003075.simul.P7P_pi_e100_eta5     40      0       1000    40000
dc2.003076.simul.P8P_pi_e200_eta5     40      0       1000    40000
dc2.003077.simul.P9P_pi_e500_eta5     100     0       400     40000
dc2.003078.simul.P10P_pi_e1000_eta5   200     0       200     40000
dc2.003112.simul.P11P_pi_e10000_eta5  801     199     20      16020

 some samples already digitized No-noise
 Sample P5P:
 ------------
/castor/cern.ch/user/c/costanzo/validation/data/
dc2val.pi_e20_eta50.006006.g4sim    100 files    100Kevts

/castor/cern.ch/user/c/costanzo/validation/data/
dc2val.pi_e20_eta50.006006.g4dig     100 files (nonoise)

 Sample P6P:
 ------------
/castor/cern.ch/user/c/costanzo/validation/data/
dc2val.pi_e50.006001.g4sim    100 files   100Kevts

/castor/cern.ch/user/c/costanzo/validation/data/
dc2val.pi_e50.006001.g4dig    100 files (nonoise)

 Sample P7P:
 ------------
/castor/cern.ch/user/c/costanzo/validation/data/
dc2val.pi_e100_eta50.006003.g4sim    100 files  100Kevts

/castor/cern.ch/user/c/costanzo/validation/data/
dc2val.pi_e100_eta50.006003.g4dig     100 files (nonoise)

 Sample P8P:
 ------------
/castor/cern.ch/user/c/costanzo/validation/data/
dc2val.pi_e200_eta50.006004.g4dig      99 files

  Sample FJ1-FJ8: jets in FWD
  ------------------------------
dc2.003108.evgen.FJ1_fwjets_e200      1       0       10000   10000
dc2.003108.simul.FJ1_fwjets_e200      57      143     50      2850
dc2.003109.evgen.FJ2_fwjets_e500      1       0       10000   10000
dc2.003109.simul.FJ2_fwjets_e500      59      141     50      2950
dc2.003110.evgen.FJ3_fwjets_e1000     1       0       10000   10000
dc2.003110.simul.FJ3_fwjets_e1000     48      152     50      2400
dc2.003111.evgen.FJ4_fwjets_e2000     1       0       10000   10000
dc2.003111.simul.FJ4_fwjets_e2000     58      142     50      2900



  Other useful samples
  --------------------
```

```
  Sample B1: dijet180
  -------------------
(information in
http://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/SOFT_VALID/list_of_samples.html)

 evgen:
   http://tier2-01.uchicago.edu/dc2-se/datafiles/dc2/evgen/
   dc2.003003.evgen.B1_jets_180.grid3
 simul:
  /castor/cern.ch/grid/atlas/validation/datafiles/dc2/simul/
  dc2.003003.simul.B1_jets_180
  /castor/cern.ch/atlas/transfer/wdeng/datafiles/dc2/simul/
  dc2.003003.simul.B1_jets_180   102 files
 digit:
  /castor/cern.ch/user/c/costanzo/validation/data/
  dc2val.003003.digit.B1_jets_180  86 files (nonoise and noise)
```

Available Calibration samples for muon group

```
castor/cern.ch/atlas/project/dc2/preprod/g4dig805/
dc2.002883.pyt_z_mumu.g4dig805/data/
Files:
    dc2.002883.pyt_z_mumu.g4dig805._0001.pool.root
    dc2.002883.pyt_z_mumu.g4dig805._0002.pool.root
    ...
    dc2.002883.pyt_z_mumu.g4dig805._0020.pool.root

castor/cern.ch/atlas/project/dc2/preprod/g4dig805/dc2.002929.mu_pt3_eta320.g4dig
805/data/
Files:
    dc2.002929.mu_pt3_eta320.g4dig805._0001.pool.root
    dc2.002929.mu_pt3_eta320.g4dig805._0002.pool.root
    ...
    dc2.002929.mu_pt3_eta320.g4dig805._0020.pool.root

/castor/cern.ch/atlas/project/dc2/preprod/g4dig805/dc2.002865.mu_pt10_eta320.g4d
ig805/data/
Files:
    dc2.002865.mu_pt10_eta320.g4dig805._0001.pool.root
    dc2.002865.mu_pt10_eta320.g4dig805._0002.pool.root
    ...
    dc2.002865.mu_pt10_eta320.g4dig805._0020.pool.root

/castor/cern.ch/atlas/project/dc2/preprod/g4dig805/dc2.002930.mu_pt30_eta320.g4d
ig805/data/
Files:
    dc2.002930.mu_pt30_eta320.g4dig805._0001.pool.root
    dc2.002930.mu_pt30_eta320.g4dig805._0002.pool.root
    ...
    dc2.002930.mu_pt30_eta320.g4dig805._0020.pool.root

/castor/cern.ch/atlas/project/dc2/preprod/g4dig805/dc2.002870.mu_pt50_eta320.g4d
ig805/data/
Files:
    dc2.002870.mu_pt50_eta320.g4dig805._0001.pool.root
    dc2.002870.mu_pt50_eta320.g4dig805._0002.pool.root
    ...
    dc2.002870.mu_pt50_eta320.g4dig805._0020.pool.root

/castor/cern.ch/atlas/project/dc2/preprod/g4dig805/dc2.002864.mu_pt100_eta320.g4
dig805/data/
```

```
Files:
    dc2.002864.mu_pt100_eta320.g4dig805._0001.pool.root
    dc2.002864.mu_pt100_eta320.g4dig805._0002.pool.root
    ...
    dc2.002864.mu_pt100_eta320.g4dig805._0020.pool.root

/castor/cern.ch/atlas/project/dc2/preprod/g4dig805/dc2.002931.mu_pt300_eta320.g4
dig805/data/
Files:
    dc2.002931.mu_pt300_eta320.g4dig805._0001.pool.root
    dc2.002931.mu_pt300_eta320.g4dig805._0002.pool.root
    ...
    dc2.002931.mu_pt300_eta320.g4dig805._0020.pool.root
```

In the web page: **http://atlfarm003.mi.infn.it/%7Enegri/dataset.htm** can be found all the other DC2 files here not reported.