



ALICE

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# TPC simulation in Run 3

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Offline week, July 2015



- Current status
- A list of questions
- Next steps
- Developments summarised in JIRA mother task: <https://alice.its.cern.ch/jira/browse/ATO-157>



# TPC in AliceO<sup>2</sup>

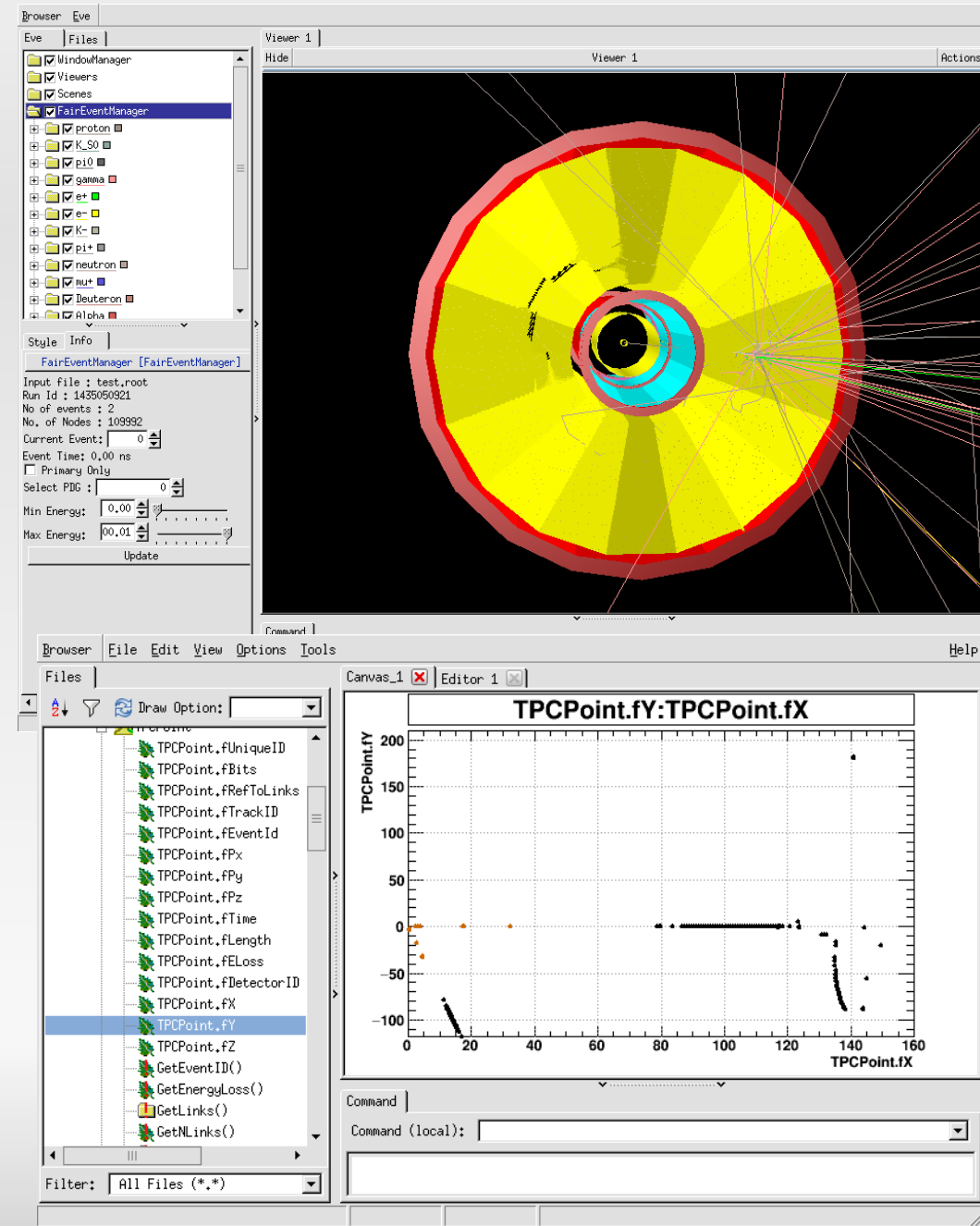
## Basic simulation



- Material + geometry ported
- Hit creation being worked on
  - Simple hit creation implemented
  - Current AliRoot implementation requires many classes from AliRoot
    - Detector description classes
- Quite some work, especially if new coding conventions should be met

<https://alice.its.cern.ch/jira/browse/ATO-157>

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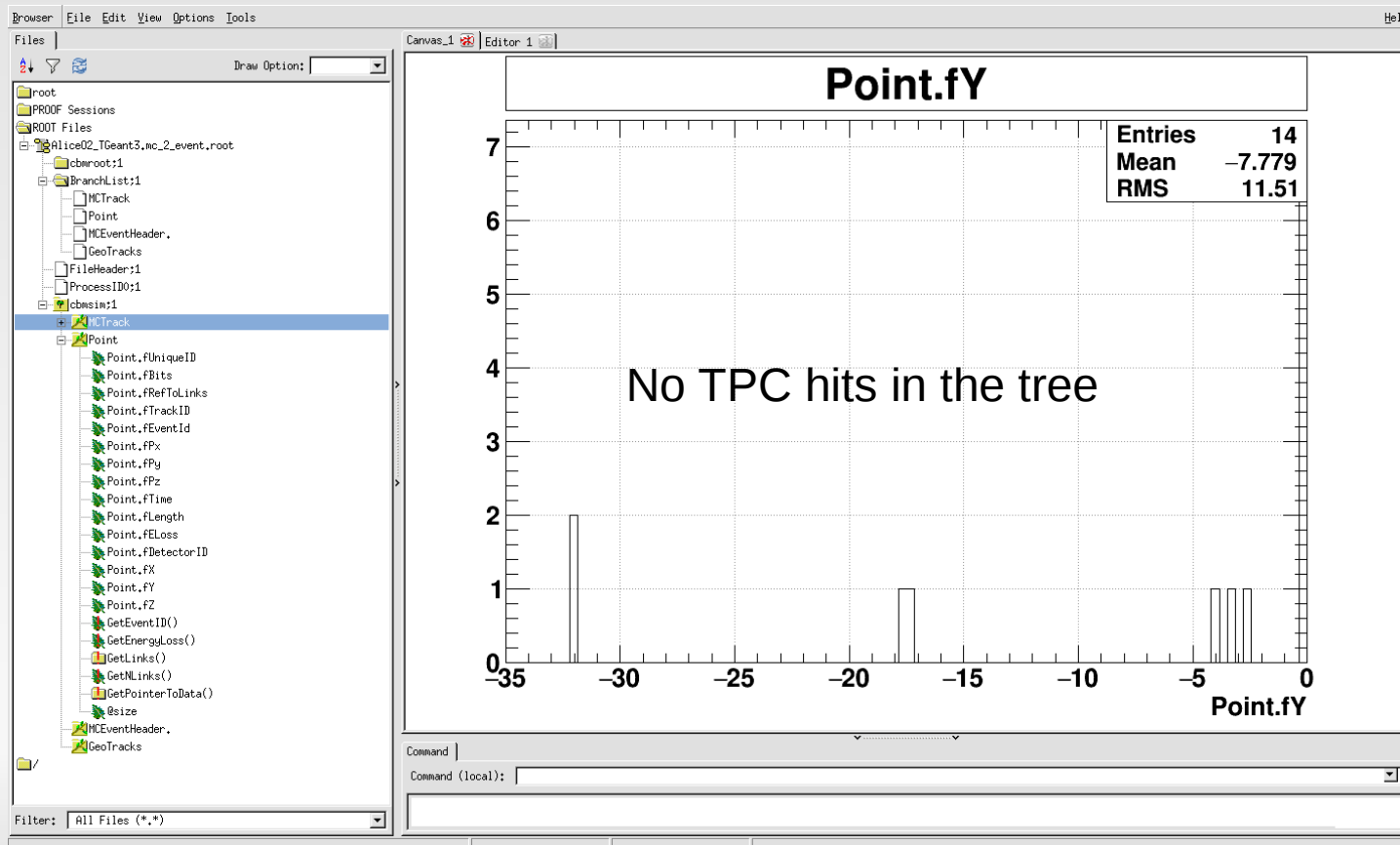
# A list of questions

## Hit creation I



```
void Detector::Register()
{
    /** This will create a branch in the output tree called
    DetectorPoint, setting the last parameter to kFALSE means:
    this collection will not be written to the file, it will exist
    only during the simulation.
    */

    FairRootManager::Instance()->Register("Point", "TPC",mPointCollection, kTRUE);
}
```



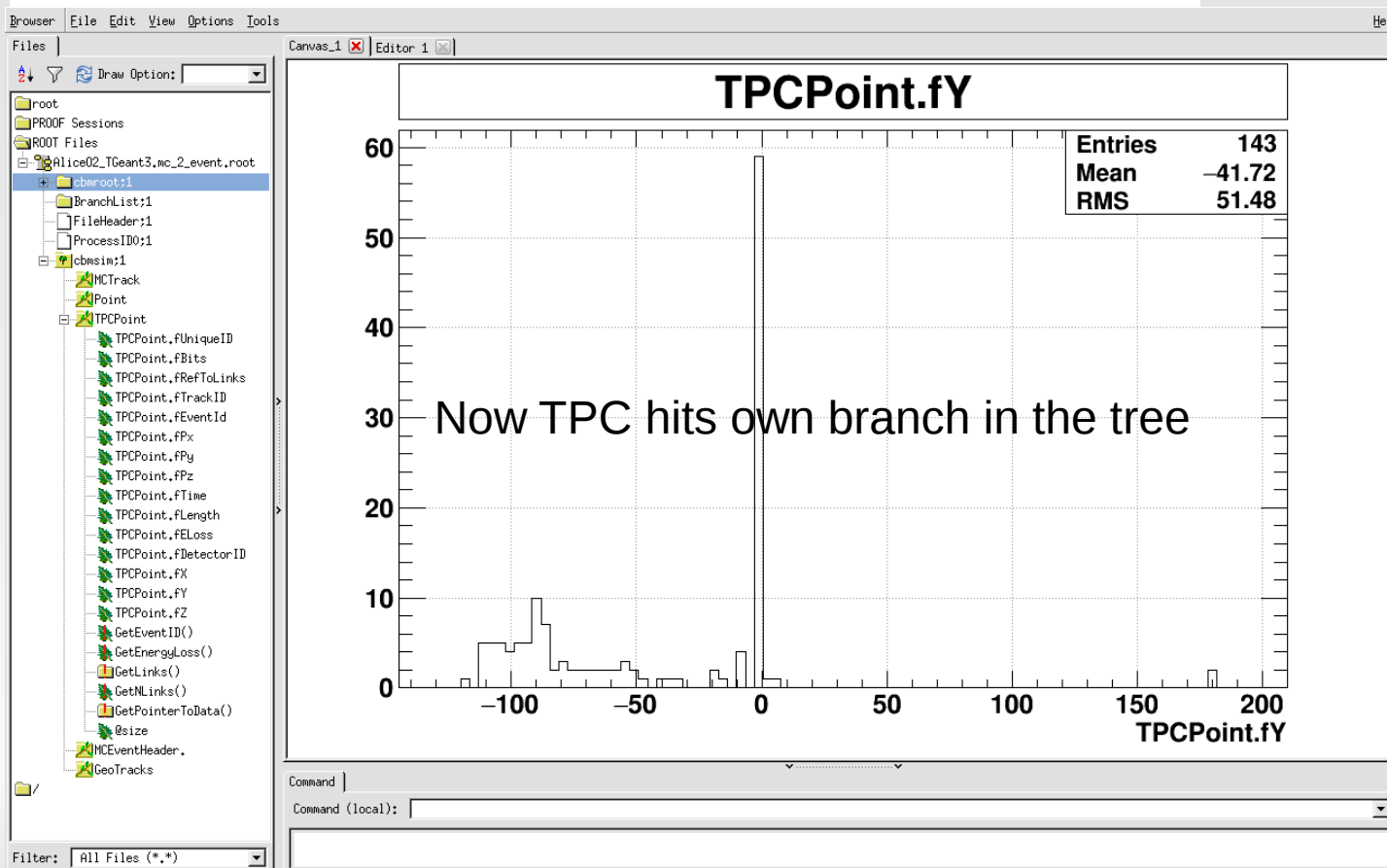
# A list of questions

## Hit creation II



```
void Detector::Register()  
{  
  
  /** This will create a branch in the output tree called  
  DetectorPoint, setting the last parameter to kFALSE means:  
  this collection will not be written to the file, it will exist  
  only during the simulation.  
  */  
  
  FairRootManager::Instance()->Register("TPCPoint", "TPC", mPointCollection, kTRUE);  
}
```

Changed to 'TPCPoint'



# A list of questions

## Simulation



- Simple run macro exists in 'macros' dir
  - Implemented TPC into this one
  - Uses O2 CDB Manager, requires env variable ALICEO2  
→ Better way to do this?

```
// CDB manager
AliceO2::CDB::Manager *cdbManager = AliceO2::CDB::Manager::Instance();
cdbManager->setDefaultStorage("local://$ALICEO2/tpc/dirty/o2cdb");
cdbManager->setRun(0);
```

- Are there more elaborate examples?
  - E.g. Hijing min. bias
  - + high pt pythias tracks
  - Pile-up simulation
- Seeding?



# A list of questions

## Digitisation



- Is there an example for digitisation
  - In which place should the digitisation be implemented
  - How is digitisation the invoked
  - How to load Hits (SDigits) for pile-up sim
- Is there a concept of summable digits or only digits from hits
  - → How will pile-up simulation be run
  - Hits → SDigits → Build pile up → Digits → Reco
  - Hits → Build pile-up → Digits → Reco
- Is the digit format fixed → will it work with the HLT tracking



# A list of questions

## Visualisation



- Simple visualisation macro in 'macros'
- More elaborate examples e.g. visualisation of hits?
- Simple geometry for visualisation?





# Next steps



- What is most important for the O<sup>2</sup> project?
- Clean up code (debug messages) push current version to github
- Implement 'manual' hit creation as in current AliRoot as option
  - → understand how much is needed in future
- Start with simple digitisation



# Backup





- Realistic implementation of distortions challenging
  - Required to develop calibration procedures
  - Studies ongoing in a fast MC  
<https://alice.its.cern.ch/jira/browse/ATO-157>
- For physics simulation parametrised distortions should be enough
  - Strategy to be developed

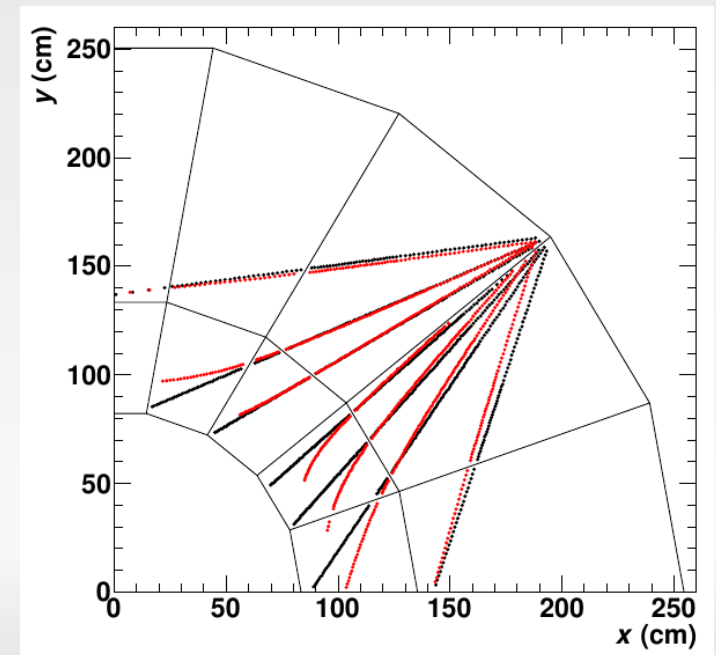
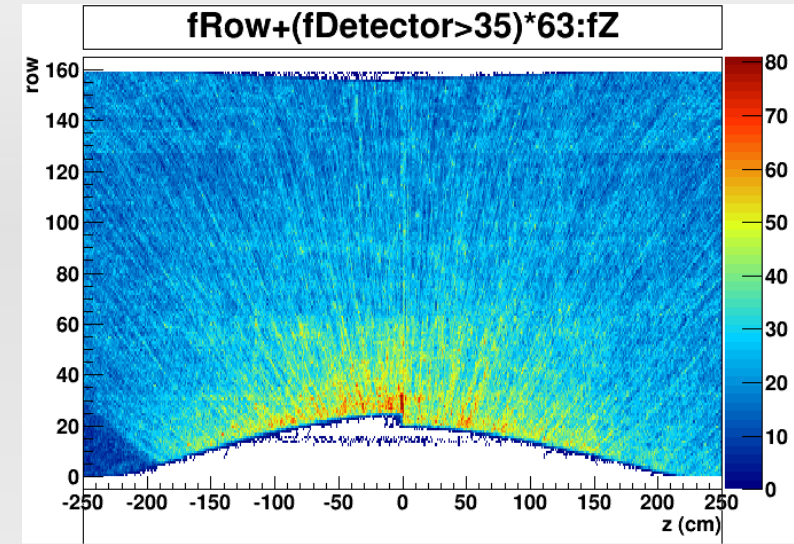


# Tracking in run 3

## Further investigation



- Full distortions in AliRoot
- Test if cluster to track association works with full distortions (no correction) with current HLT code
- → might ease reconstruction
- HLT experts looking into this



<https://alice.its.cern.ch/jira/browse/ATO-38>

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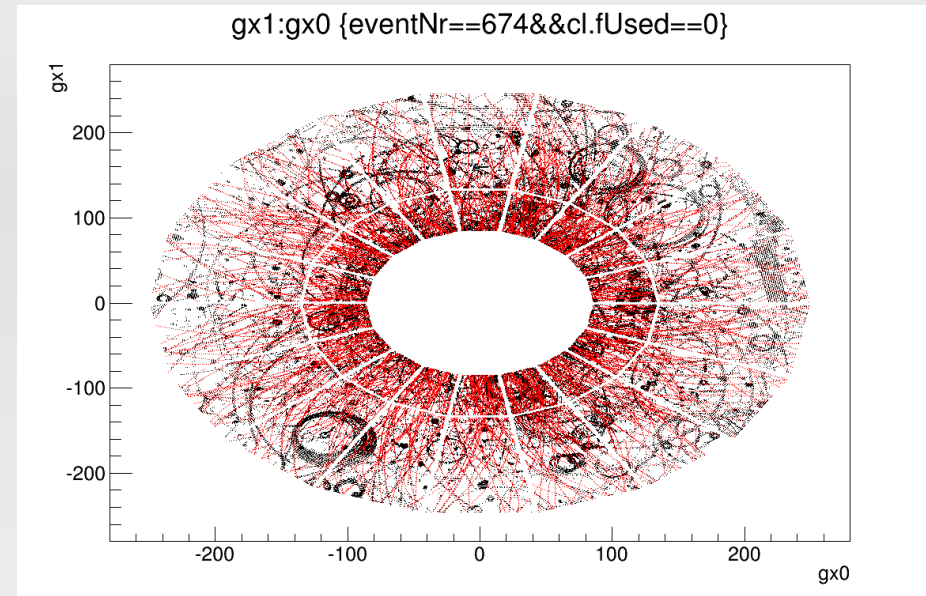


# Lossy compression

## reminder



- Compression strategy requires removing of clusters not belonging to physics tracks
- Category 1:  $f_1 \sim 70\%$  of background clusters
  - low momenta loopers to be signed and then rejected (if not overlap with category 2) -  $m_1(0$  bits) to represent
  - $\rightarrow$  Loop finder efficiency ( $\varepsilon$ ) to be validated ( $\varepsilon * f_1$ )
- Category 2:  $f_2 \sim 30\%$  of remaining will be close to the tracks (more than one cluster should be allowed to be attached)
  - to be compressed to  $m_2(\sim 30)$  bits per cluster – expected
  - $\rightarrow$   $m_2$  expectation to be validated
- Category 3: rest  $\sim f_3$  (1-10%) will be not assigned to any topology above to be compressed to  $m_3$  bits ( $\sim 40$ .)



Clusters belonging to physics tracks  
Clusters of non-physics tracks

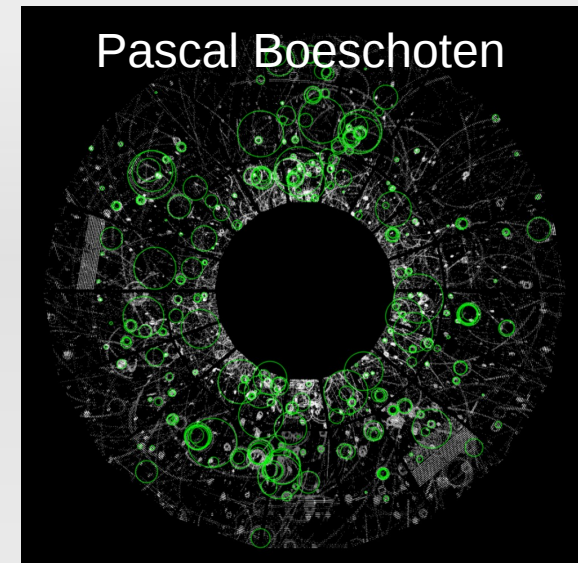


# Lossy compression

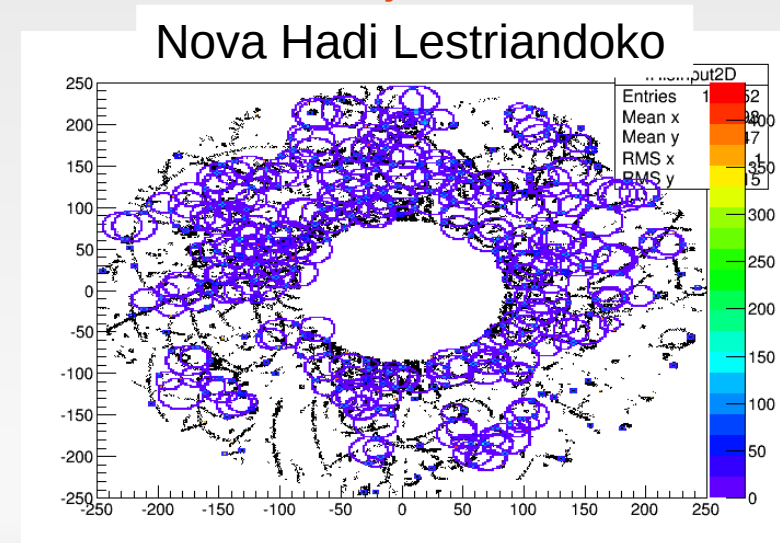
progress



- Development of junk detection e.g. hough transform methods
- Several people working on this topic
- Efficiency/fake rate/computing performance not yet satisfactory
- Lots of work still required



<https://alice.its.cern.ch/jira/browse/ATO-218>



<https://alice.its.cern.ch/jira/browse/ATO-168>



# Overall compression



- Clusterization & Huffman encoding routinely used in data taking suppression factor of  $> 4$  (5) achieved
- Identifying loopers pp, p-Pb real data
  - 70% (80%background)
  - assume  $>80(90)\%$  efficiency  $1 - 0.7 \times 0.8(0.9) = 0.44$  (0.33)  $\rightarrow$  factor  $> 2(3)$
- Hierarchical cluster – tracklet – track model
  - store params w.r.t. resolution, saves bits + makes Huffman encoding more efficient 25 instead of 77 bits per cluster  $\rightarrow$  factor  $> 3$  (to be demonstrated)
- Huffman x loopers x hierarchical track model  
 $= 4$  (5)  $\times$   $2(3)$   $\times$   $3$  (?) = 24(45?)





- Digitisation simulation (SAMPA chip) → Implemented in AliRoot, baseline correction performance ok

<https://alice.its.cern.ch/jira/browse/ATO-123>

- Development of ITS-TRD/TOF interpolation (to be used already in Run 2!)

<https://alice.its.cern.ch/jira/browse/ATO-108>

- Space charge distortion calculation/correction
  - Development of performant methods for fast SC calculation
  - Usage of read-out current for SC calculation
  - ...

<https://alice.its.cern.ch/jira/browse/ATO-10>





# Summary



- Basic TPC implementation in AliceO<sup>2</sup> simulation
- Tracking with full distortions still under investigation
- Work started on junk removal algorithms
- Many other related issues being worked on
  
- Still man power required on many levels
  - Implementation/porting of TPC code in O2
  - Development of performant calibration methods (CPU/GPU)
  - ...

