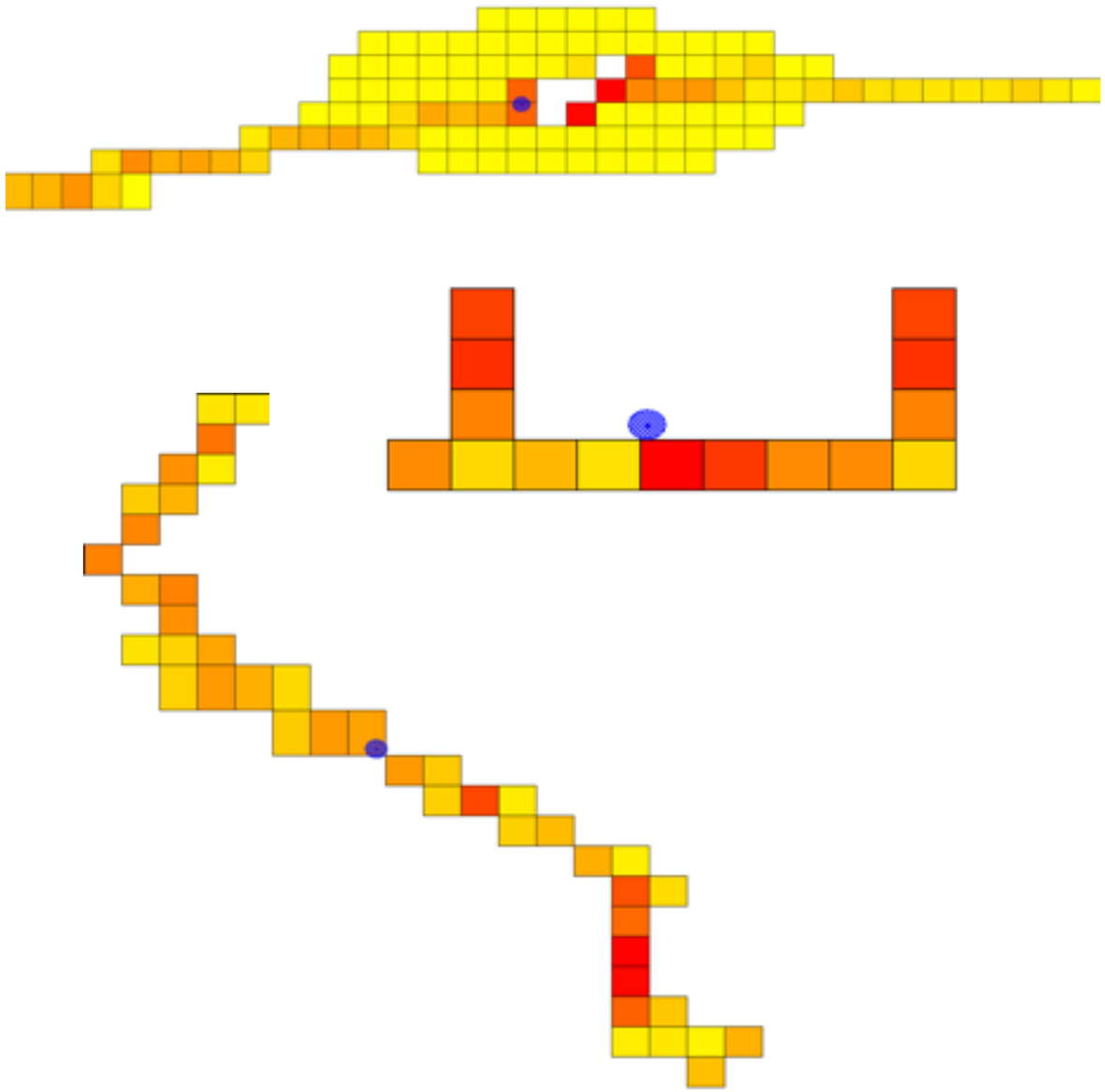


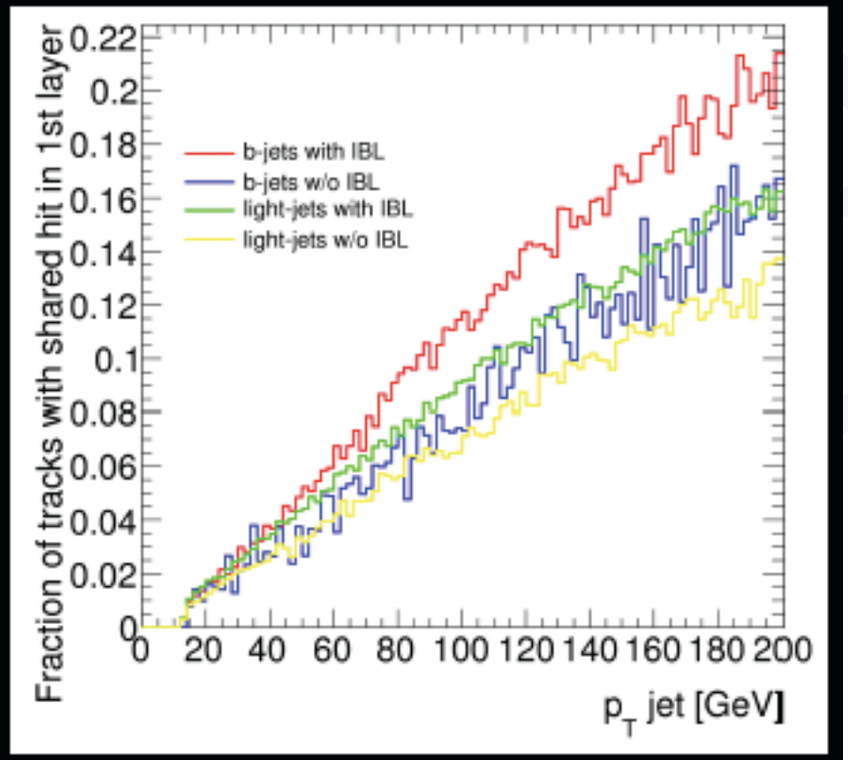
Pixel Clusterisation Task Force

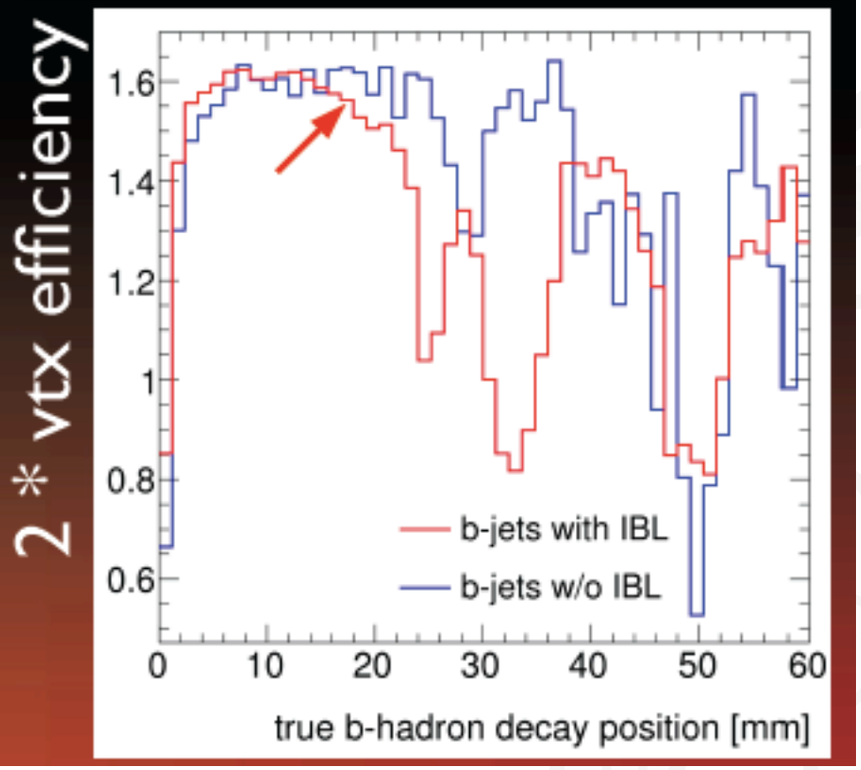
Andreas Salzburger, CERN
Giacinto Piacquadio, CERN

Giacinto

Dominant: Shared Hits ?

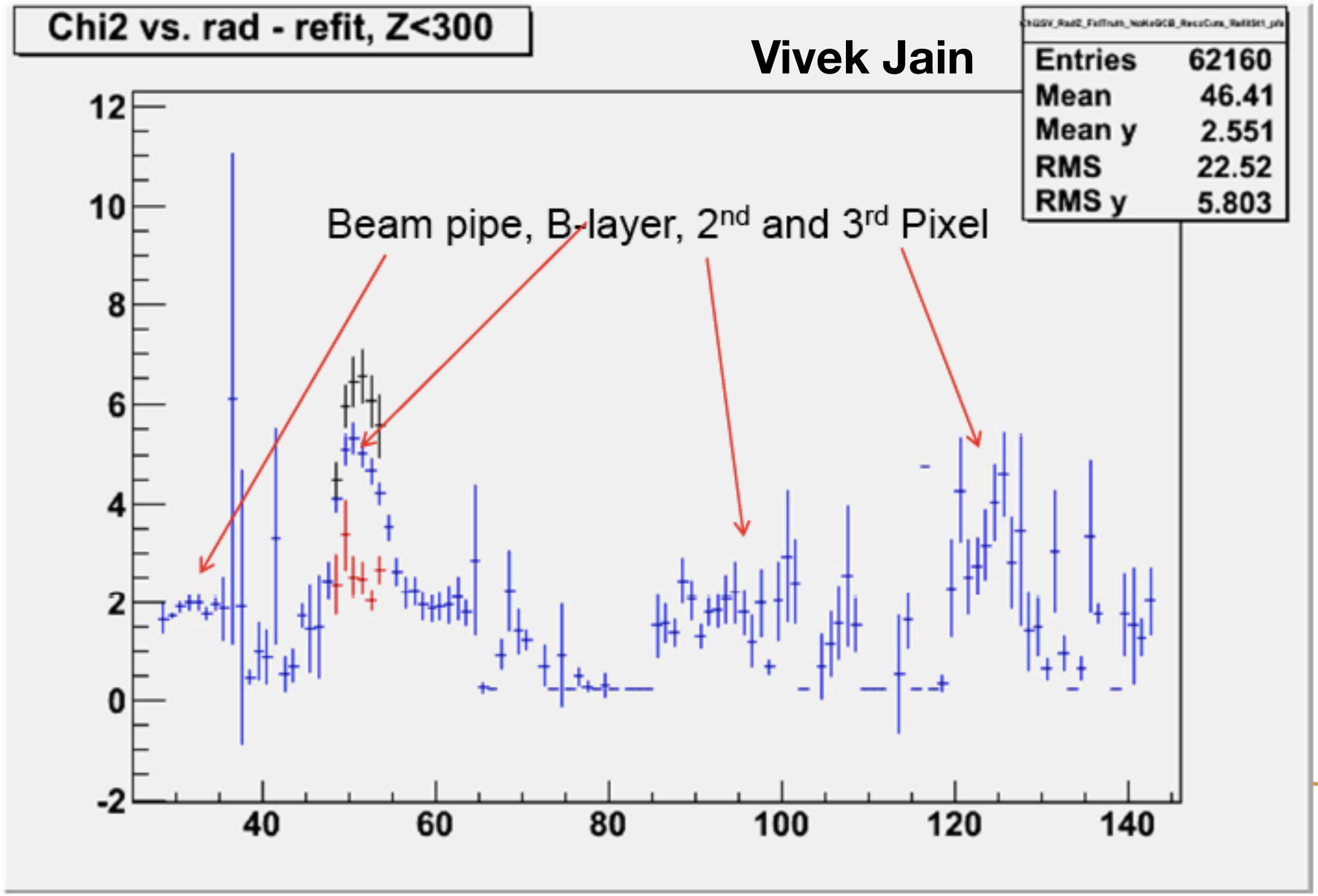
- rate of shared hits strong function of b-decay radius
  - ➡ not unexpected, but worse for IBL
  - ➡ at ~10% shared blayer hits: problems
- in release 16
  - ➡ already so minor retuning of track selection in pattern to minimize shared hits
- some signs that secondary rejection removes vertices far from beam pipe
  - ➡ not optimal tuning in tagging code ?





Markus Elsing

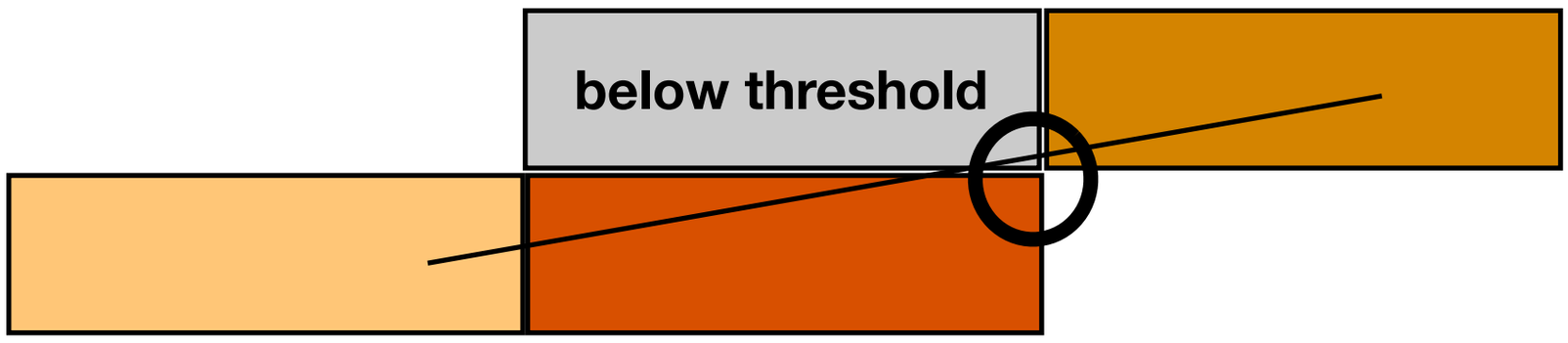
Vertices in the B-layer have a larger χ^2/dof than at beampipe, at other pixel layers (**only look at the blue points for now**)



Current Pixel Clusterisation Setup

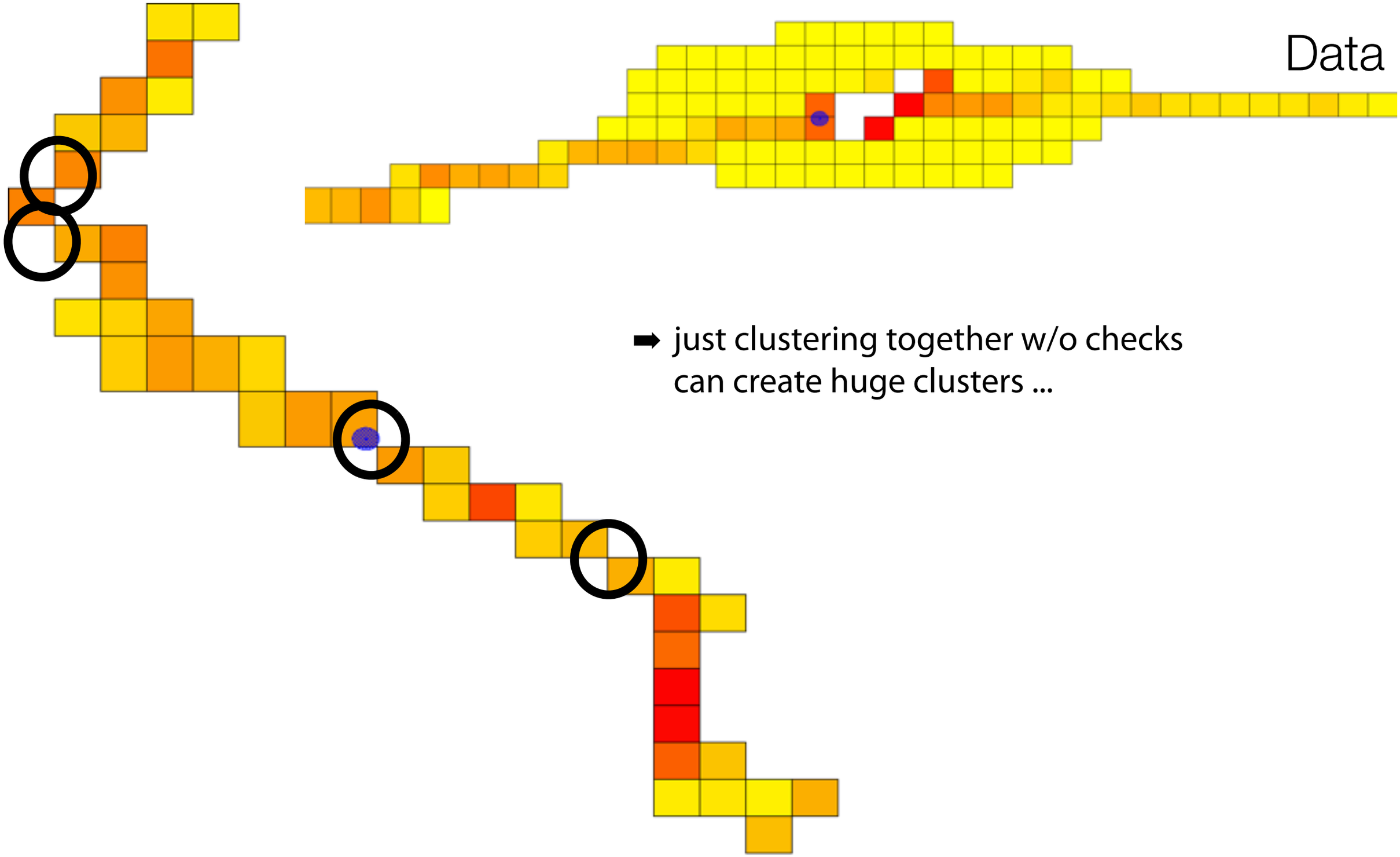
- PixelClusterisation is configured to maximise cluster size
  - ➡ pixels only need to have a common edge to be joint
  - ➡ no size limitation given
  - ➡ both options are available in the clusterisation code, but switched off

- simple cluster splitting and size
  - ➡ is dangerous ...



➡ this is a perfectly ok cluster with edge-attachment

Cluster types ...



➡ just clustering together w/o checks can create huge clusters ...

Obvious split candidates ...

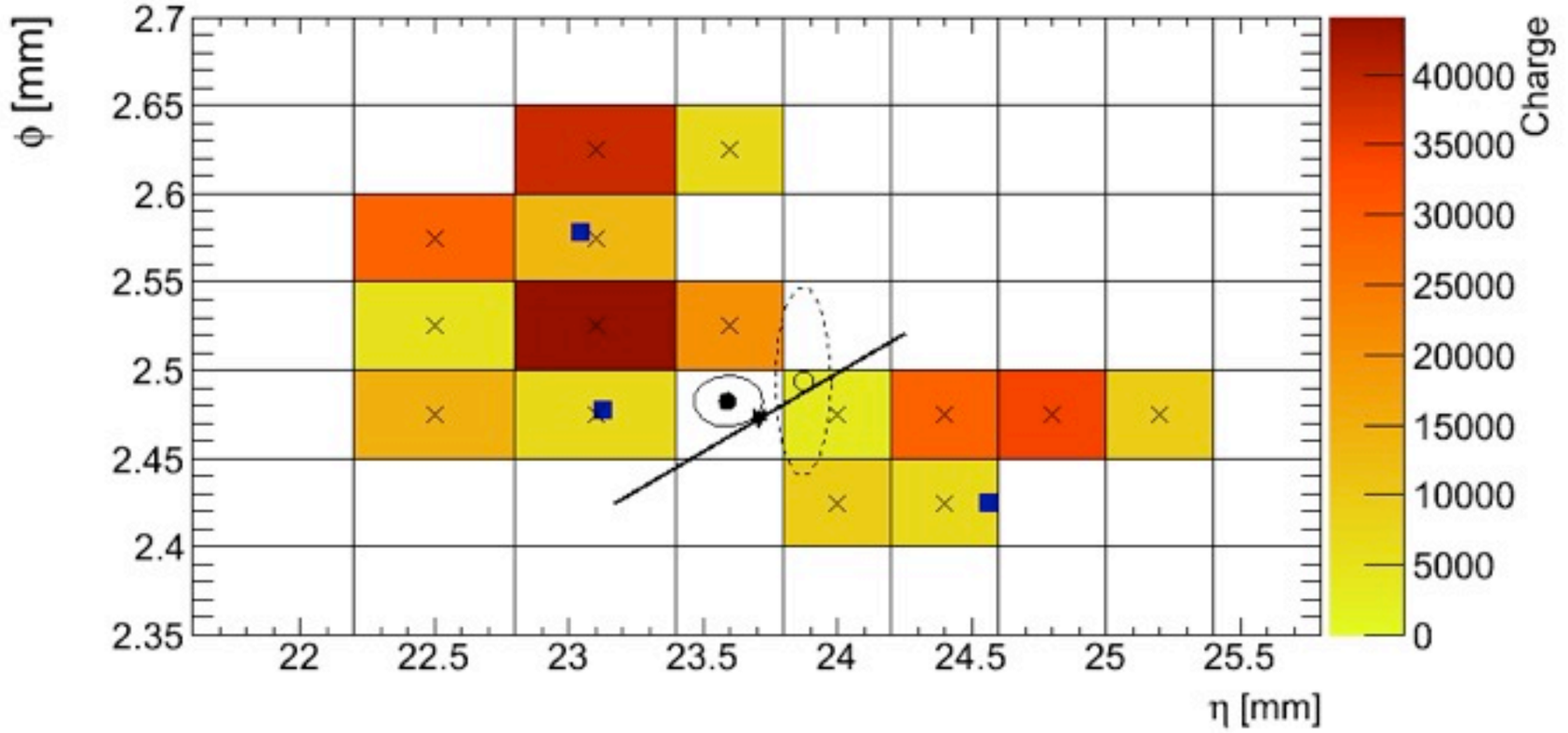
MinBias MC

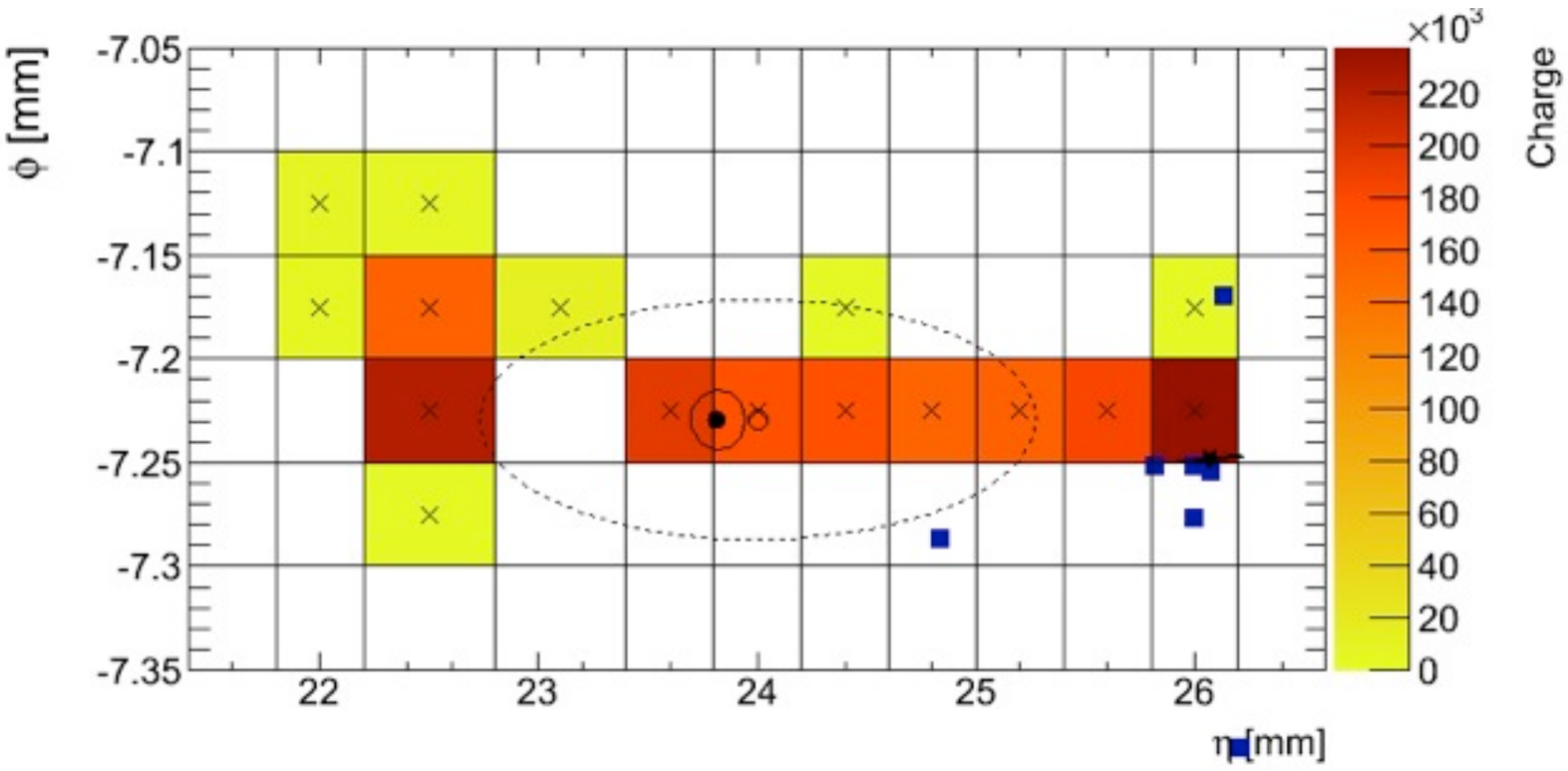
pred. truth impact

pred. track impact (with path)

PRD with error

ROT with error



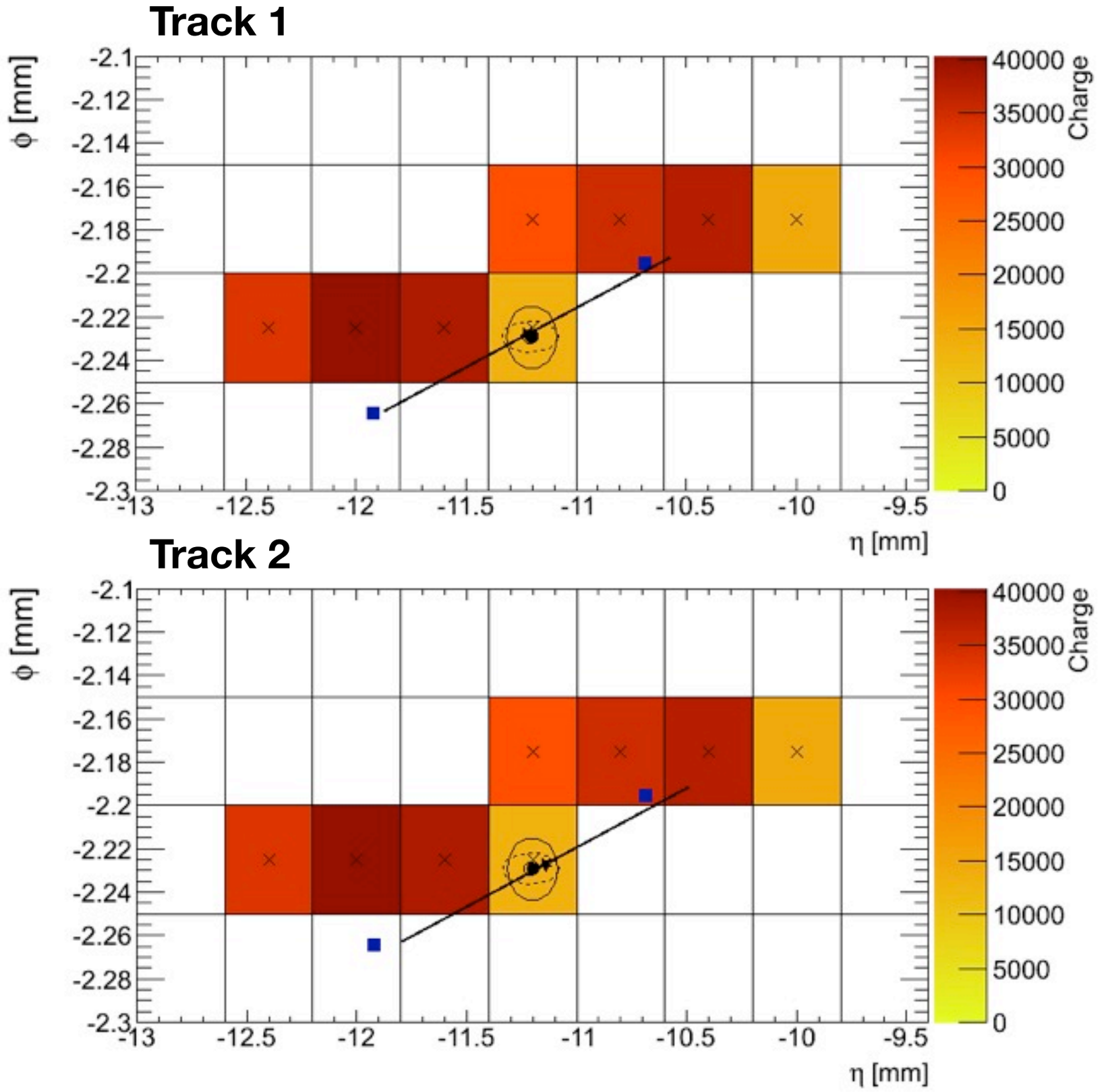


A dangerous species ...

MinBias MC

- Two particles create one joint cluster
  - ➡ center of gravity moved away from particle intersection
  - ➡ both tracks are pulled to a common “vertex”

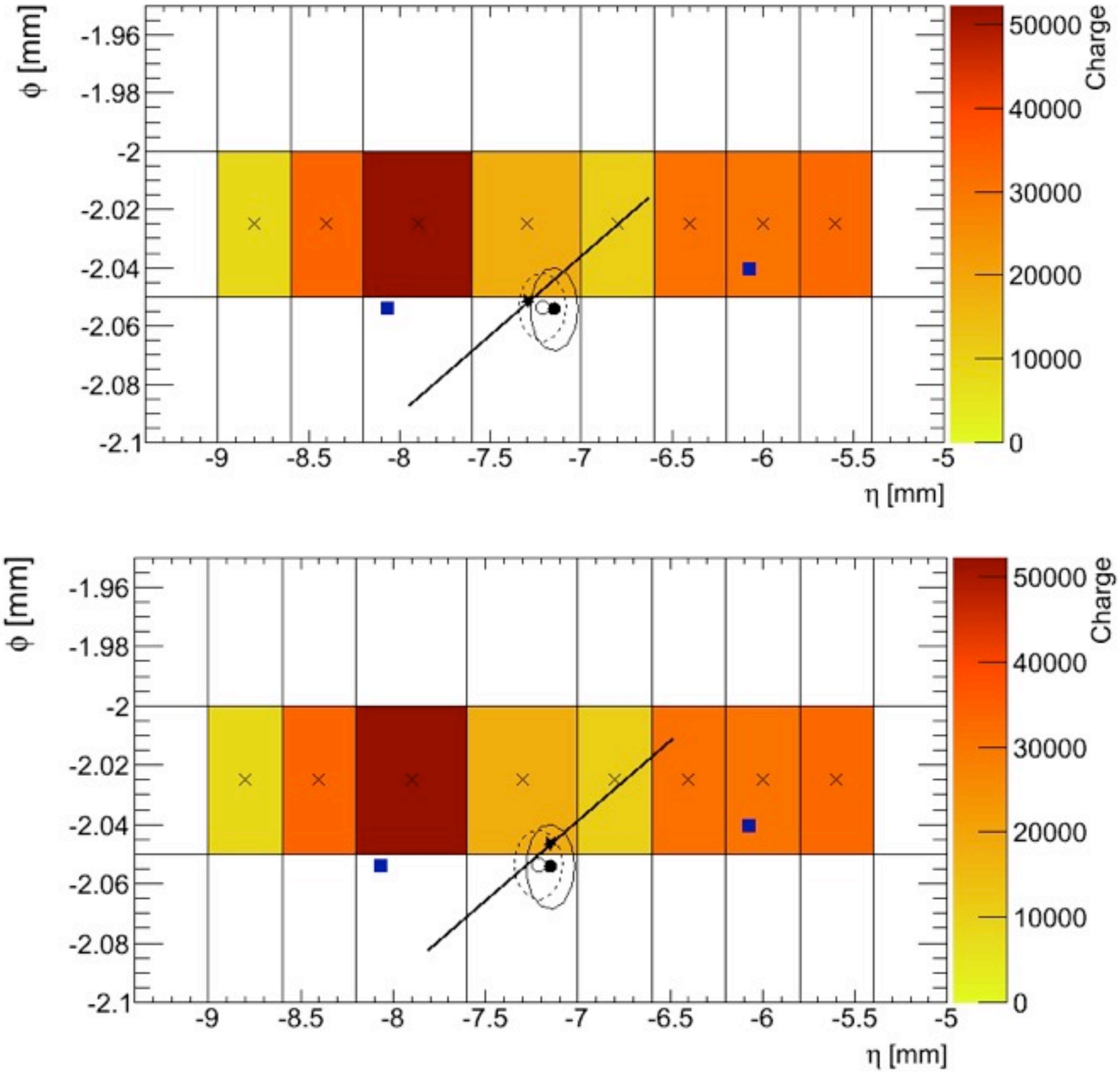
- This needs a smart cluster algorithm
  - ➡ probably test if the cluster drifts apart w.r.t. to the joint center of gravity ...



A dangerous species ...

MinBias MC

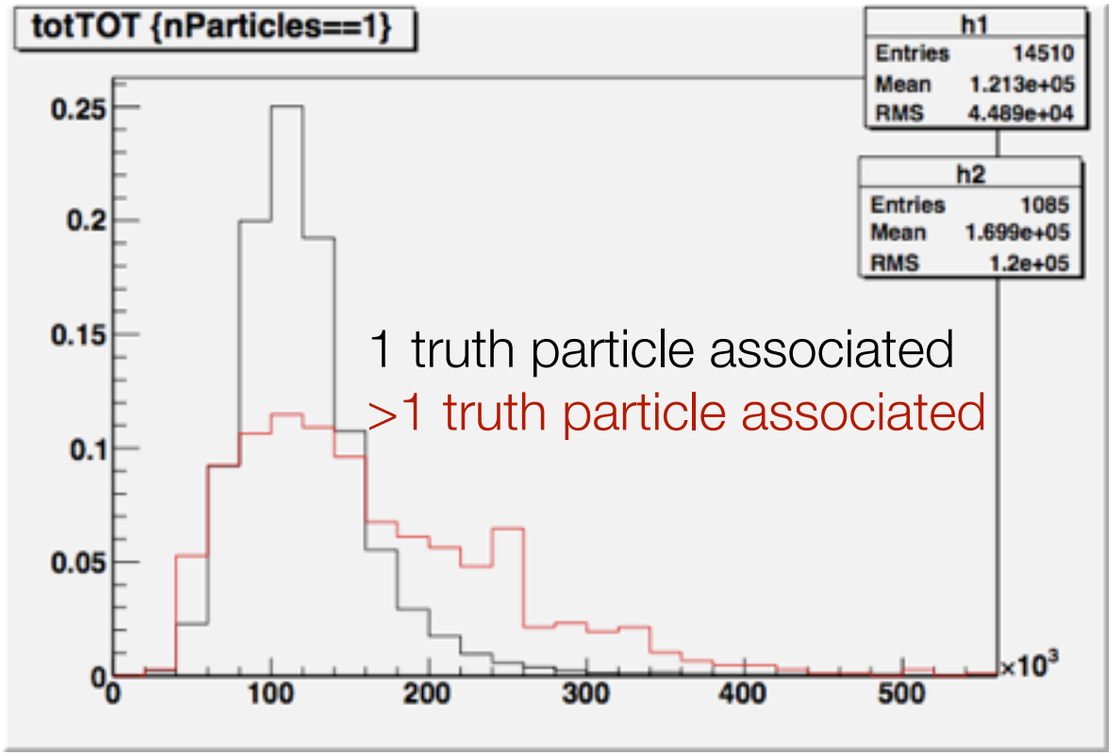
- Can we split that ?
  - ➡ at the track fit cluster splitting would be simpler
  - ➡ too late for pattern !
  - ➡ splitting must happen in the clusterisation phase to fully profit from it ...

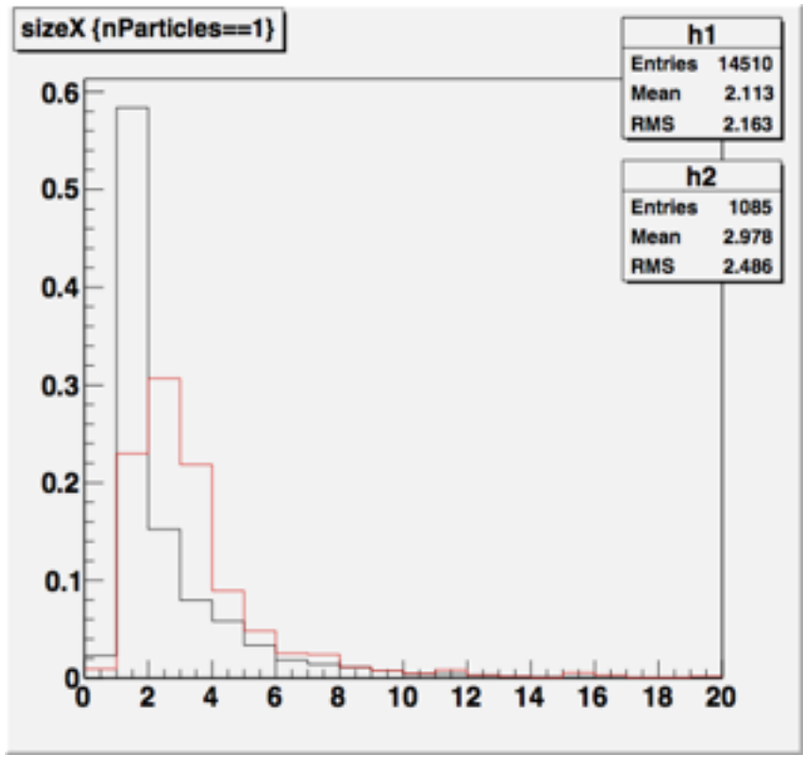


B-layer clusters

Giacinto

- Cluster properties on MC checked ...
  - ➡ some obvious observations ... the more particles, the bigger the size





VP1 PixelView Prototype ...

- Implemented a 2D pop-up view for VP1
  - ➡ still in prototype stage, but should be available soon

https://espace.cern.ch/atlas-project-pixel-offlinesw/PixelClusterizationTF/default.aspx

TF Composition

Giacinto Piacquadio - chair
Andreas Salzburger - chair

Clustering Experts:
- Tim Nelson
- Michael Duehrssen (Calo clustering)

Trigger:
- Dmitry Emeliyanov

Tracking:
- Heather Gray (+ Thijs Cornelissen for fitter integration ?)

Pixel Community :
- Dimitris Varouchas
- Stephen Gibson
- Dennis Helmich (MC toy model)

B-Tagging:
- Cecile Lapoire (+ Vadim, Laurent on occasion ??)
- Sara Strandberg

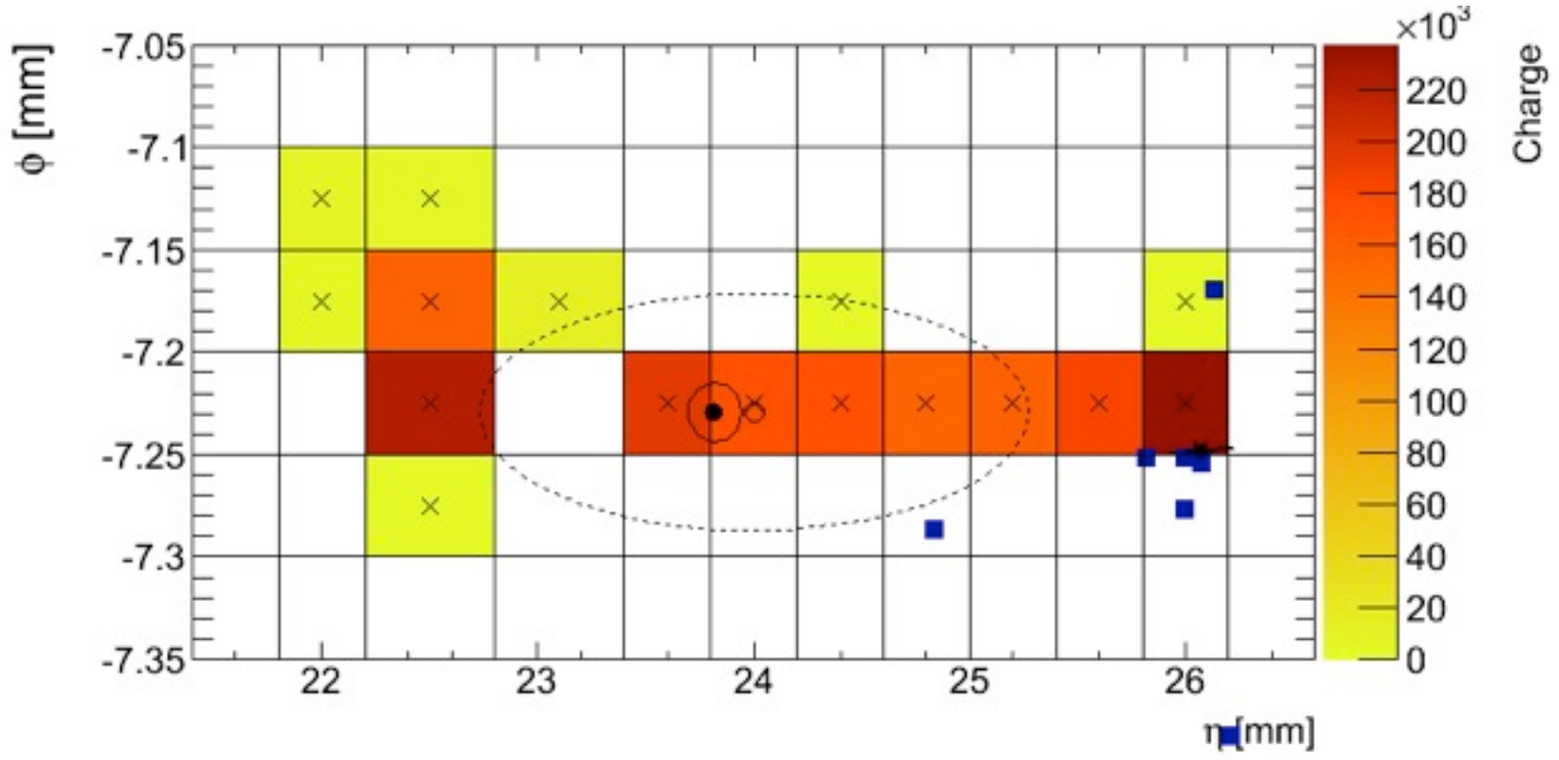
Clustering Code / SW integration :
- Attilio Andreazza

Fares Djama - ex officio Pixel SW coord.
Markus Elsing - ex officio ID SW coord.

Roadmap (1)

- STEP1 : Evaluation of current Pixel Clusterisation software
  - ➡ current setup: clusters are merged as soon as they attach on an edge
  - ➡ 2 options available: **split, limit on size**
  - ➡ how are **ganged pixels treated** ?
  - ➡ test these options on :
    - ➡ single particle MC : how often are sane clusters split
    - ➡ MC WH sample (stats needed ? turnaround ?)
    - ➡ data samples: in contact with DataPrep for a skim of high pt jets

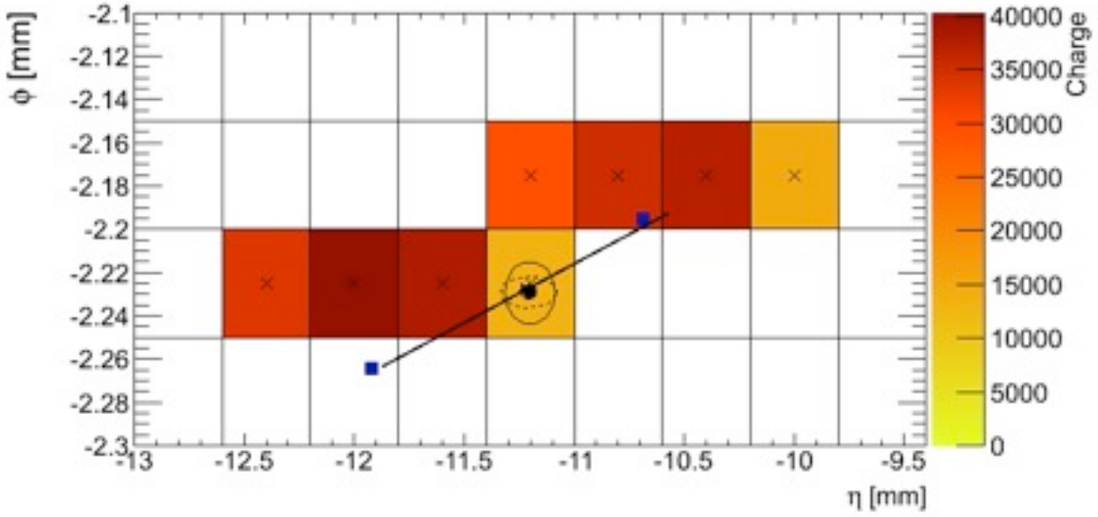
➡ Software review:
- encapsulation of merging / splitting methods to dedicated interface



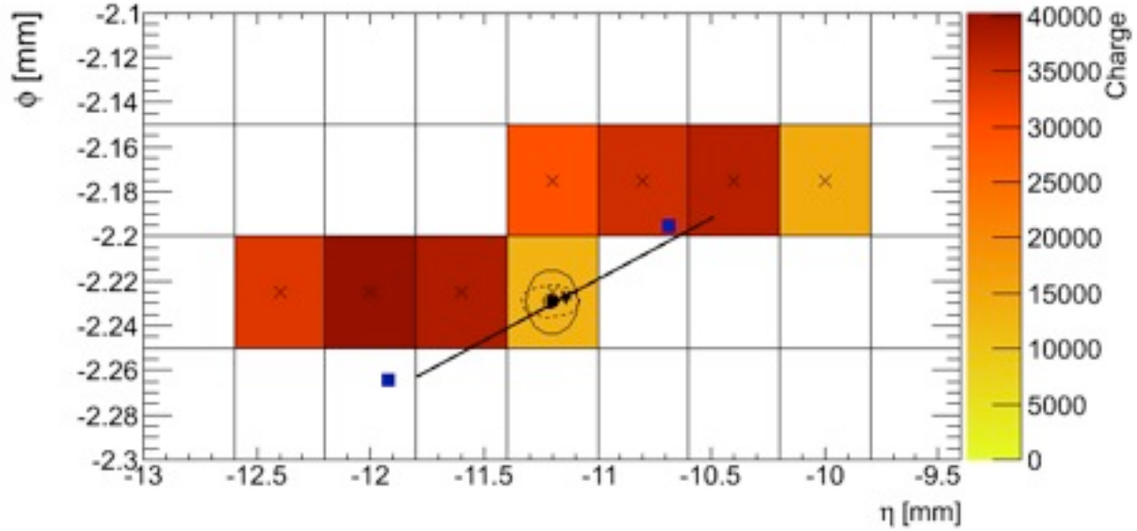
Roadmap (2)

- STEP2 : Evolution of current Pixel Clusterisation software
  - ➡ potential improvement of the clusterisation algorithms

Track 1



Track 2



- ➡ can we start splitting these types of clusters ?
- ➡ enhanced ToyMC may be useful (Dennis is working for this)
- ➡ hopefully we have an easier way (IClusterSplitter interface in place) to get different implementations, approaches available

Roadmap (3)

- STEP3 : Software integration
  - ➡ I think we could very much follow the Tracking model:
    - one task, one interface, down the line, but we should keep that in mind
  - ➡ VP1 display integration : has proven to be very useful

Downstream consequences

- Need to be able to undo "split" in Track fitting
  - ➡ probably filling into the ambiguity maps **agreed**
  - ➡ new type of split cluster map ? **agreed**
  - ➡ fitter integration via ROT_Creators needs to be understood, **or even the ambiguity solver ?**

- Validation, validation, validation
  - ➡ this is not "just" about data/MC agreement
  - ➡ we need not only average cluster sizes to agree,
    we also need an outlier analysis (i.e. look at very large clusters)
  - ➡ the clusterization code/algorithms can be extensively tested on MC
    (what MC samples do we need ?)
  - ➡ are we set up with the right tests ?
  - ➡ are we looking at the relevent distributions (Tracking, 2-nd vertexing, b-tagging)

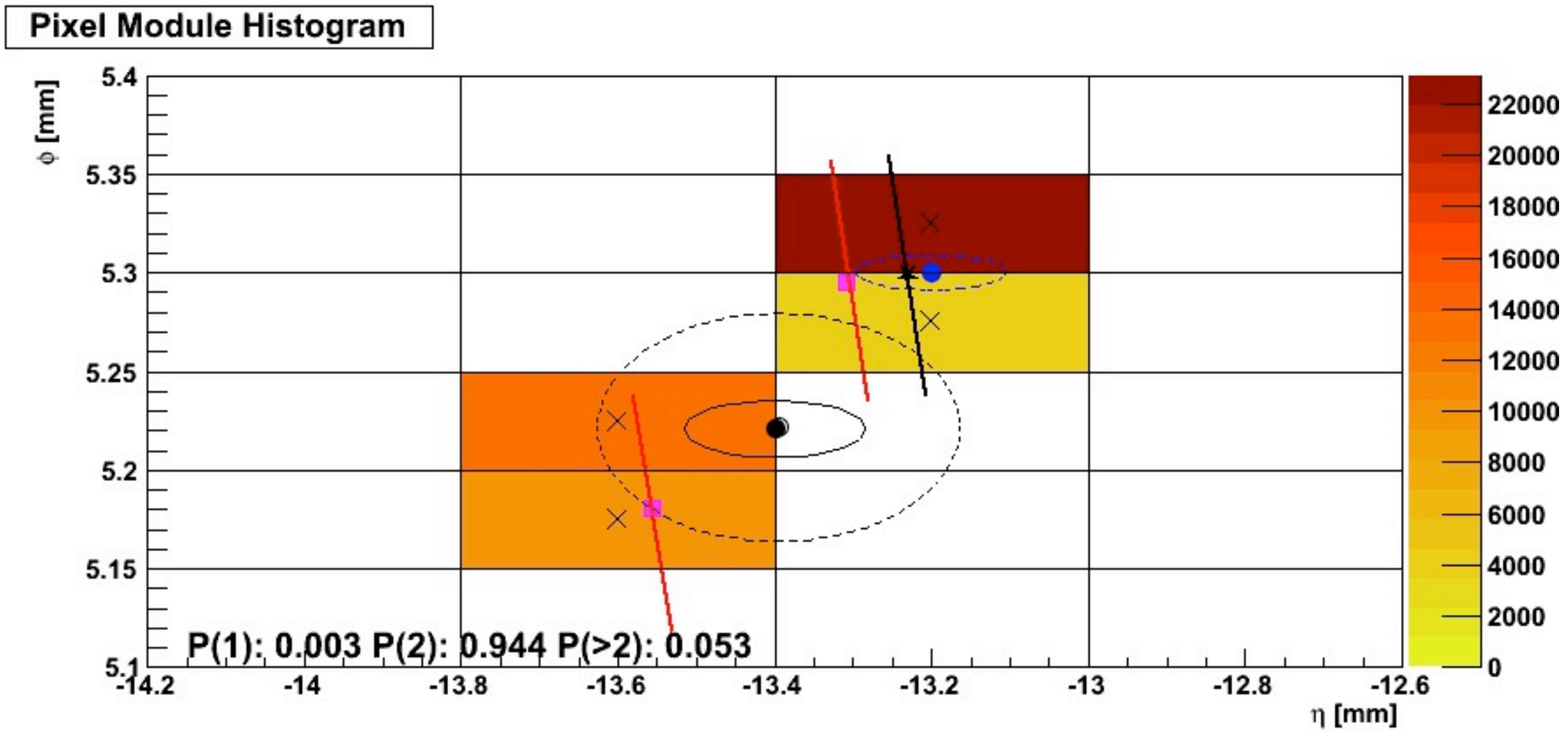
Timeline & Technicalities

- Ultimate goal is the spring reprocessing
  - ➡ Release 17.0.0 (February +/- who knows)
  - ➡ but intermediate steps may be needed
  - ➡ depending on the needed samples, we may request a patch release to be able to run grid jobs

- Final Task Force Report for the Ringberg Workshop
  - ➡ 17. - 21. January 2011
  - ➡ **write-up** and **documentation**
    ... in particular if new code, algorithms are implemented

First Steps (1)

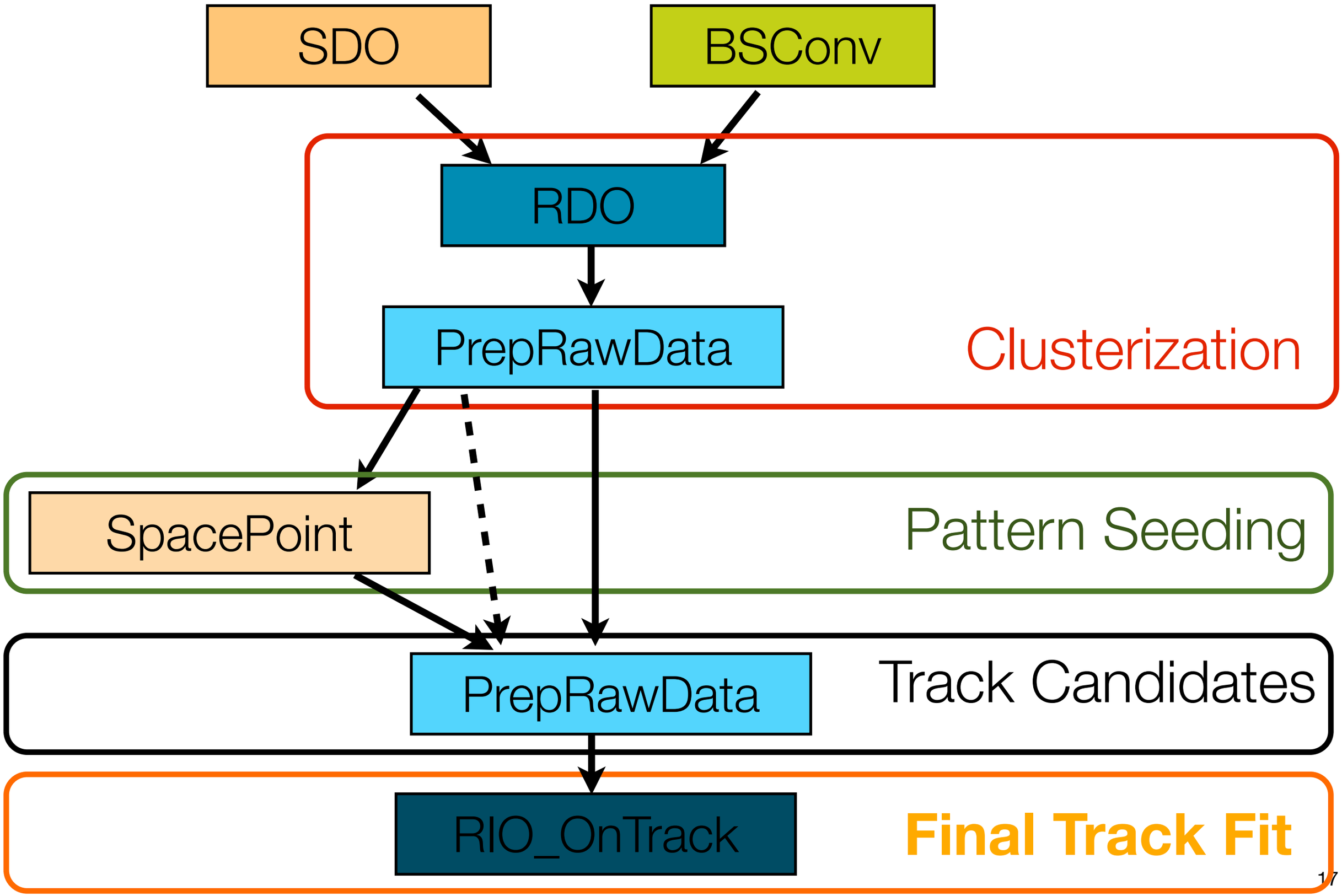
➡ Neuronal network trained to distinguish single/multi-track cluster



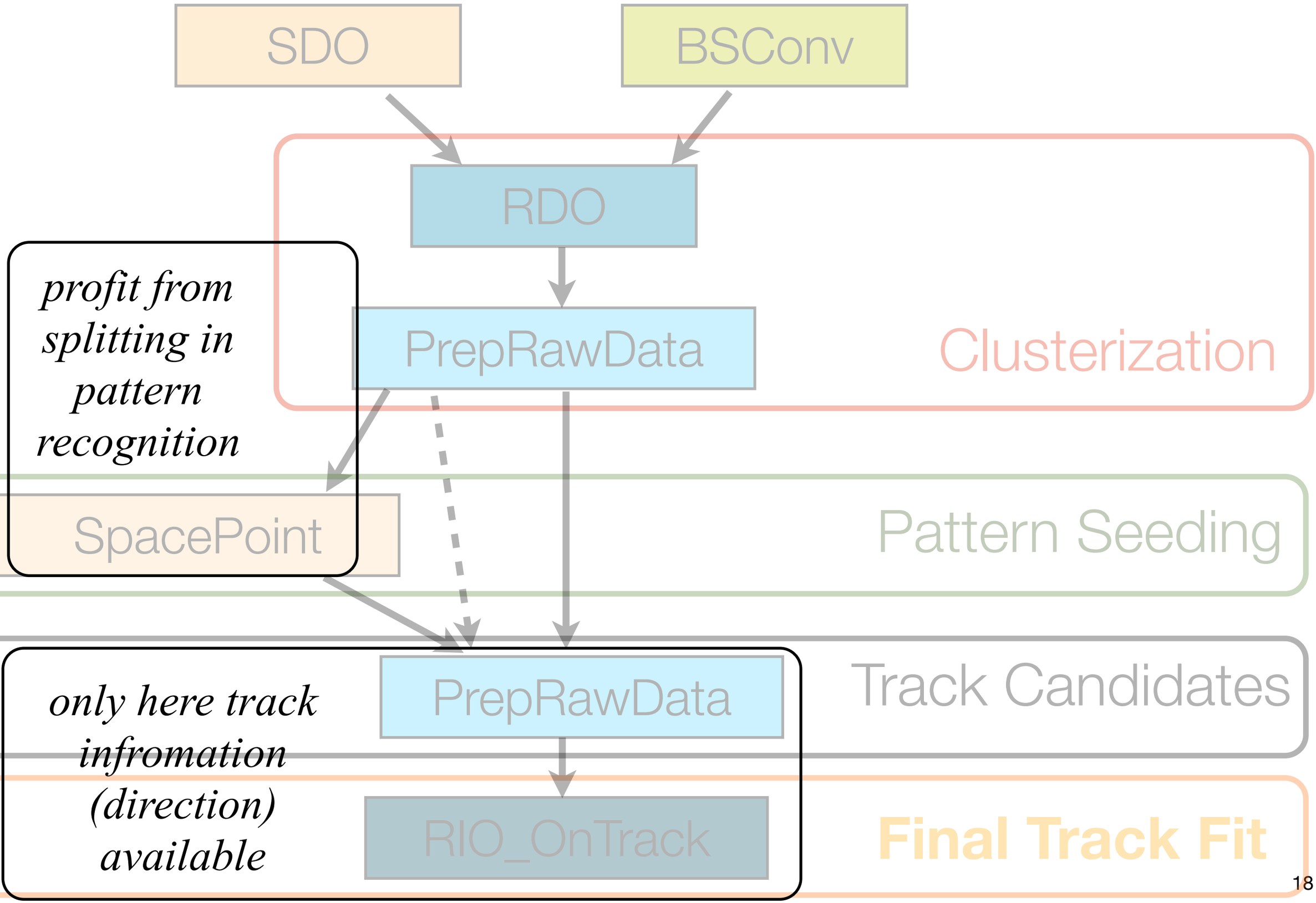
➡ Looks promising, but purely based on MC

➡ Can we train this from data ?
(e.g. reconstruct without B-layer and find "merged" clusters)

(BS/SDO)-> RDOs -> PRDs -> ROTs



(BS/SDO)-> RDOs -> PRDs -> ROTs



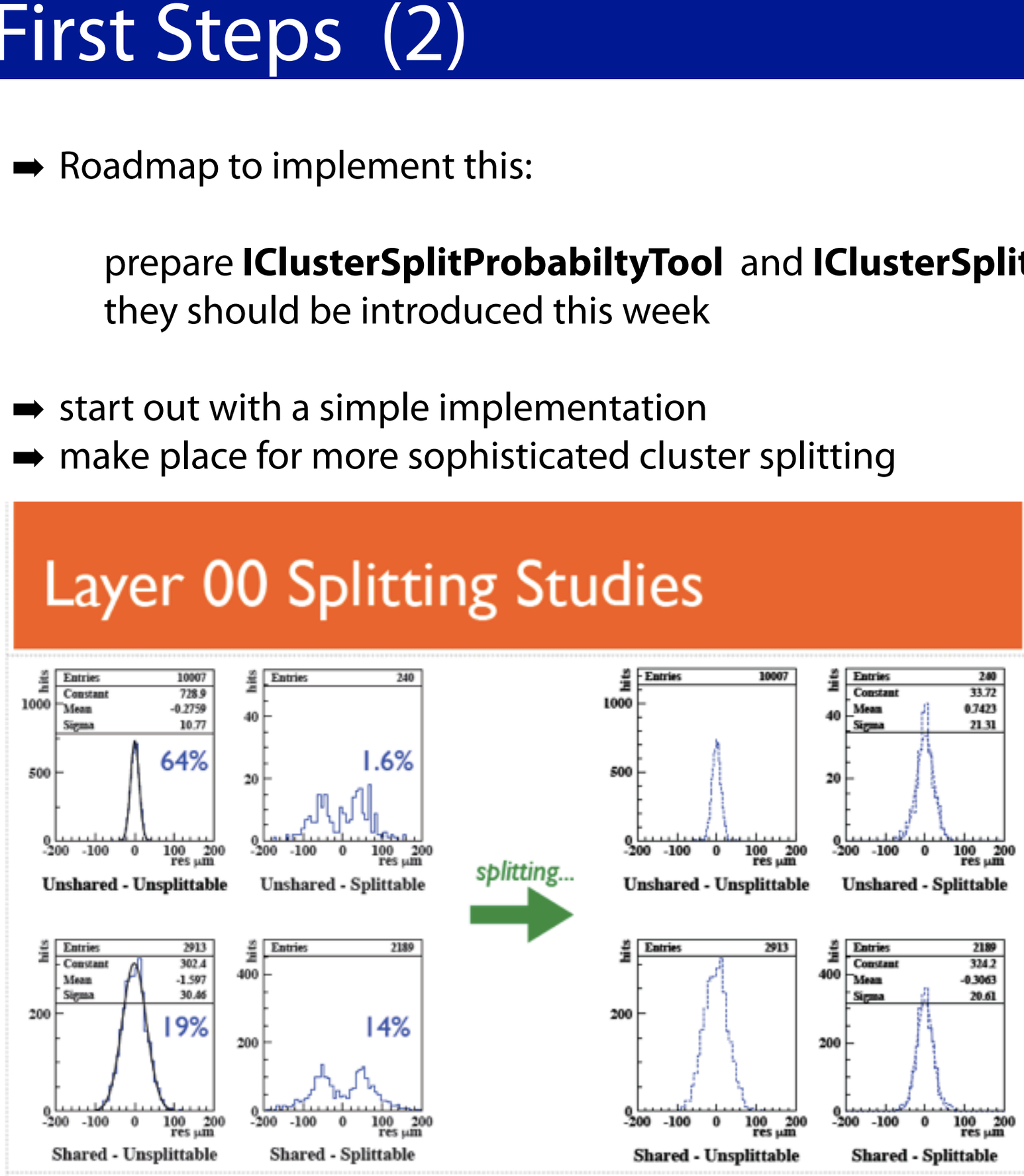
First Steps (2)

➡ Roadmap to implement this:

prepare **IClusterSplitProbabiltyTool** and **IClusterSplitter** interfaces
they should be introduced this week

➡ start out with a simple implementation
➡ make place for more sophisticated cluster splitting

Layer 00 Splitting Studies



stay tuned ...