e – gamma separation – update

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Introduction

Update on results of electron selection in various hardware configurations:

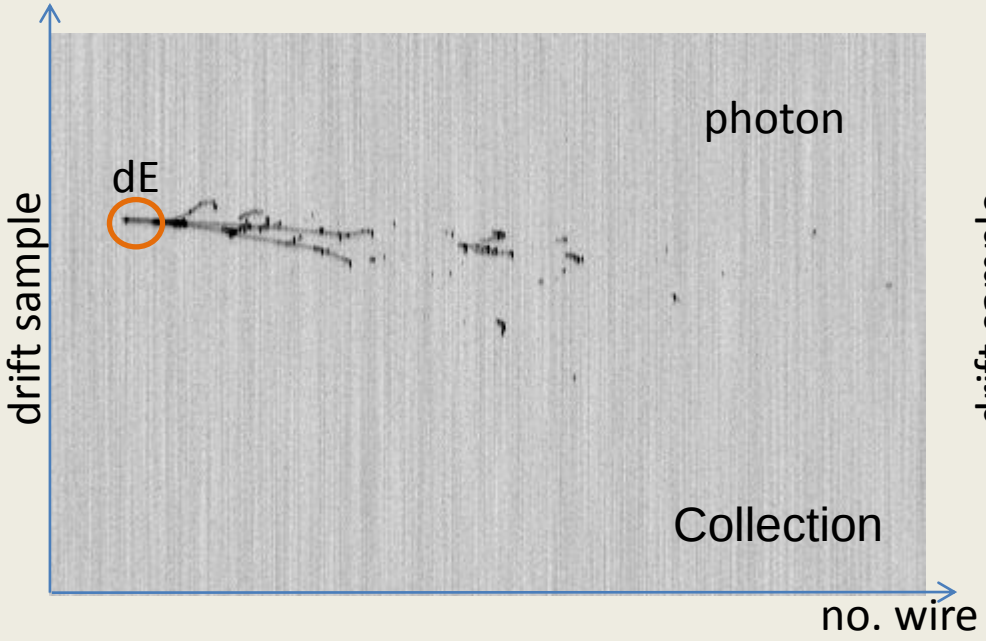
- wire pitch / wire orientations
- S/N level

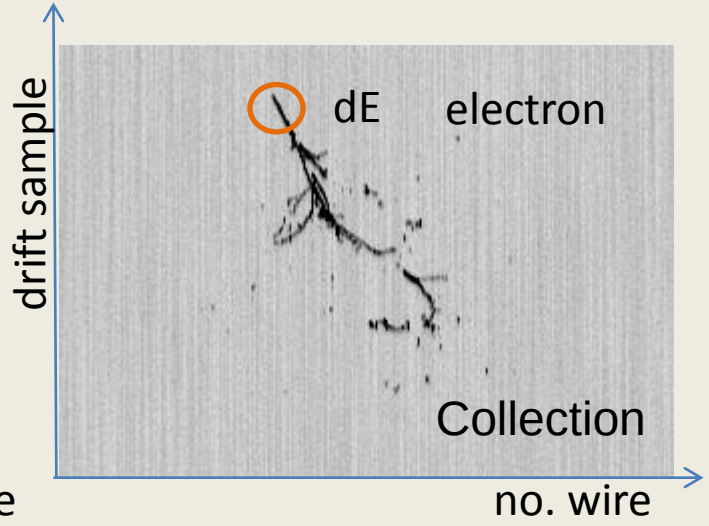
Regardless the final configuration chosen for CERN prototype and Far Detector, the prototype can provide information on:

- S/N level
- possibility to use 3 planes for spatial reconstruction
- possibility to use Iduction for dE/dx measurement

Data

- Simulation of single electrons and photons in FLUKA
- 795 electrons in the **isotropic angular distribution**
- Momentum of incoming particle: **0.2 - 1 GeV/c**
- **APA geo**: wire pitch 4.67 mm, orientation +/- 35.7^{o}
- **T600 geo**: wire pitch 3.0 mm, orientation +/- 60^{o}

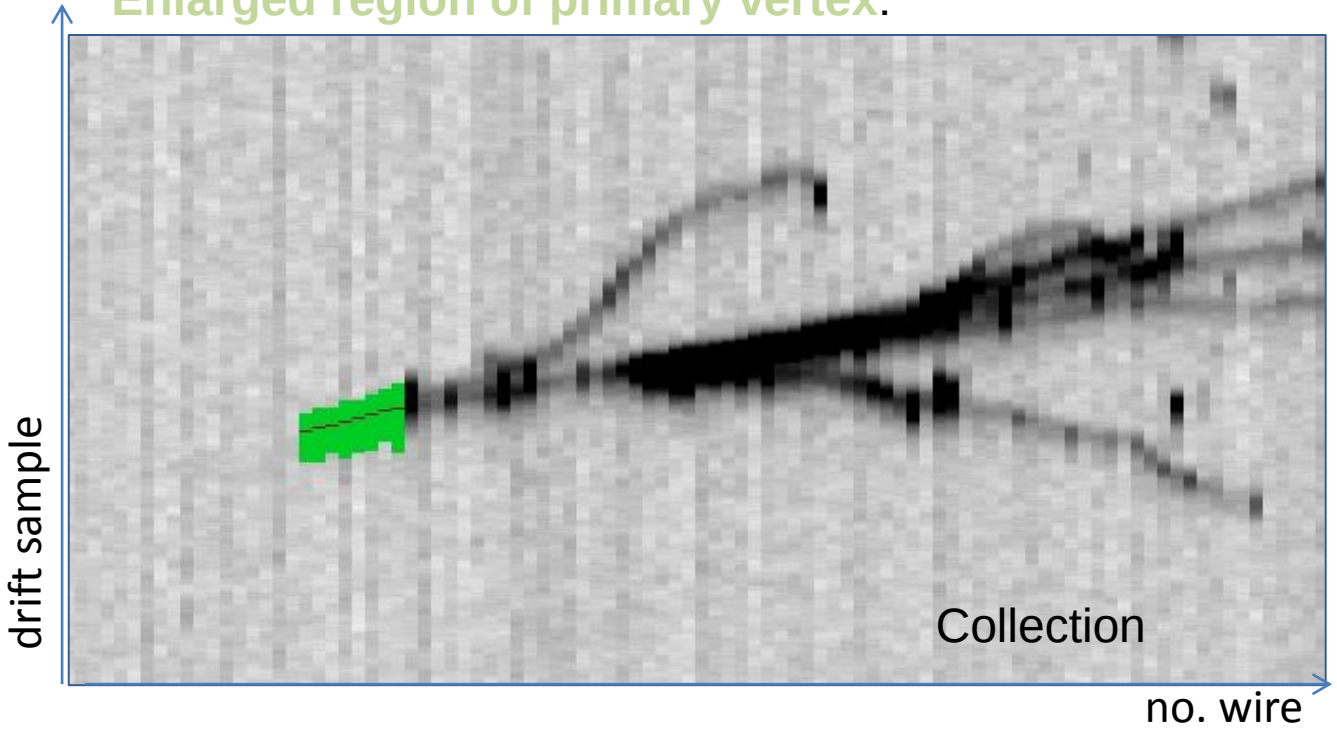




Reconstruction

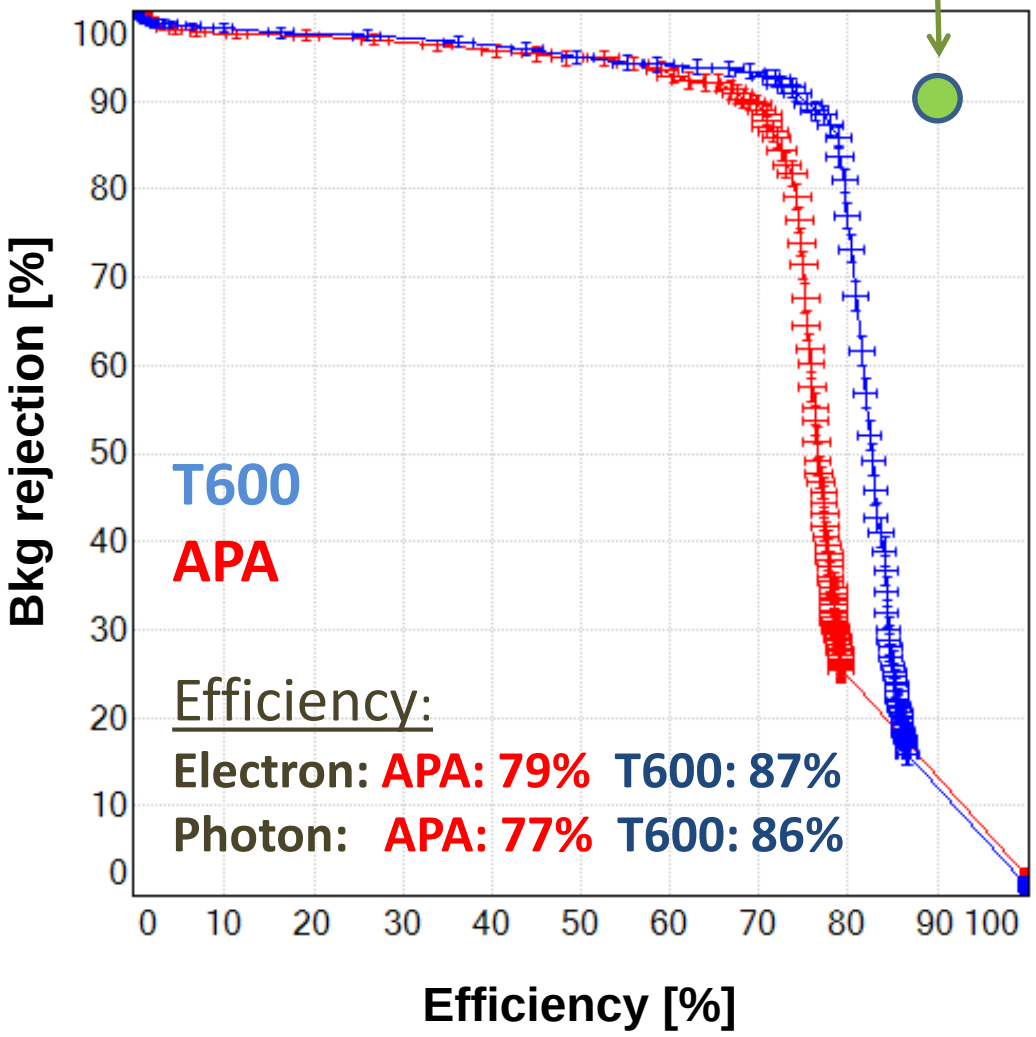
- Cluster from different views → **reconstructed** 3D direction
- Reconstruction used information from Collection and Induction2
- Assumption: only collection used for charge measurement

Enlarged region of primary vertex:



comparison sensitive to the full configuration:
detector and reconstruction

Guess or goal:
90% bkg rejection / 90% signal selection.
However there is a question about normalization: Do we normalize to all events? Do we normalize only to events, which we reconstructed?



Collection view
Induction view
} **3D**

Reconstruction fails due to

- too short 2D projection of the initial part of the cascade
- tracks parallel to the drift coord.

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detector and reconstruction

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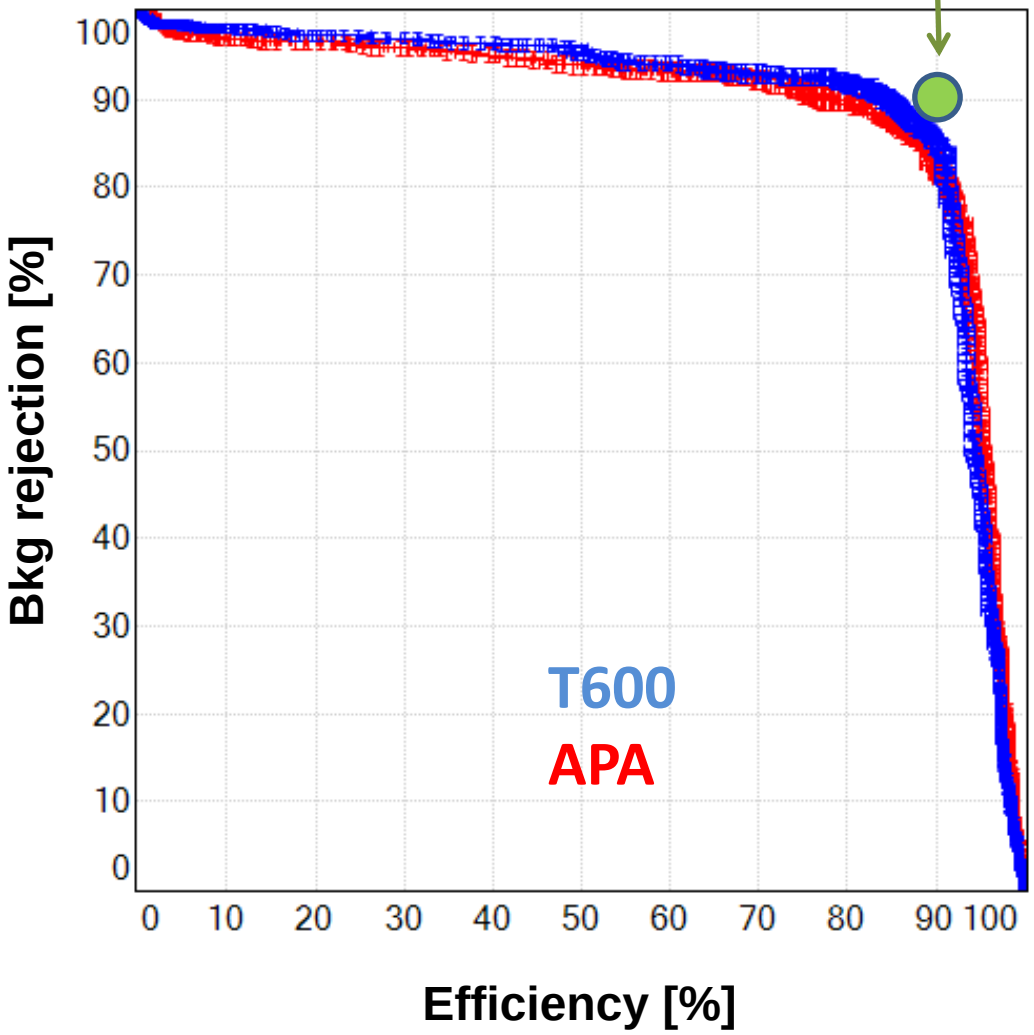
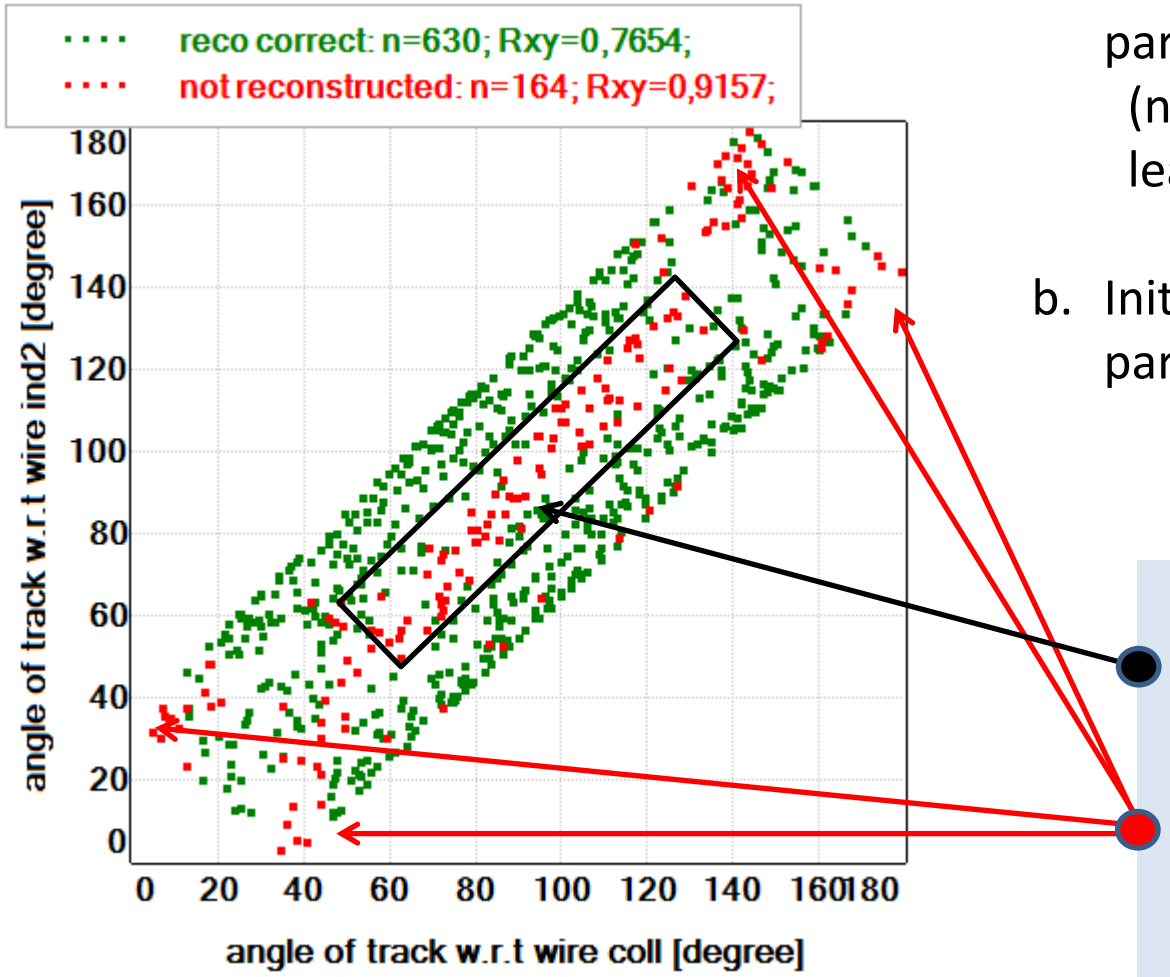


Collection view
Induction view
} **3D**

Normalized to the number of events that passed the reconstruction

Sources of inefficiency - electrons

- **2 views available: Coll and Ind2**
- **Coll used for charge measurement**



79% reconstructed:

a. adverse orientation of the initial part of the cascade
(note: **86%** electrons with at least 9.34 mm (2 hits))

b. Initial part of the cascade parallel to the drift coord.

Parallel to the drift coord., hit finding is difficult in this direction.

Along wires – adverse orientation of the initial part of the cascade

Note for the next slides:

To avoid mixing different factors we use unipolar signal shape in Induction plane.

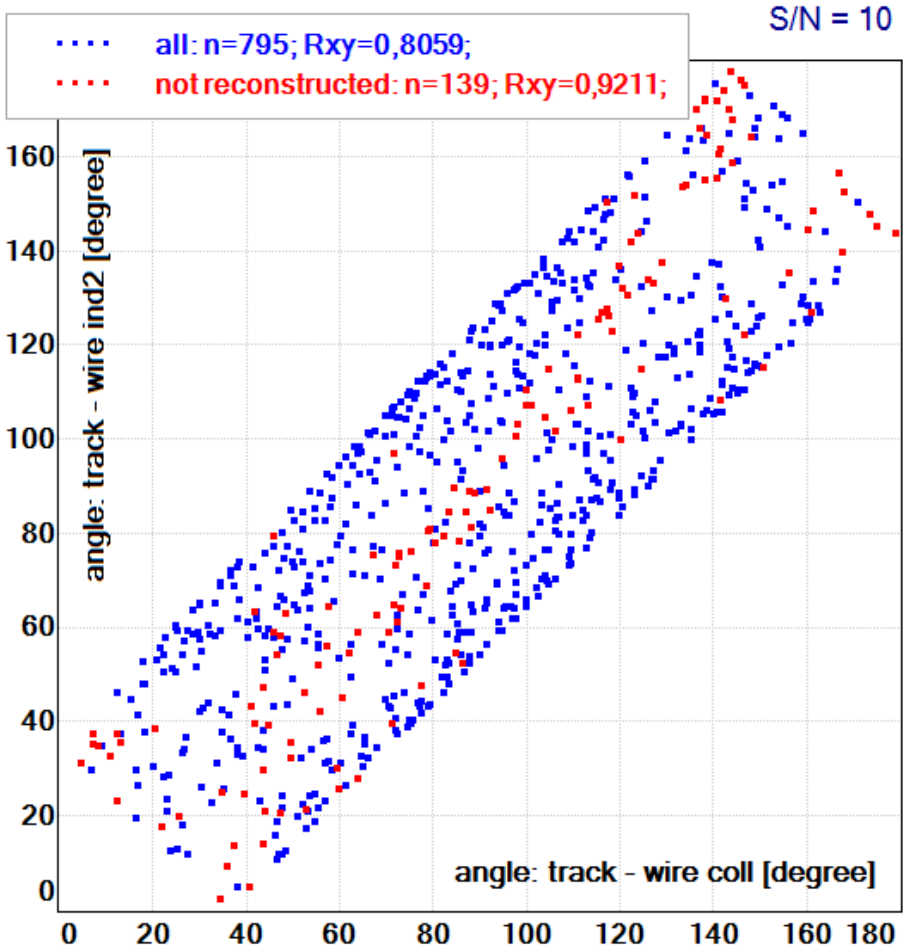
This allows to use the same hit finding in both planes.

Also S/N is assumed the same in both planes.

But we would expect lower performance of Induction plane in real data.

Sources of inefficiency – electrons, S/N = 10

- **2 views available: Coll and Ind**



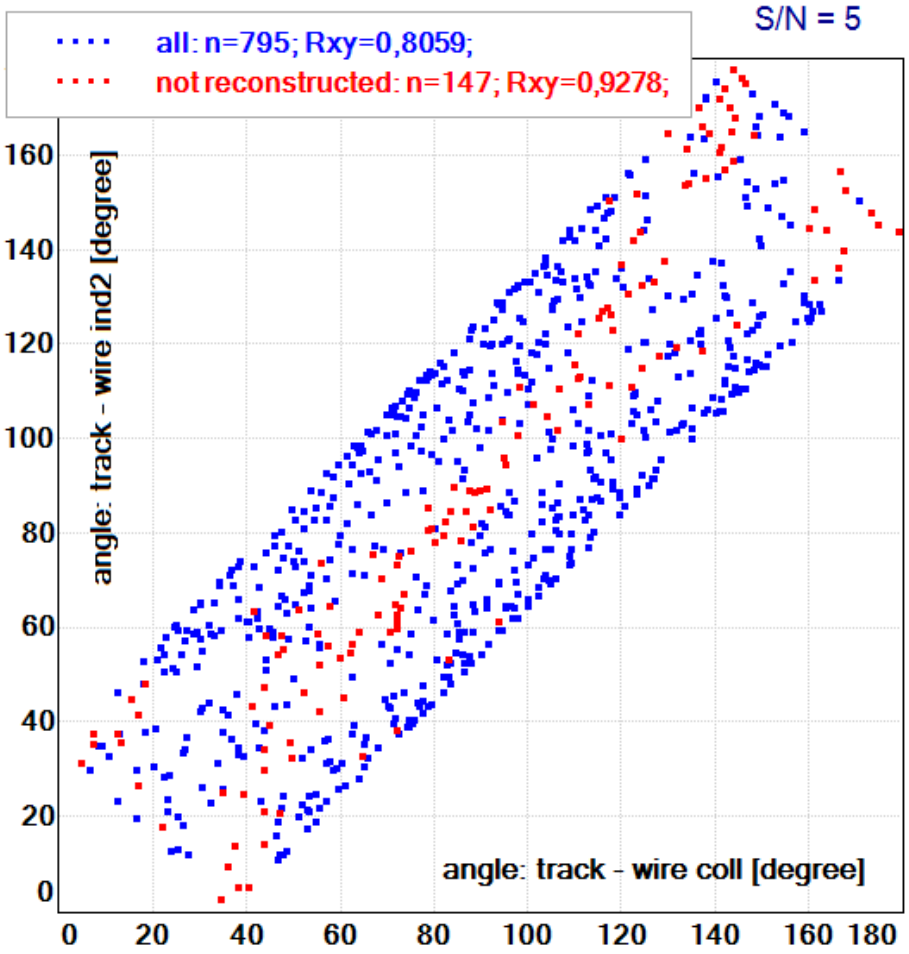
83% reconstructed:

a. adverse orientation of the initial part of the cascade
   (note: **86%** electrons with at least 9.34 mm (2 hits))

b. Initial part of the cascade parallel to the dift coord.

Sources of inefficiency – electrons, S/N = 5

- **2 views available: Coll and Ind**



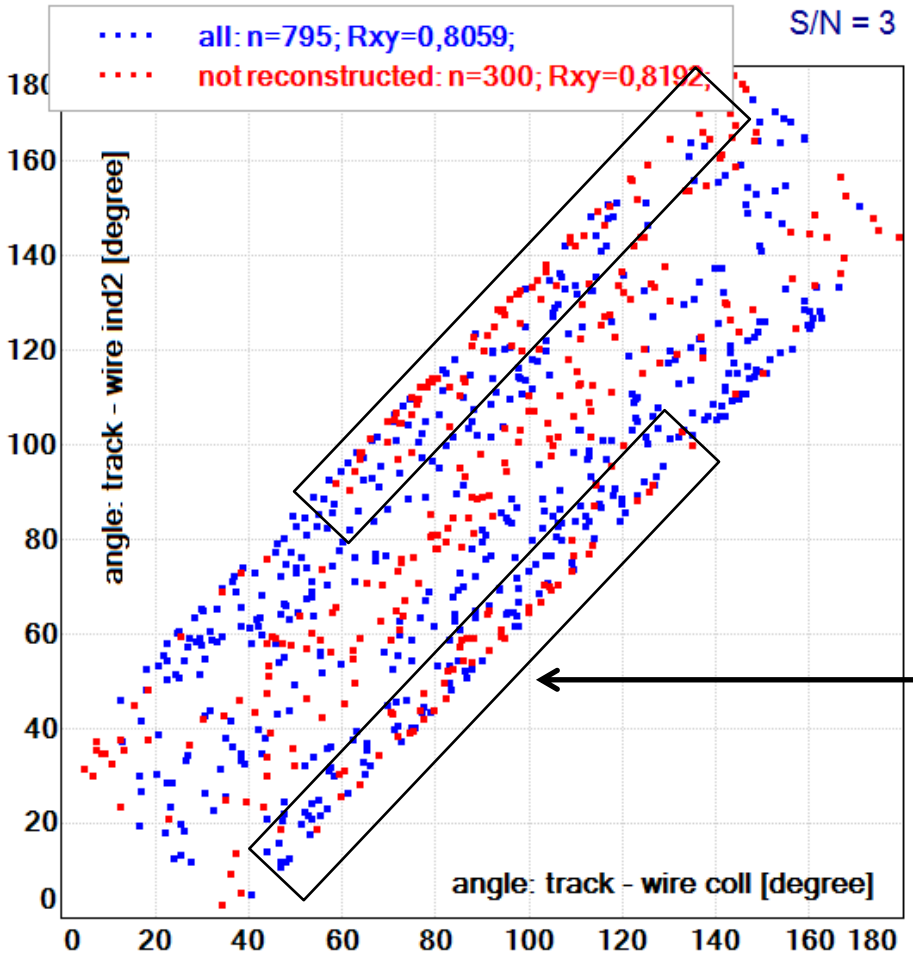
82% reconstructed (1% less w.r.t S/N = 10):

a. adverse orientation of the initial part of the cascade (note: **86%** electrons with at least 9.34 mm (2 hits))

b. Initial part of the cascade parallel to the dift coord.

Sources of inefficiency – electrons, S/N = 3

- **2 views available: Coll and Ind**



62% reconstructed (21% less w.r.t S/N = 10):

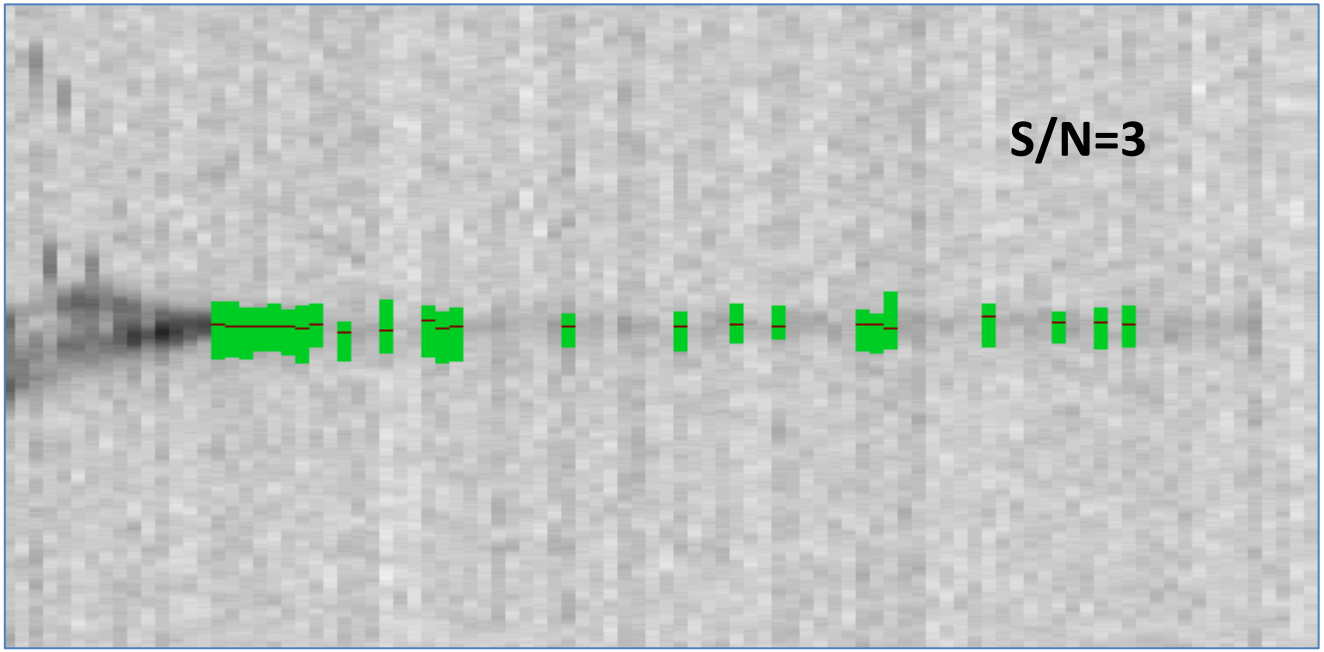
a. adverse orientation of the initial part of the cascade, (note: **86%** electrons with at least 9.34 mm (2 hits))

b. initial part of the cascade parallel to the dift coord,

c. tracks parallel to the wire plane AND many wires are crossed → smaller S/N ratio w.r.t other orientations.

Example of the initial part of the cascade for S/N = 3

- track parallel to the wire plane
- many wires crossed

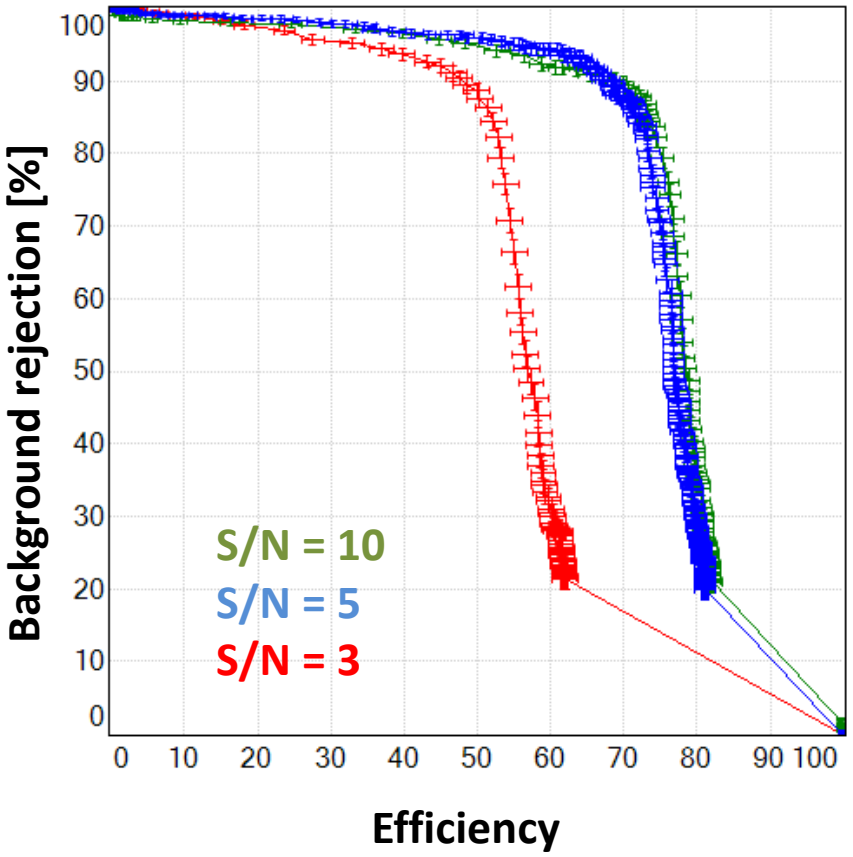


Two effects:

1. Prevent the automatic reconstruction
2. Reduce statistics on the dE/dx evaluation

- Signal „visible” in 2D correlations – in principle, possible to prepare algorithm (image-processing-like) to deal with such situation.
- If above done, higher noise in dE/dx than in a shorter 2D projections can be expected.
- But – this recovers an electron event, while a double m.i.p. in case of gamma still has higher signal level and should not be affected with this S/N.

Separation e-gamma for different S/N



Compare comments on slide 11:

Low S/N affects mostly electrons (1m.i.p) and **decrease efficiency**; gamma (2m.i.p) is not changed very much.

-> With higher S/N or/and good 2D processing we can ensure that electrons are not missed.

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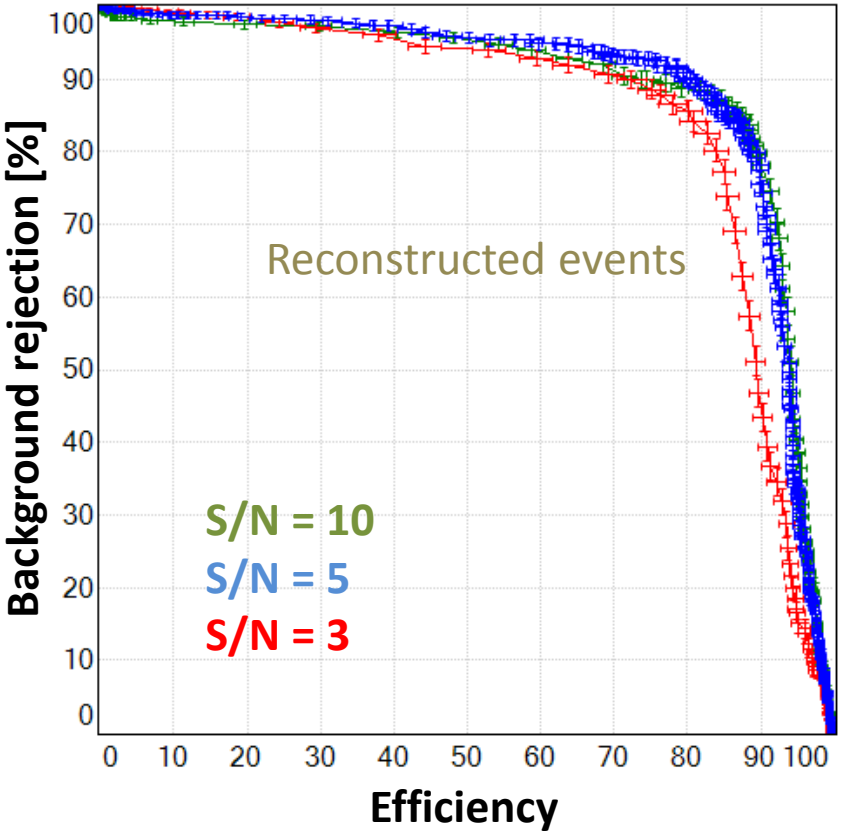

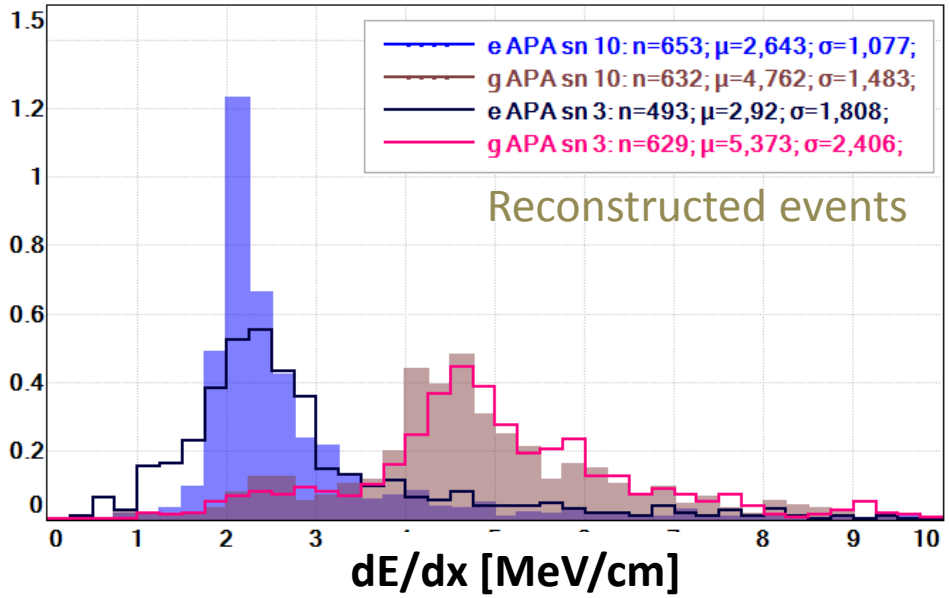

Compare comments on slide 11:

Low S/N affects mostly electrons (1m.i.p) and decrease efficiency; gamma (2m.i.p) is not changed very much **-> overall sig.selection/bkg.rejection curve slightly lower.**

-> With higher S/N or/and good 2D processing we can ensure that electrons are not missed.

Summary

- Goal: the best possible separation of electron-gamma.
- Low S/N or wire geometry can affect the **number of reconstructed events**.

  -> efficiency can decrease
- The effect of smearing e/gamma dE/dx peaks is less dangerous

  -> we do not loose much on the max. achievable bkg rejection

- Inefficiency sources:

a. Effect of the adverse orientation of initial part of cascade – can be minimized when 3 wire planes are used for reconstruction, and 2 of them for charge measurement.

b. Initial part of the cascade parallel to the dift direction – problem is due to long signal which is difficult for hit finding (needs another approach than hit(pulse, gauss, …) finding for tracks crossing many wires in 2D projection).

c. S/N is very low: tracks with long 2D projection affected.