FastSim EMC status and plans

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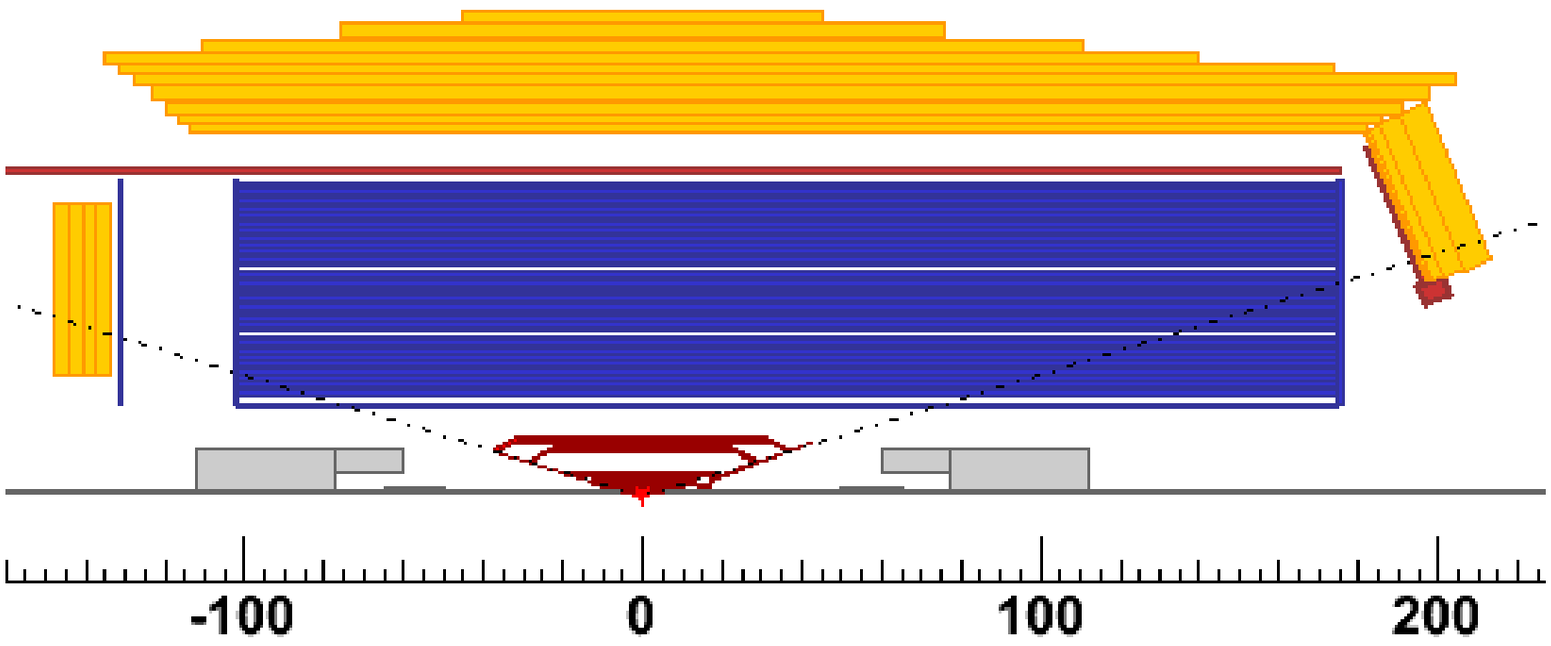
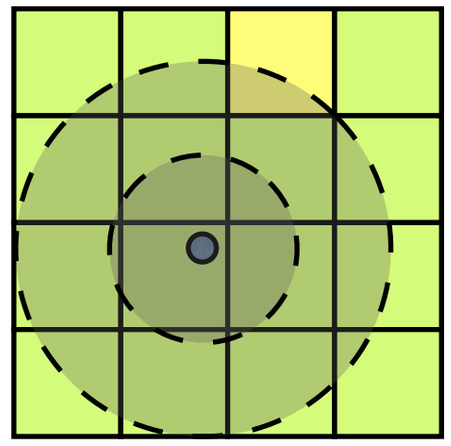
Brief discription

- EMC volumes are modeled with layers of 2D planes.
- Probability of showering and energy deposition of a particle intercepting a plane is calculated based on particle type, radiation/interaction length, shower profile.
- Each energy point is then distributed to a grid of crystals (θ,φ) based on the integral of a profile $f(r;R_M)$ over the crystal area (EM shower).
- Hadron shower distribution is created with a random walk scheme to create irregular shape.





Brief discription

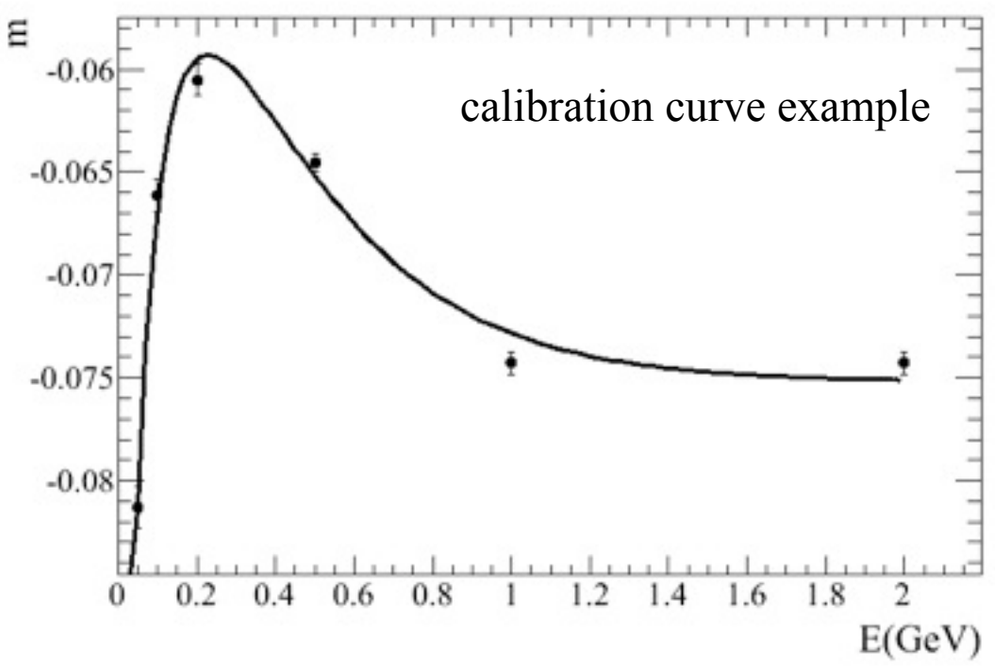
- Contributions from all layers are then merged to become a single cluster.
- Energy is smeared based on a resolution function, and then calibrated.
- Crystal energy is fluctuated to create randomize cluster shape; noise added around the cluster.
- Cluster from one particle is then split if it has more than one local maxima (with caveat).
- All cluster undergo a final merge stage if any pair can merge to create a single bump cluster.
- Most parameters are defined in an xml file.
- Current SuperB default configuration is *BABAR* barrel, LYSO forward endcap (with the same resolution as barrel), and backward EMC.

Status

- There has been very little development in EMC fastsim for the past year (or more).
- The main focus has been studying effects on energy resolution and physics sensitivity due to background and photon sensors/electronics variations.
- Two related updates to EMC are underway:
  - Allow to modify resolution parameters without re-calibration [E. Manoni].
  - Allow to use arbitrary pulse shapes by reading from tables [D. Chao].
- Both developments are in a rough stage (in terms of code) and not committed.

Resolution and calibration

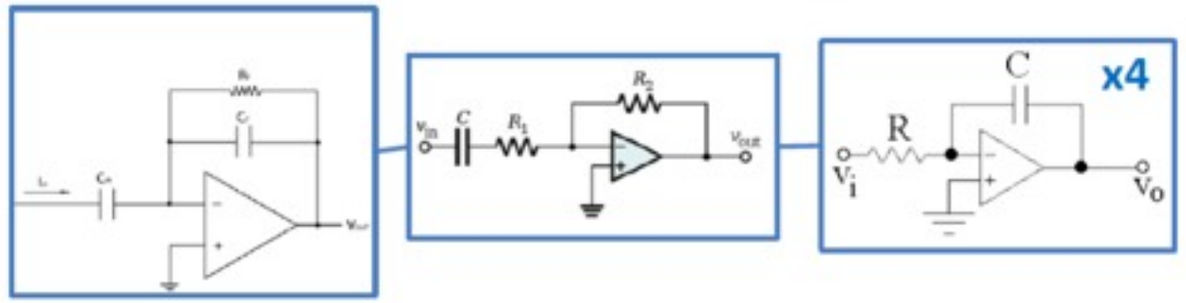
- Because of shower leakage and some approximations made in cluster creation, the energy distribution peak is lower than real photon energy. The shift is a function of energy. Also energy calculated at this stage already has fluctuations, before smearing is applied ("intrinsic" resolution).
- The energy smearing is done two stages, first a Gaussian and then an exponential to create a tail. As a result, the energy peak shifts again, depending on the resolution function for the tail.
- Elisa has developed a new method to smear with crystal ball function to keep resolution peak stable, so one doesn't have to recalibration every time resolution changes.
- She also developed a way to subtract the effect of "intrinsic" so the output resolution is exactly the parameters described. But the procedure is still a bit messy.

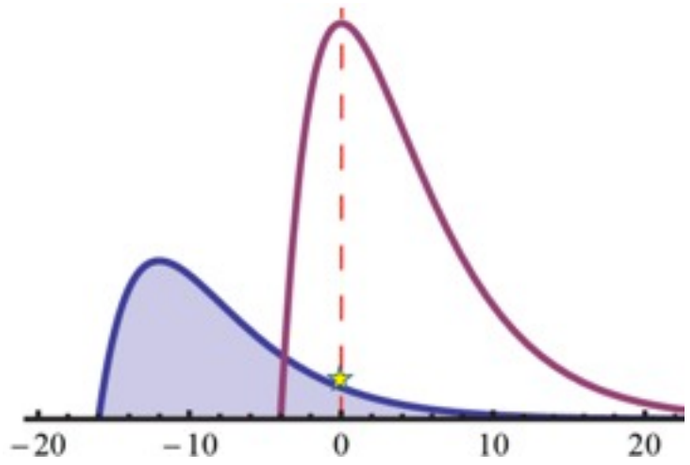


calibration curve example

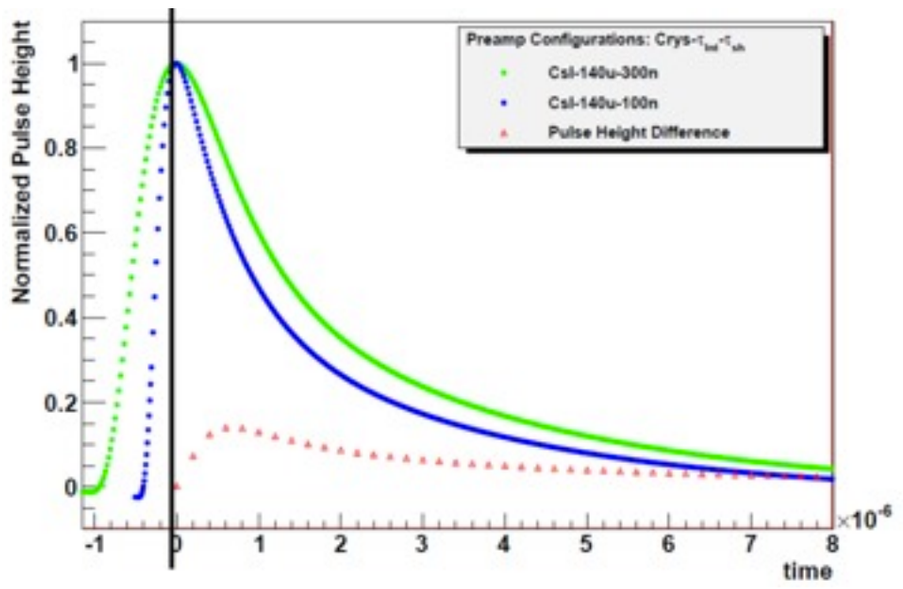
Pulse shape timing

- Pulse shape and timing window modeling is crucial to studies of background effects.
- Current model uses a simple CR-RC analytical function. But the real electronic is more complex. E.g.,



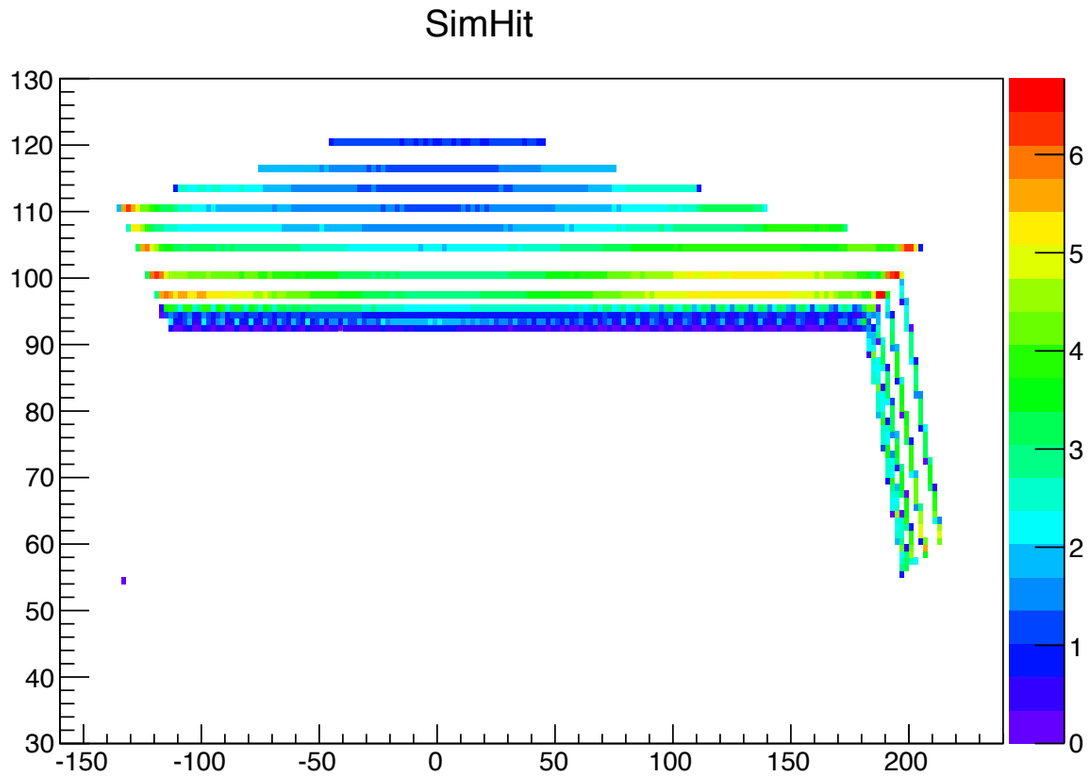


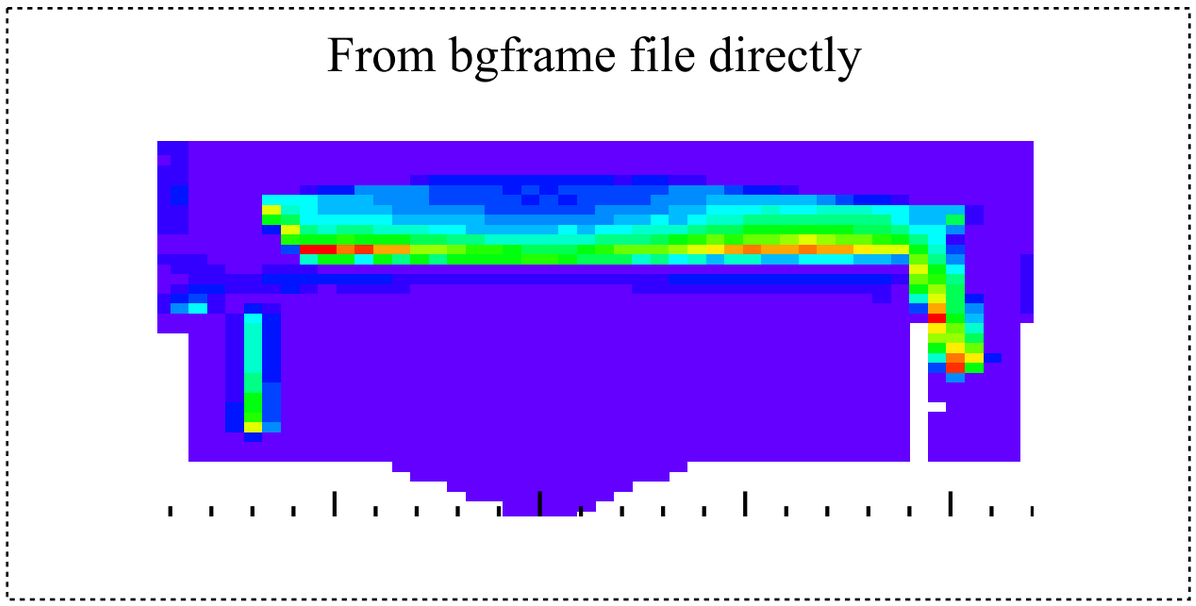
- Daniel developed a way to read the pulse shape from a table generated from outside source, e.g., electronic circuit simulator.



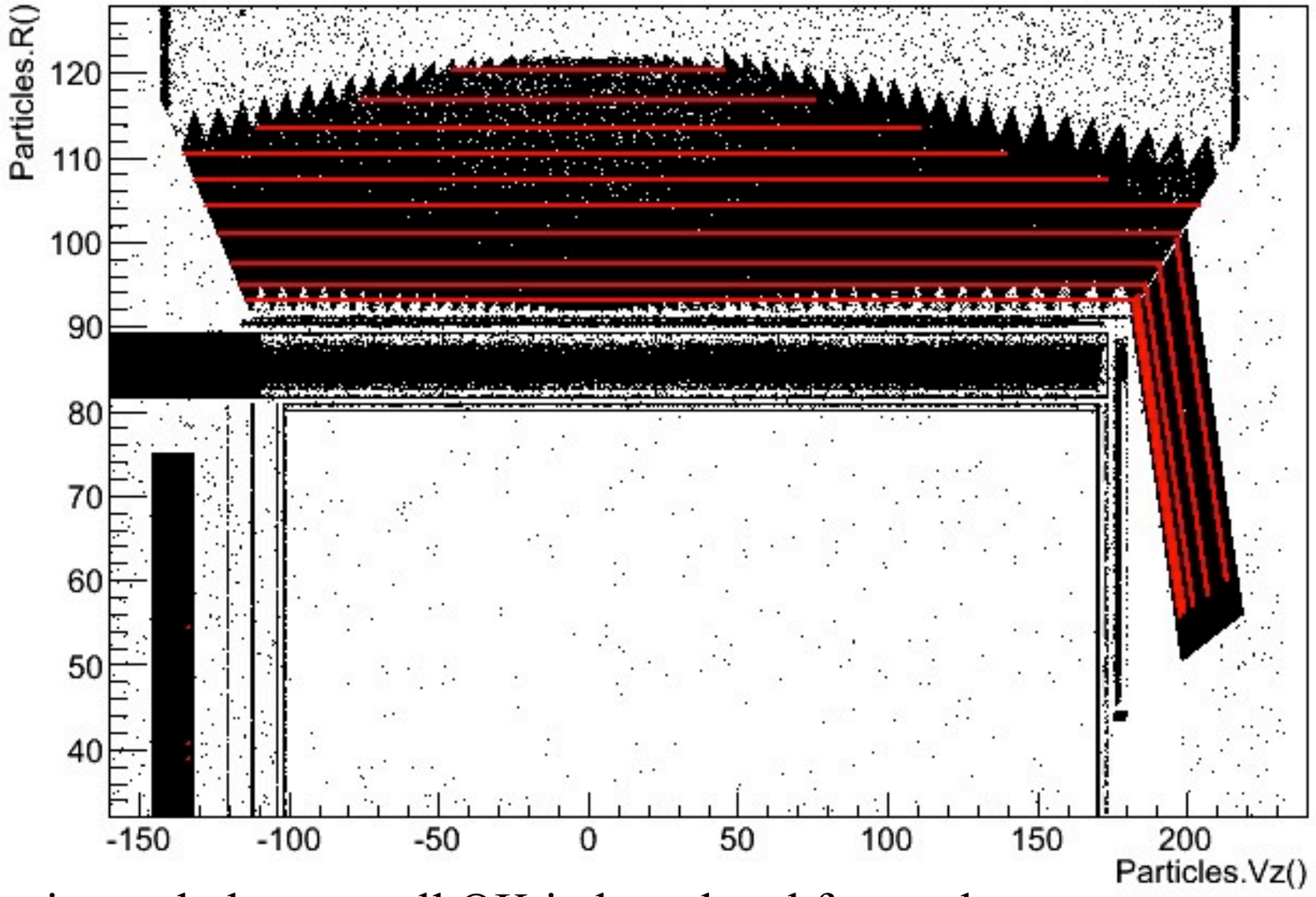
Recent problems

- While studying background and radiation rate using RadBhabha background frame, we found FastSim sees too little background compared to full simulation.
- Part of it is probably due to a quite high energy cut (8 MeV) in bgframe, but there appear to be missing SimHits from neutron.





Compare geometry



- There is small mismatch, but overall OK in barrel and forward.
- Neutrons go in all directions, so those layers may not catch them all. Ability of dealing with very low E (there are a lot of sub-MeV neutrons)?
- Backward is (almost) totally missing.
- Need investigation. Soon!

Black: Neutron hits from bgframe
Red: FastSim SimHit

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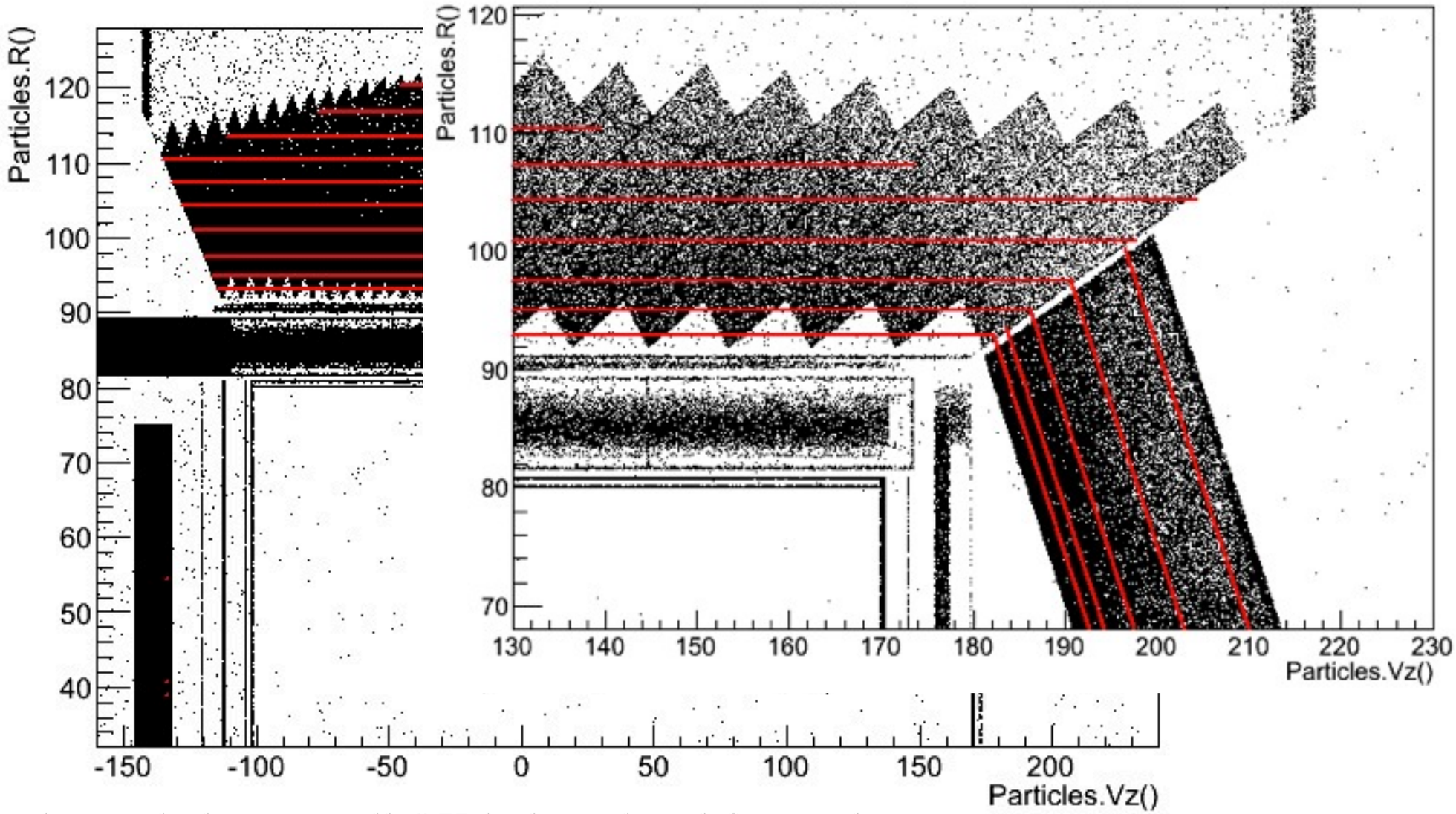

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What's next?

- Bug fixes.
- Cross check with full sim.
- Incorporate LYSO beam test energy resolution, and other detector options.
- Allow hybrid system in the forward.
- Allow variations in resolution model / efficiency in individual crystals (?).
- More realistic model for the backward.
- Clustering algorithm.
- Other requirements?