HyCal Digitization Radiative effect

- Using simulation to study whether the small radiative tail from the data and HyCal digitization make sense

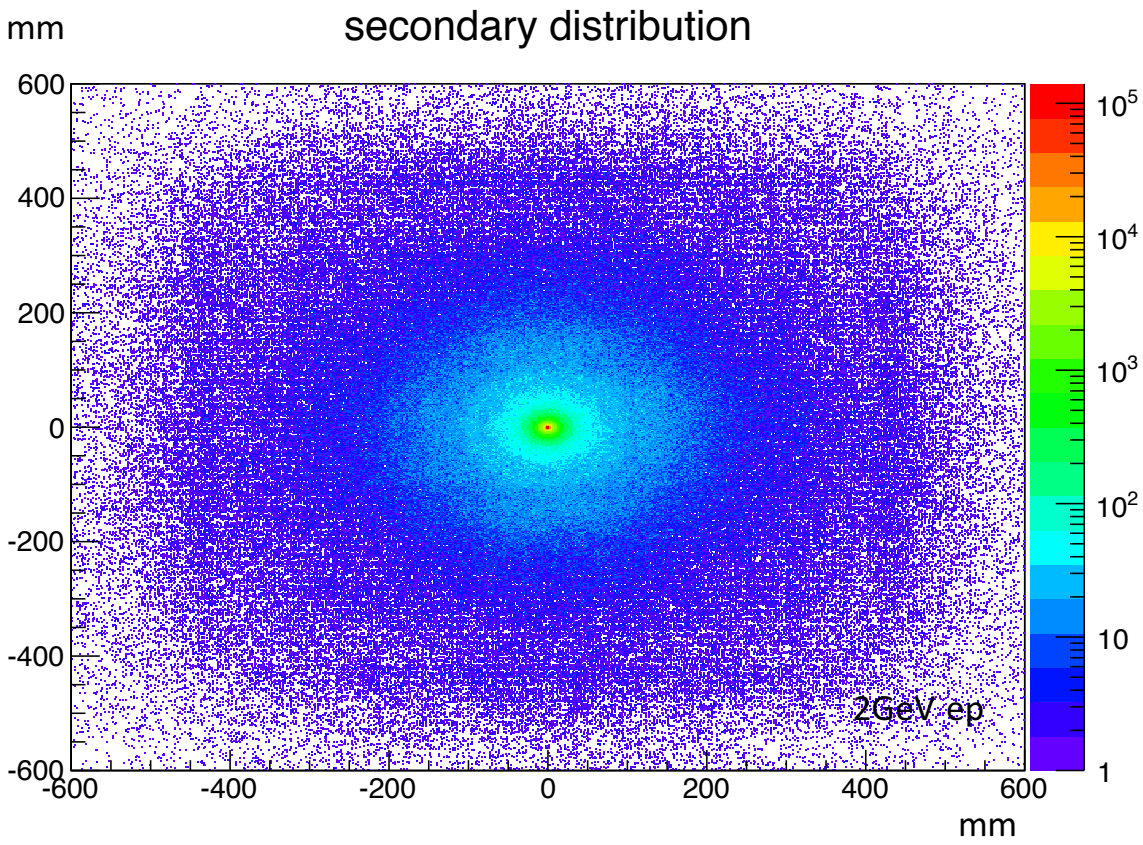
- Due to granularity of HyCal, there is no way to separate two particle if they are within 1.5 times the module size (we need at least a valley to define two local maximum)

- Even if two particle are separated by more than 1.5 times the module size, it is not guaranteed that there are two local maximum (low energy particle landing on a large and fast descending tail)

- From this study, I want to get a rough estimation on how much the radiative tail will change with and without using HyCal digitization, so that we can trust our digitization

Radiative effect for ep

- Using ep to start as it is much easier
- Select ep with with 0.7 deg < theta < 5.5 deg
- Plot shows all secondary particles (e+, e- and photons) hit position relative to the scattered electron position on HyCal
- Includes external and internal radiation and their secondaries
- We still see the LG boundary because most of the ep are near the center of HyCal
- Most of the secondary are within +/- 50mm from the scattered electron



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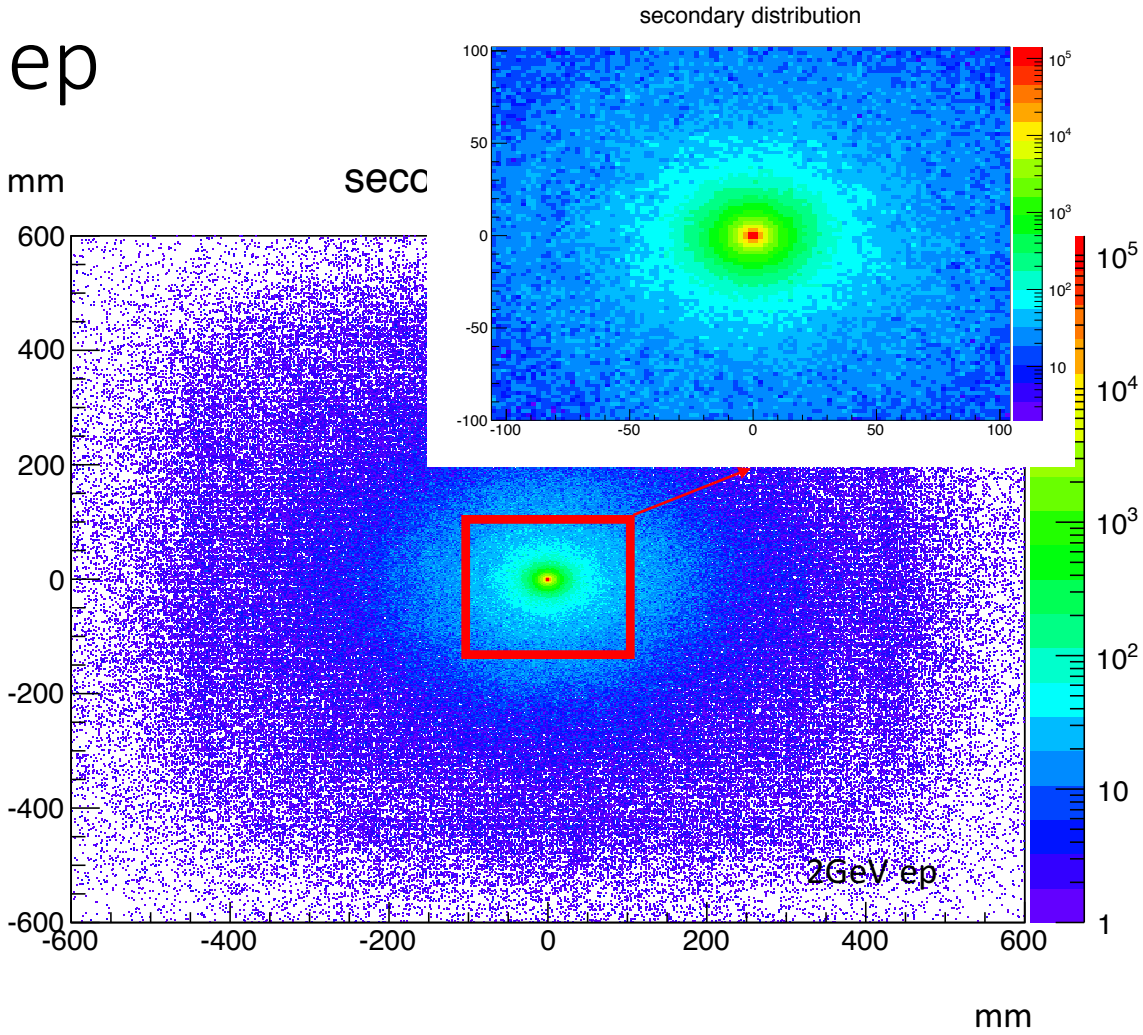
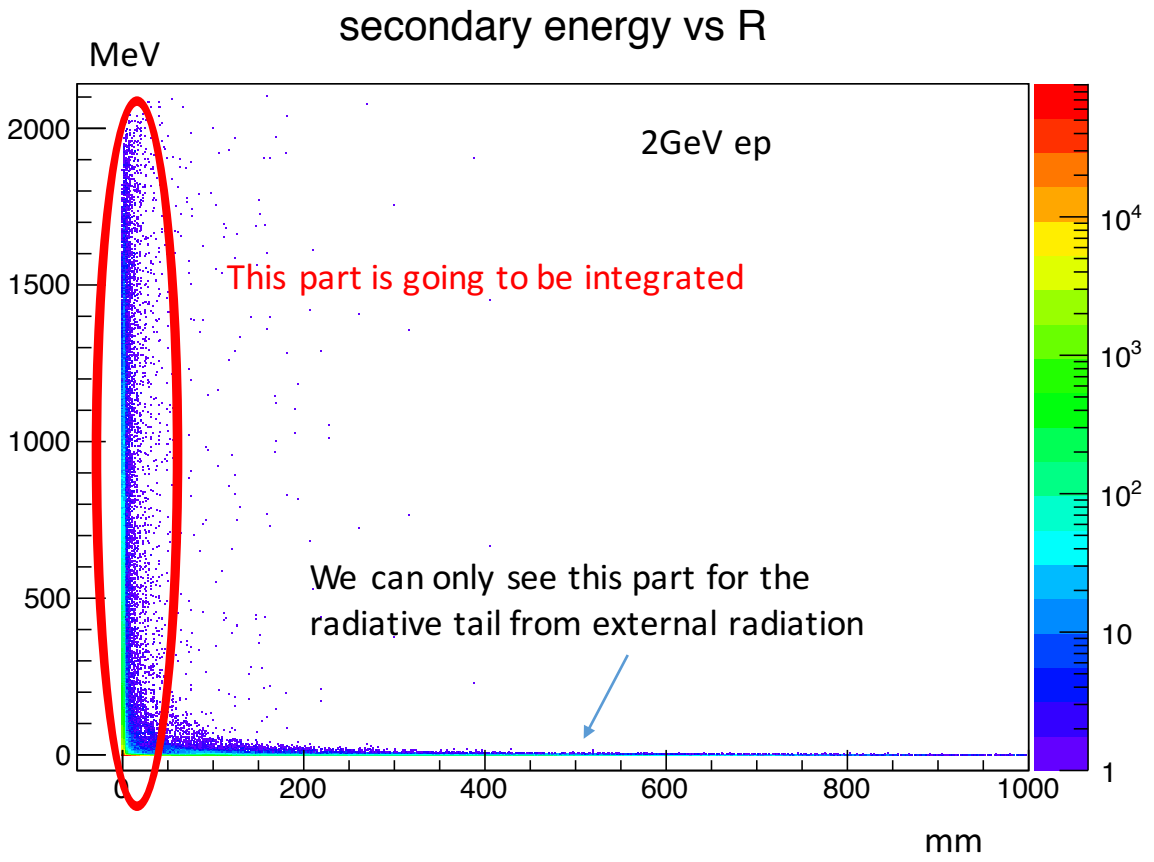


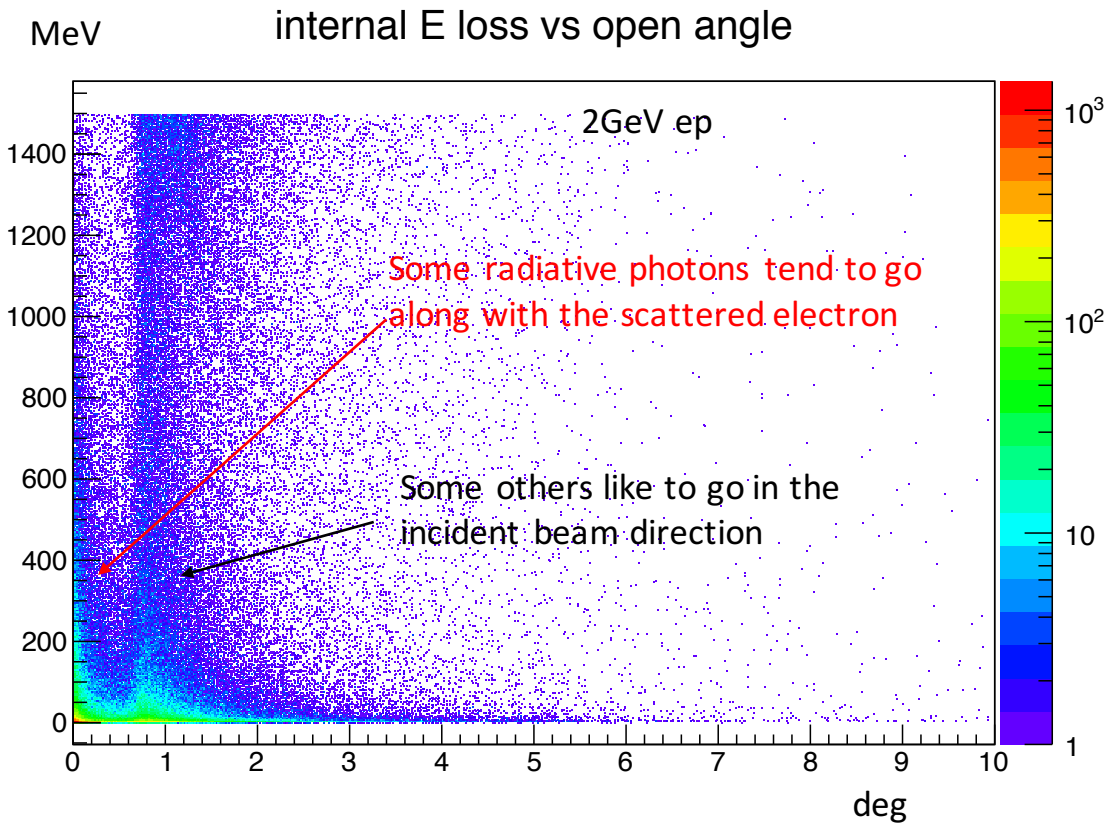
External Radiative effect for ep

- Plot shows the energy of all particles from external radiation as a function of the distance to the hit position of the scattered electron on HyCal
- Select event that has no internal radiative photon to exclude internal radiation effects
- High energy secondary from the external radiation tend to go very closely with the scattered electron
- High energy ones are going to be integrated into the same cluster as the scattered electron
- Low energy ones can go very far away



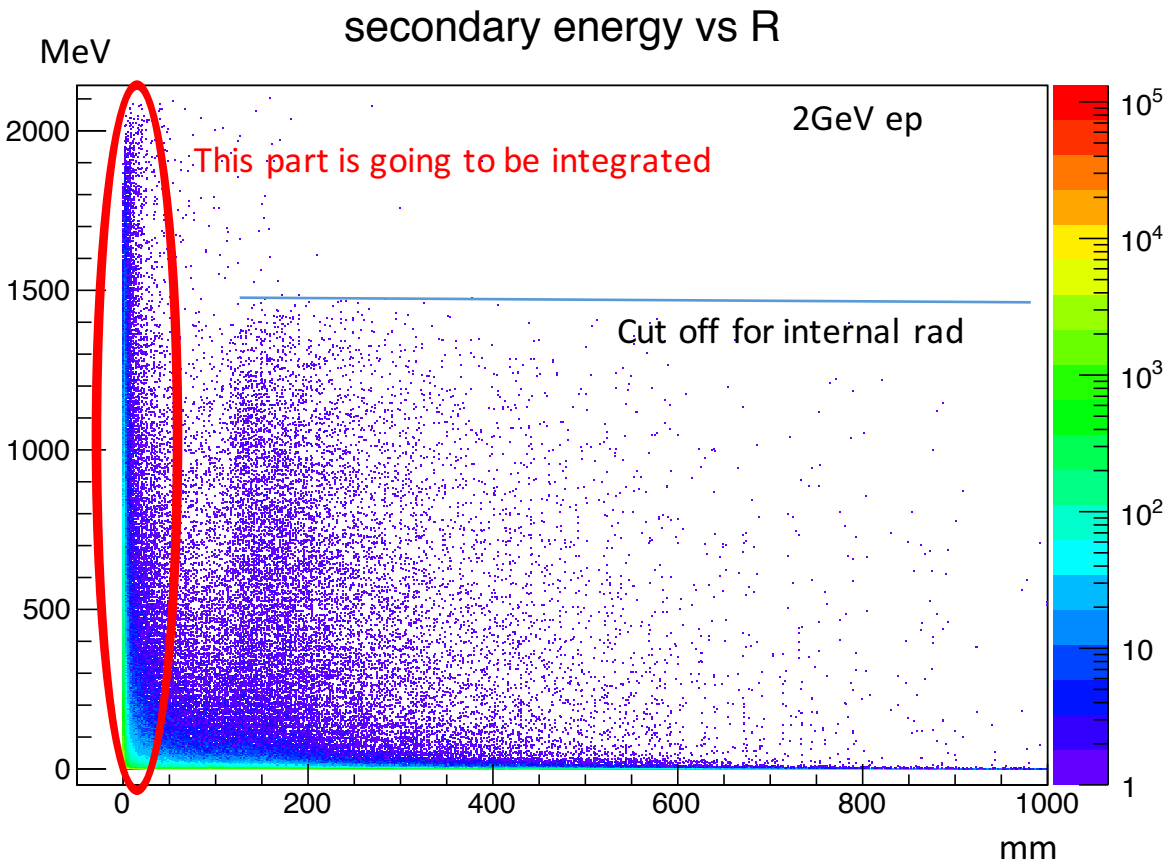
Internal Radiative effect for ep

- Using Gramolin's ep event generator
- Plot shows the energy of the radiative photon as a function of the opening angle between the photon and the scattered electron
- Gap between 0 and 0.7 deg due to the minimum theta angle cut (0.7 deg) for the scattered electron
- Maximum internal radiative photon energy set at 1499MeV (default value in the program)



Total radiative effect for ep

- Plot shows the secondary particle energy as a function of their distance to the scattered electron on HyCal
- Maximum internal radiative photon energy set at 1499 MeV (default value)
- All secondary within 30mm from the scattered electron are going to be integrated into the cluster energy for sure
- Most of the high energy secondary (mainly from external radiation) are going to be integrated into the same cluster as the scattered electron
- Gap between R = 0 mm and R = 150mm comes from the gap in internal radiation



Radiative effect for ep

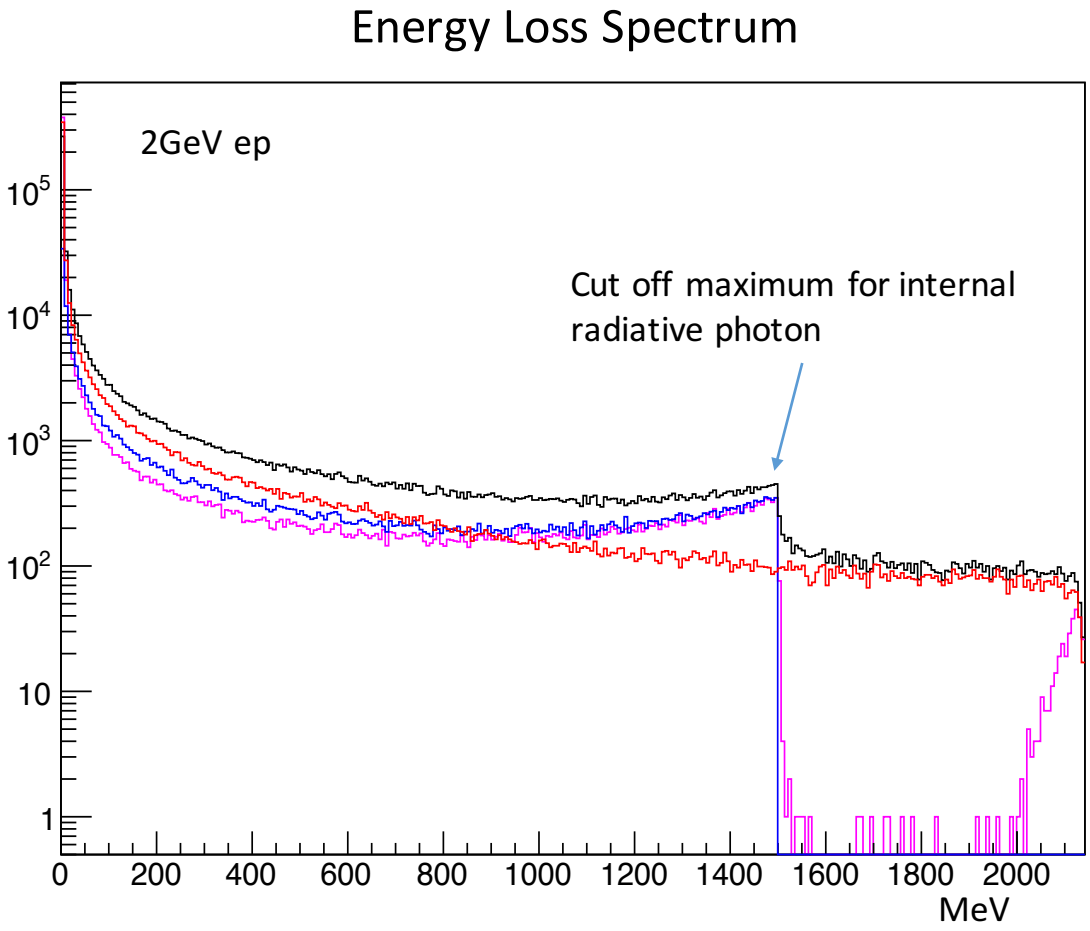
Blue: energy loss of internal radiation, as given by the energy of the internal radiative photon

Rad: energy loss of external radiation, as given by the difference between the scattered electron energy at the vertex and at HyCal

Black: total energy loss, sum of internal and external energy loss

Magenta: sum energy of all secondary within a 30mm radius from the scattered electron on HyCal. And subtract this from the total energy loss

We do expect to see a few times smaller radiative tail if using HyCal digitization



Radiative effect for ee

Blue: energy loss of internal radiation, as given by the energy of the internal radiative photon

Rad: energy loss of external radiation, as given by the difference between the sum of the two electrons energy at the vertex, and at HyCal

Black: total energy loss, sum of internal and external energy loss

Magenta: sum energy of all secondary within a 30mm radii from each scattered electron on HyCal. And subtract this from the total energy loss

We do expect to see a few times smaller radiative tail if using HyCal digitization