Studying the "confusion term" for different geometries (B and R_{min})

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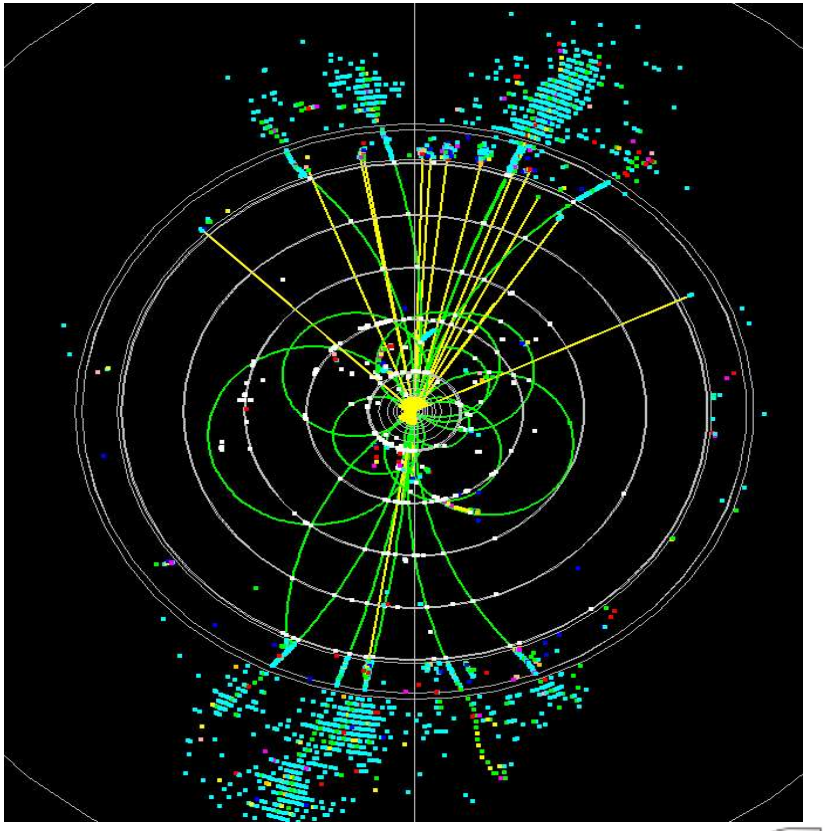
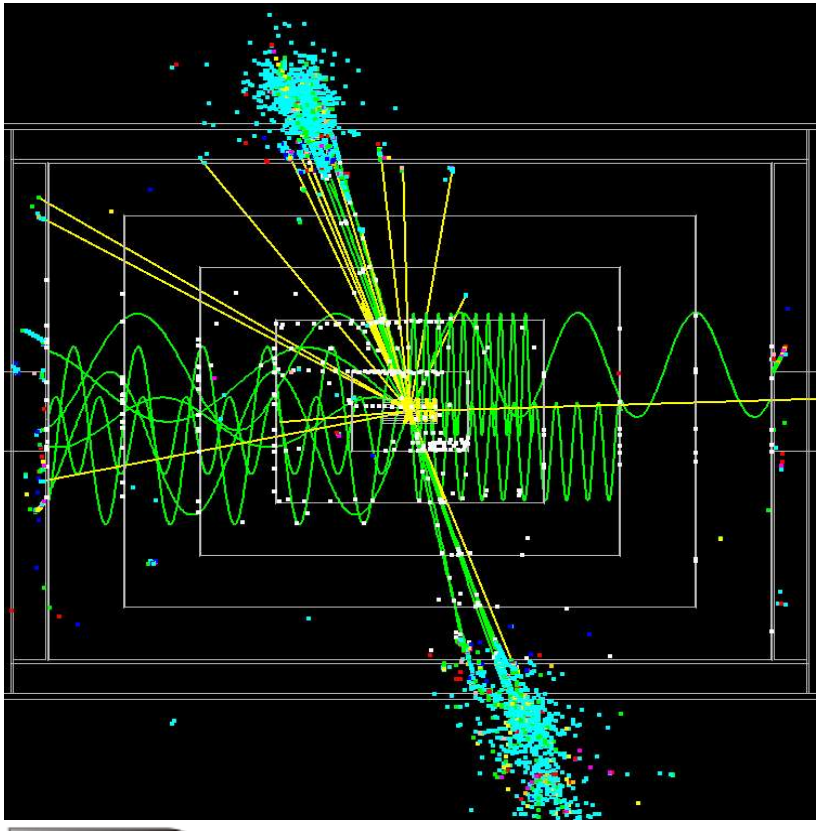
What's the “confusion term”?

- Some hits are due to more than one particle depositing energy in a single calorimeter cell

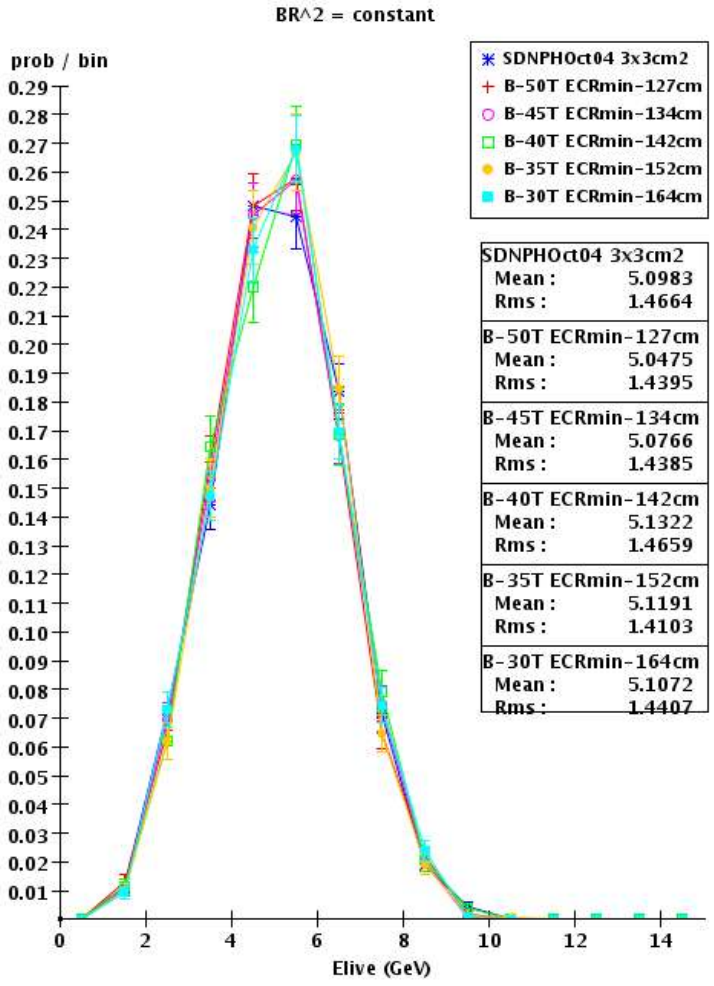


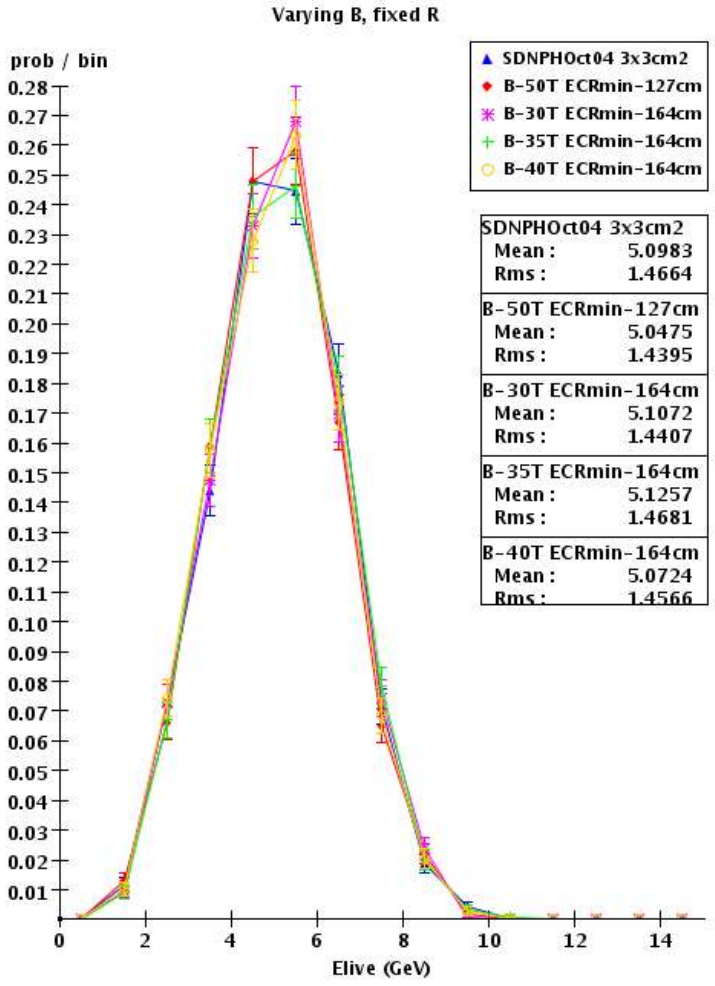


Studying the confusion term

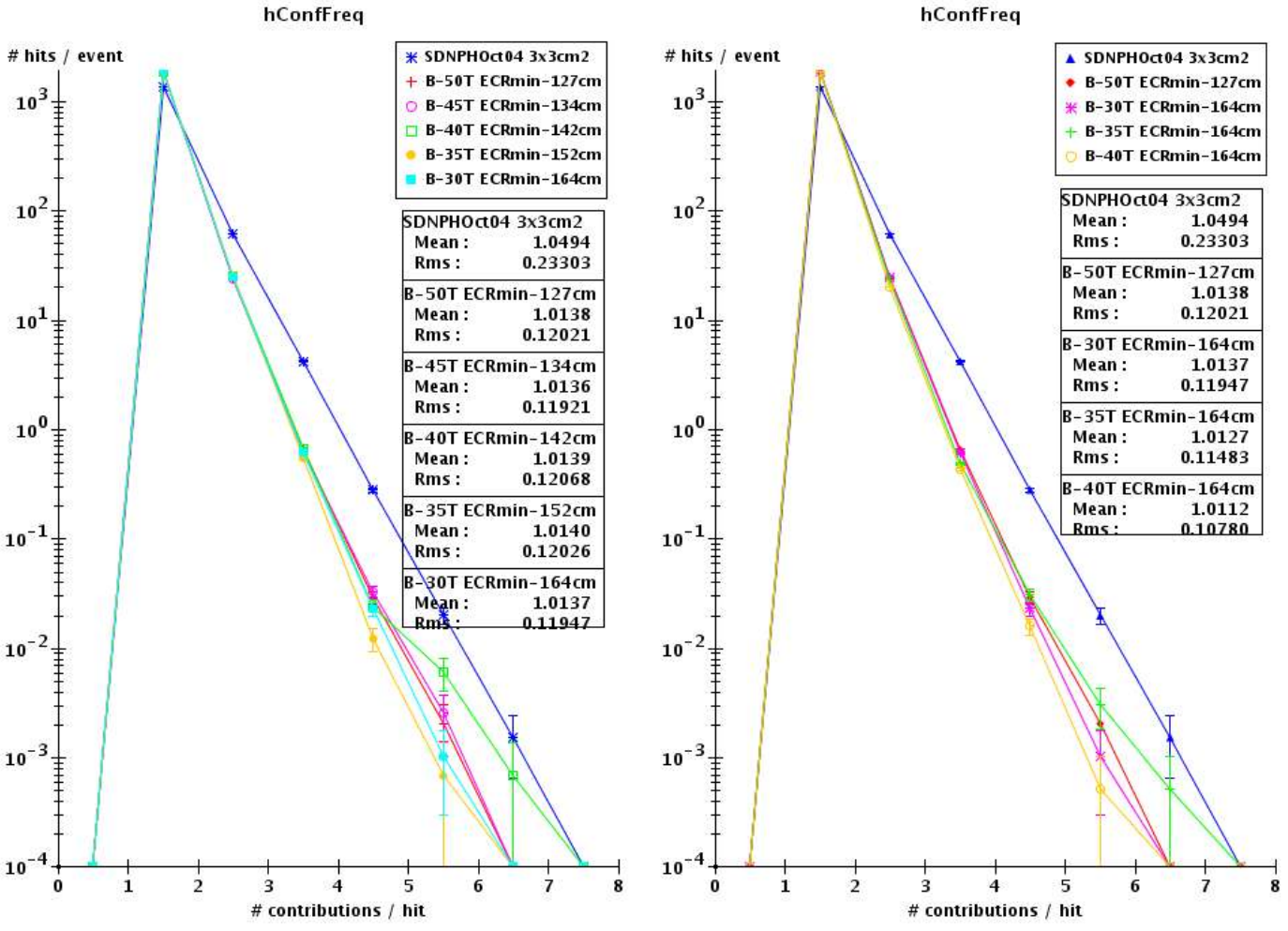
- We have studied the confusion term dependence on:
  - Type (or composition): Em vs. had components, charged vs. neutral components
  - Energy evolution (500 and 1000 GeV $e^+e^- \rightarrow ZH \rightarrow (qqbar)(bbbar)$)
  - Projective vs. Non-projective HCal (SDJan03 vs. SDNPHJun04)
- **Today**: How different geometries affect the confusion term
  - New NP HCal geometry: SDNPHJun04 → SDNPHOct04
    - 34 layers, 2cm-steel + 1cm-scintillator → 41 layers, 2cm-steel + 0.5cm-scintillator
    - Total HCal thickness 102.0cm → 102.5cm
  - B-field between 3T and 5T, keeping $BR^2 = constant$ (R is ECal inner radius)
  - B-field between 3T and 4T, keeping R fixed at 164cm
  - Larger cells: $3x3cm^2$ cells for standard (5T/127cm) and 4T/164cm designs
  - Look at HCal only (since ECal is projective, cell sizes scale with R)
  - Present results based on 2000 500-GeV ee→ZH events above

Total live energy per event

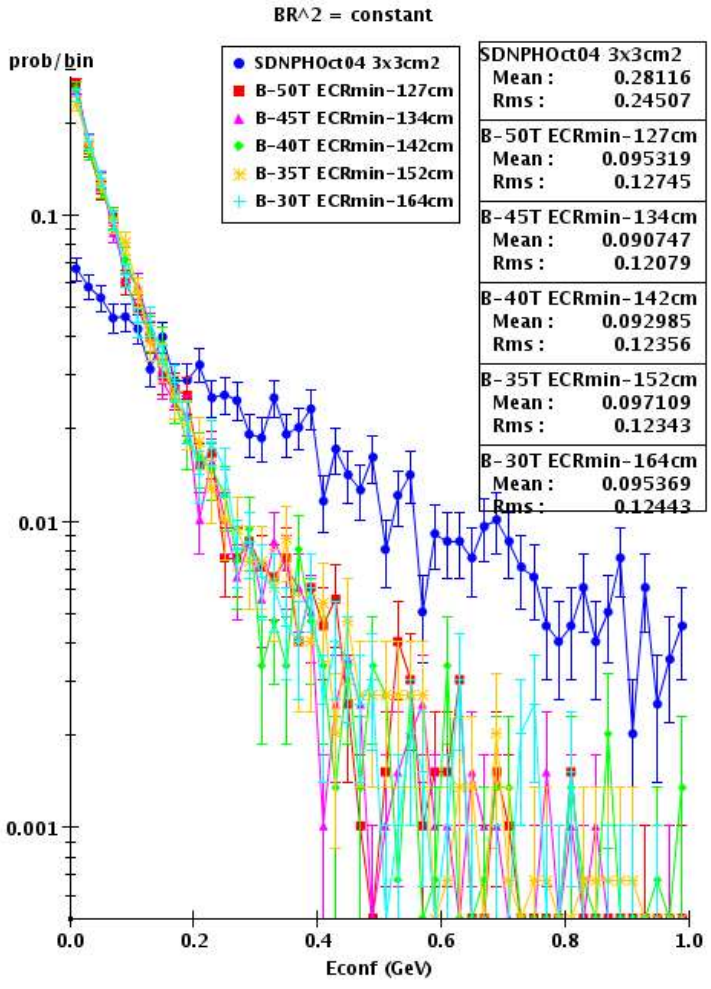


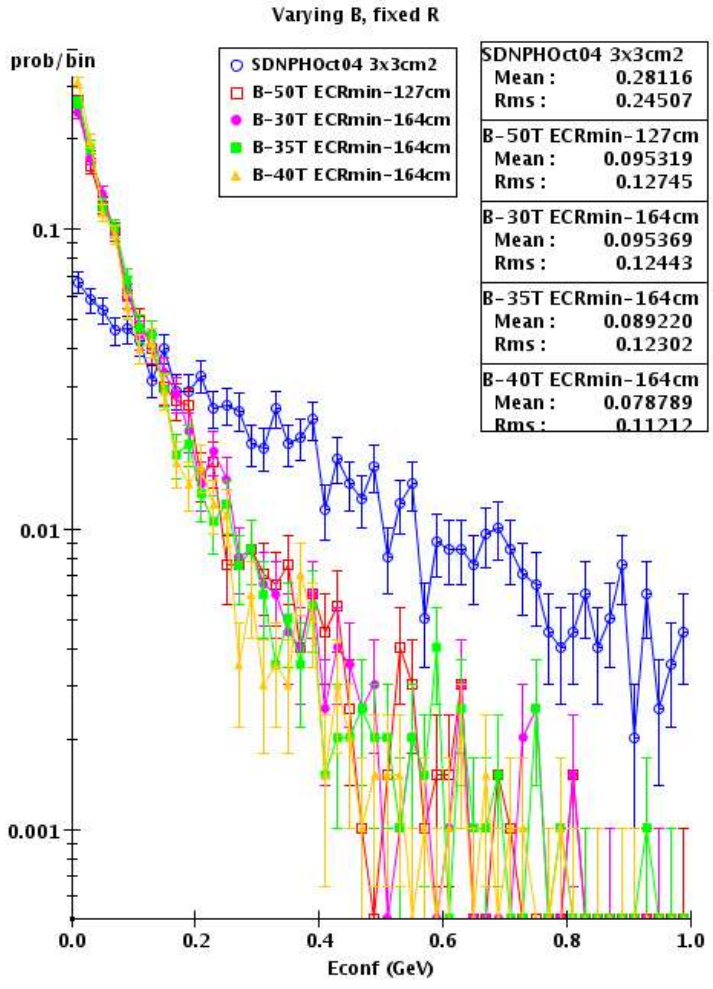


Contribution multiplicity of HCal hits

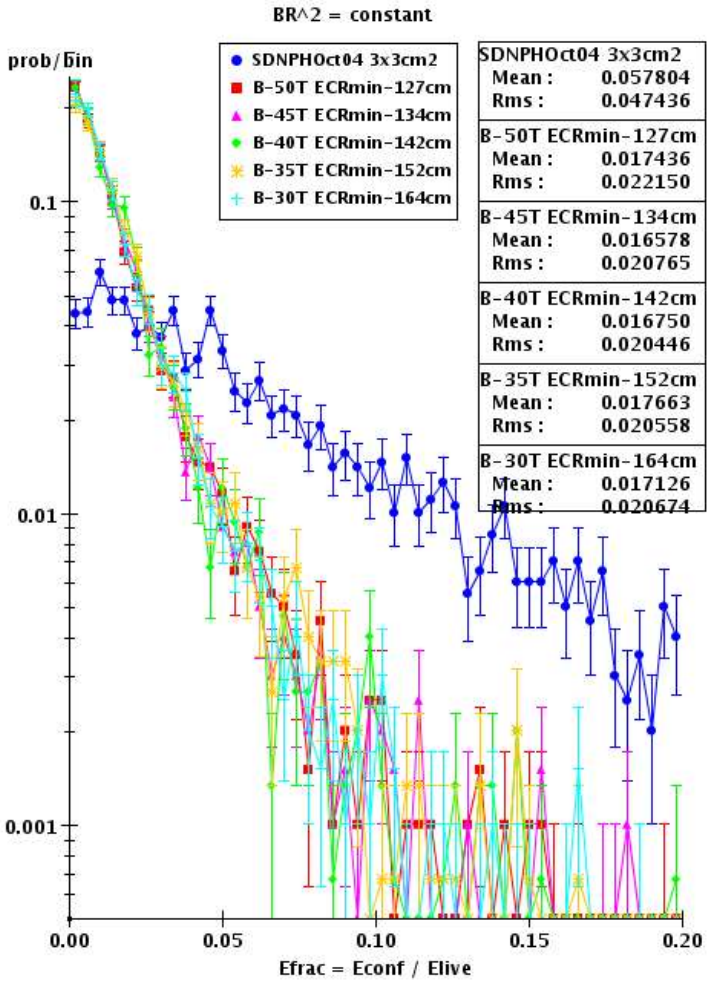


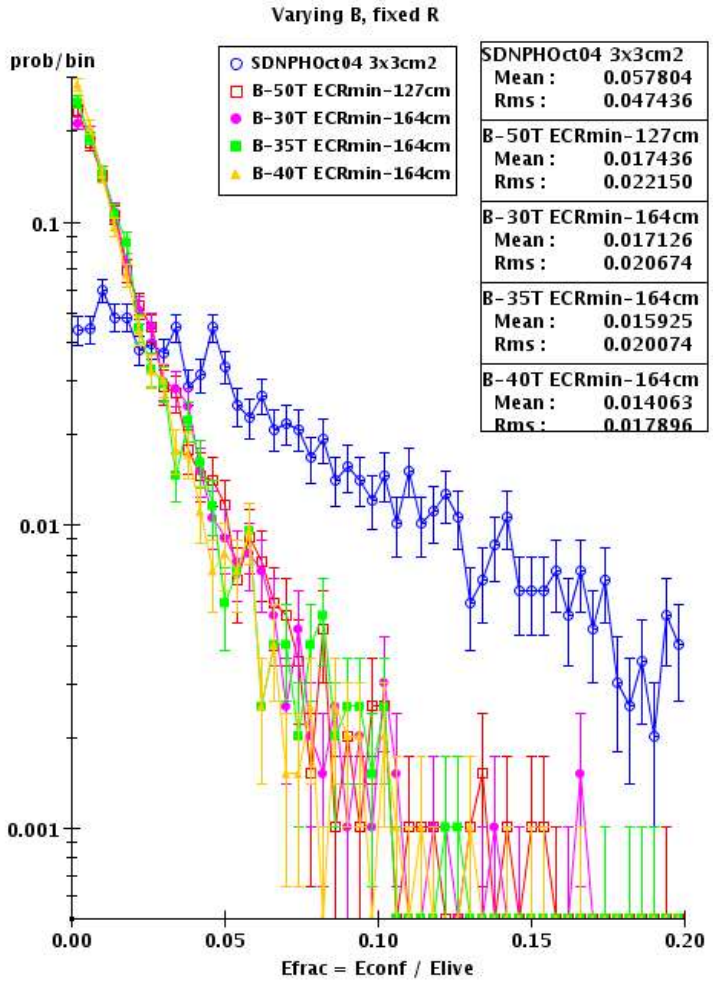
Total confusion energy per event



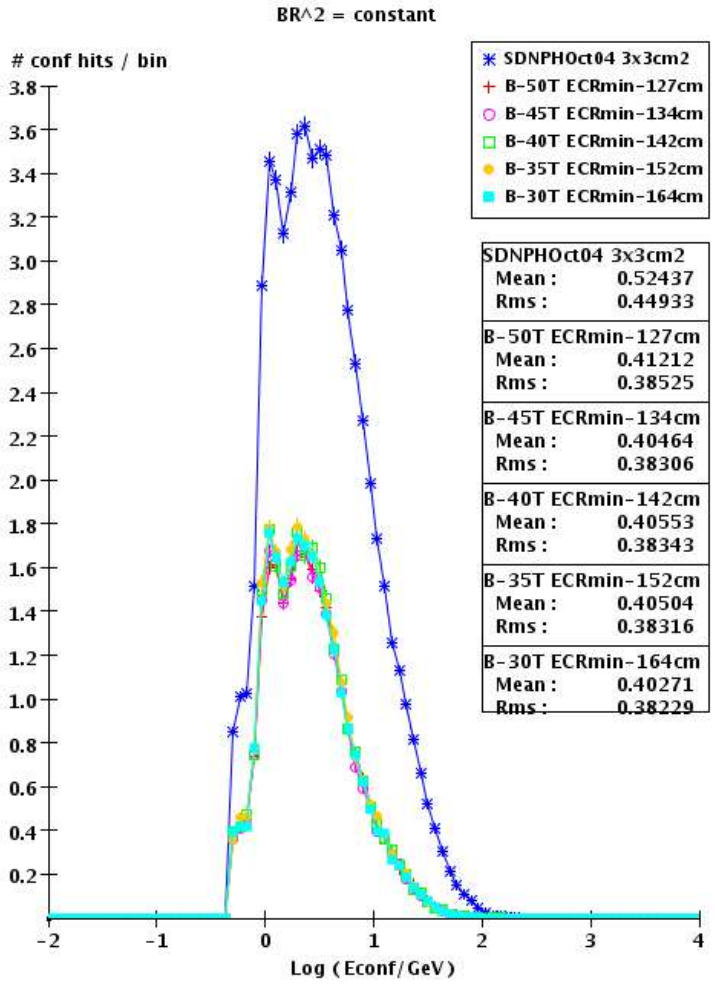


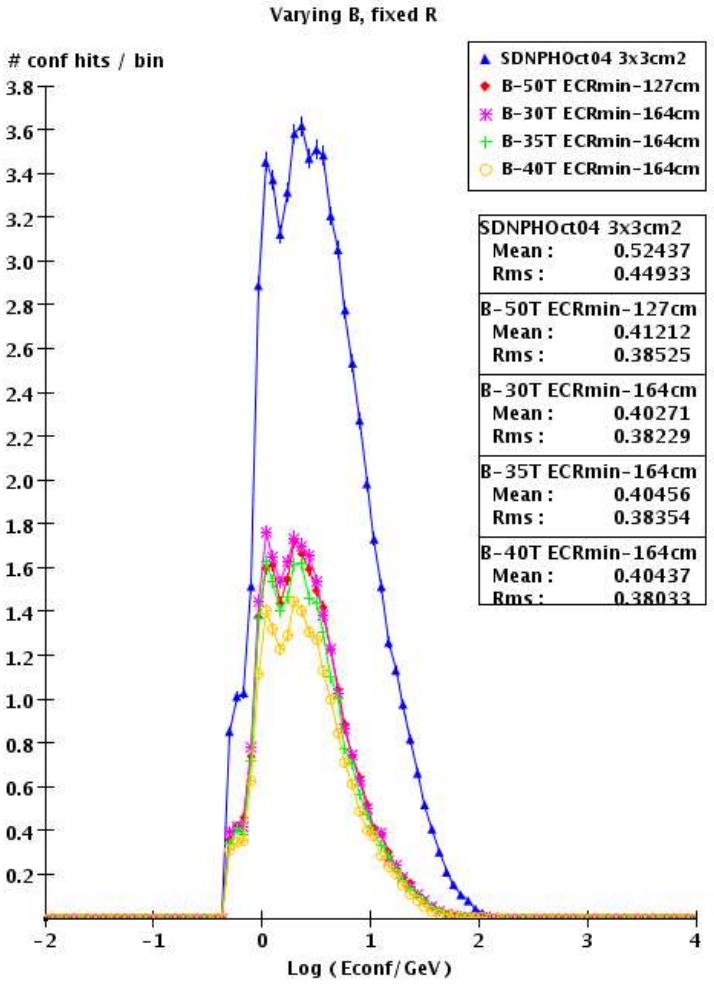
Confusion energy fraction per event



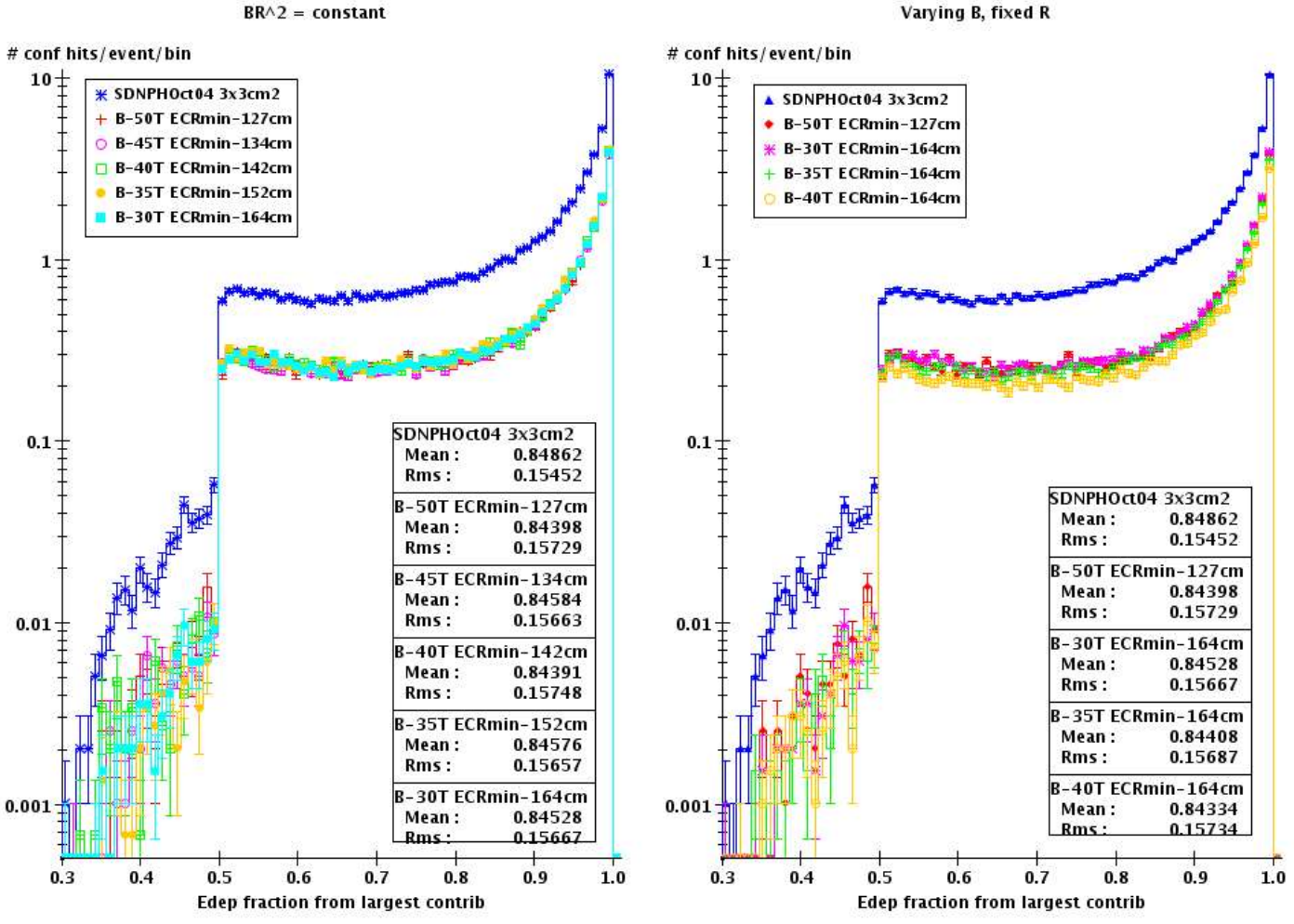


Confusion energy per hit

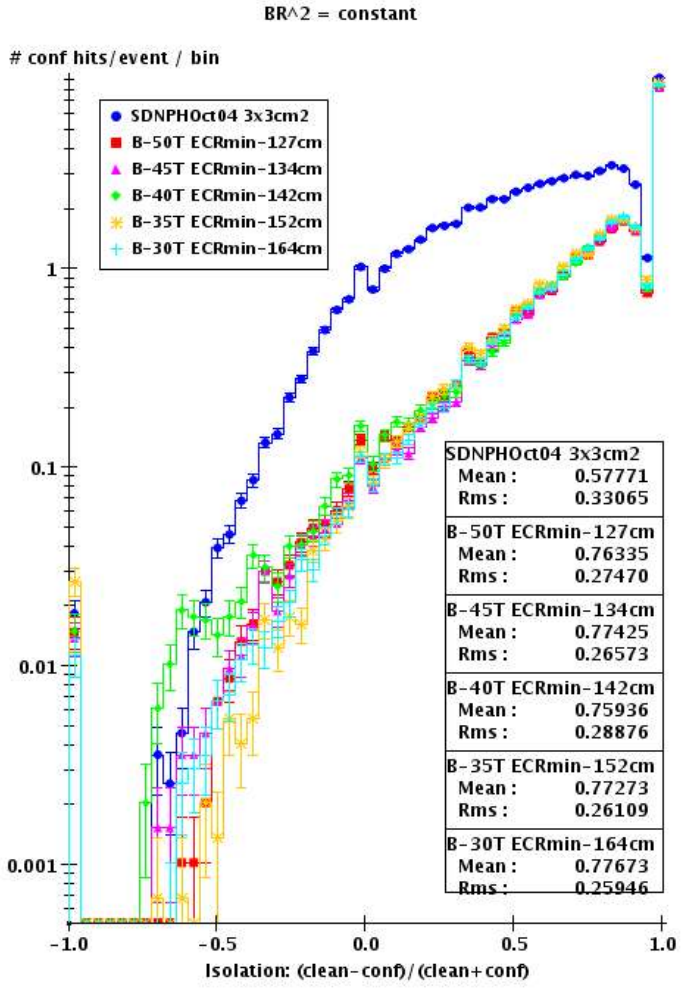


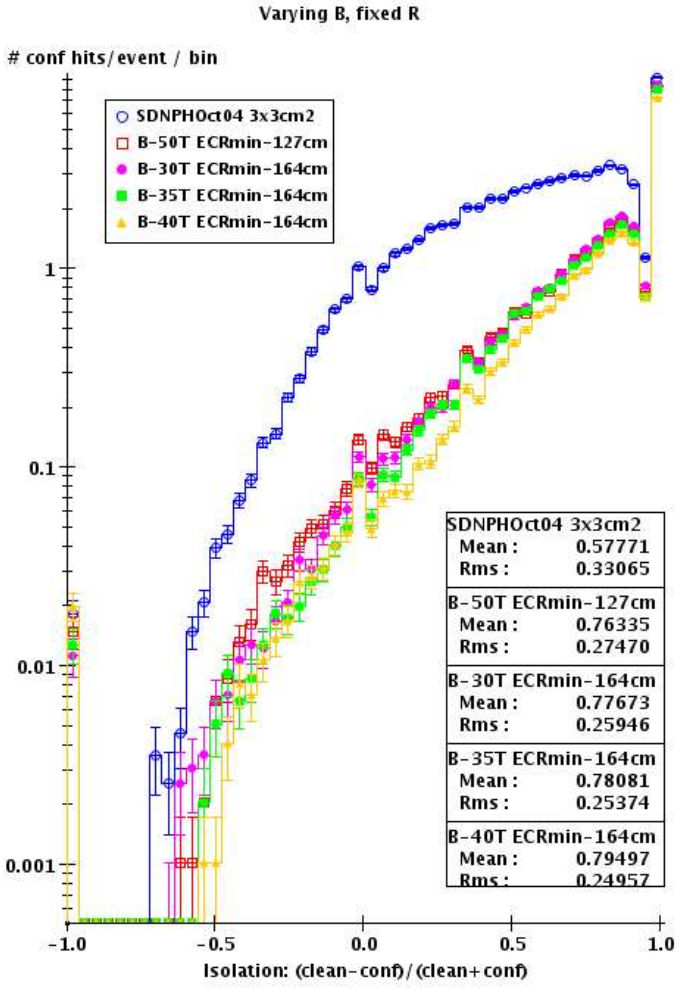


Fractional energy from largest contribution

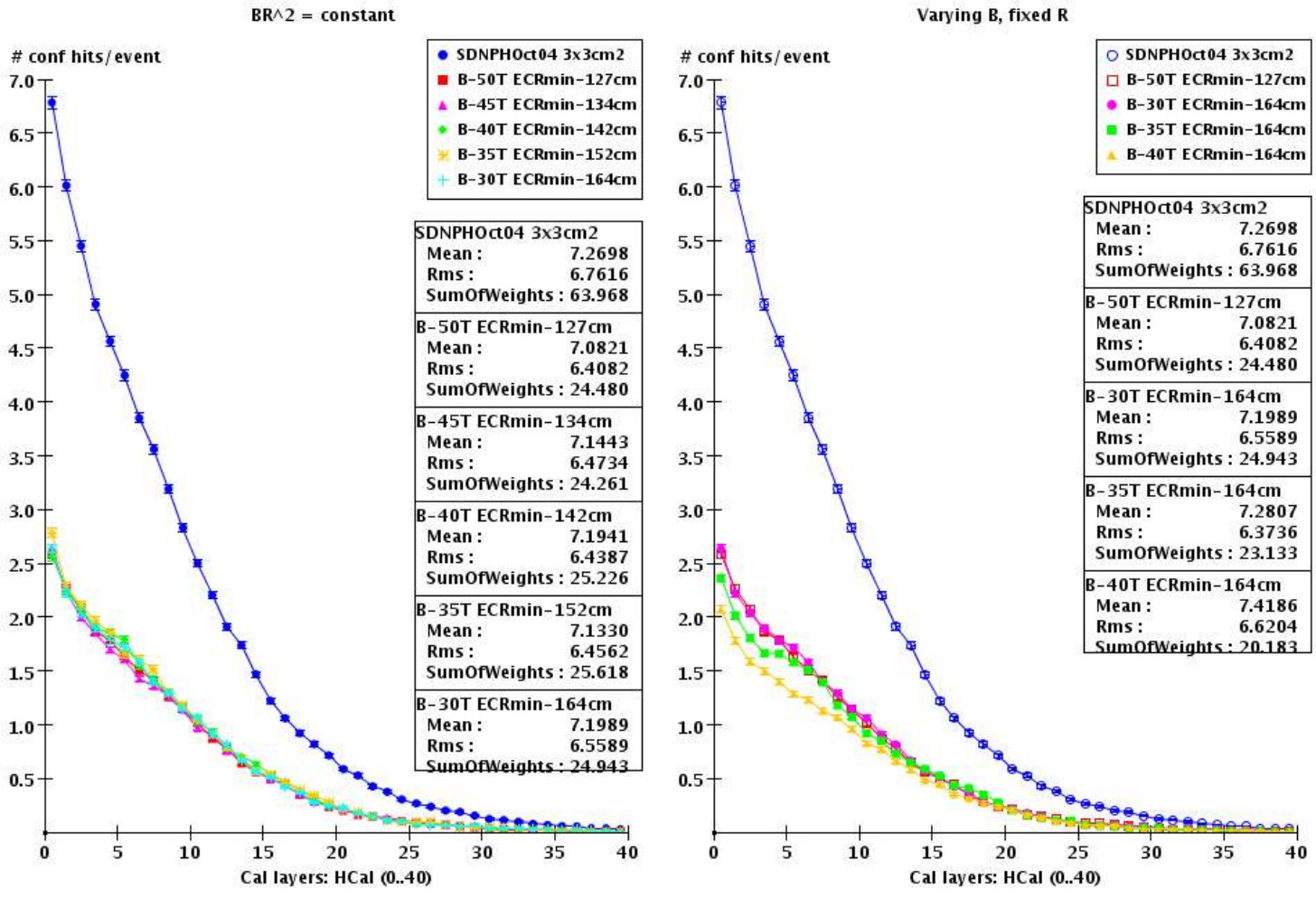


Neighborhood confusion





Longitudinal profile of confusion cells



Preliminary conclusions

- As expected, geometries with constant BR^2 have similar characteristics for showers overlapping in HCal
- For fixed calorimeter radius, a stronger B-field reduces shower overlaps in HCal (probably no significant effect on ECal overlaps, because those are dominated by $\gamma\gamma$ overlaps)
- From geometries tested, B=4T with R_{min}=164cm combination seems to minimize shower overlaps in Hcal
- Some notes worth mentioning:
  - Last presentation's PDGID=0 problem - a bug in the confusion analysis code (fixed)
  - Observed minor discrepancies (< 1discrep.hit / 10^6 hits) in hit coordinates between LCIO format and cellid+CalorimeterCell. Perfect agreement in all other HCal hits!
  - LCIO experience: Few problems. One event with Zlib data check problem, another one causing OutOfMemory error in java. But a problem in one event trashes all following events in file :-(

Next steps

- Look at projective ECal (fixed cell sizes)?
- Look at confusion compositions (em-had, charged-neutral)
- Look at 1000 GeV ee→ZH events (more confusion)
- Attempt to find/fix more problems (LCIO hit discrepancy, LCDG4 processing, isolated confusion hits (isol=0/0), etc.
- Look at confusion hits with no valid hits in immediate neighborhood (0/0)