

bHCAL Meeting — Neutron Calibration Update

Jan Vanek

University of New Hampshire

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OVERVIEW

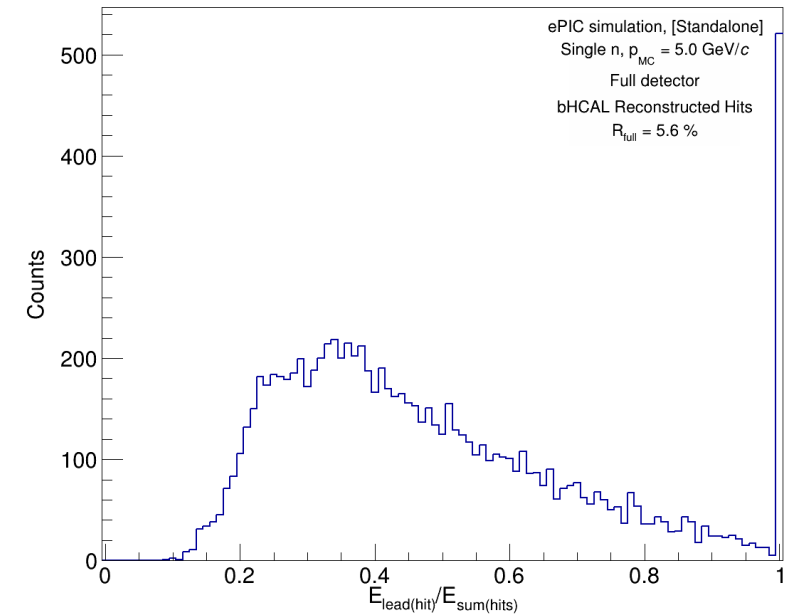
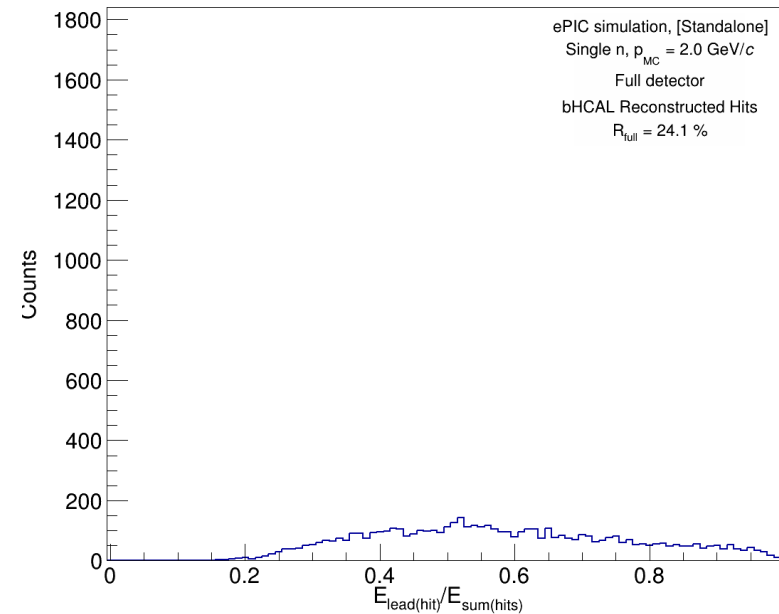
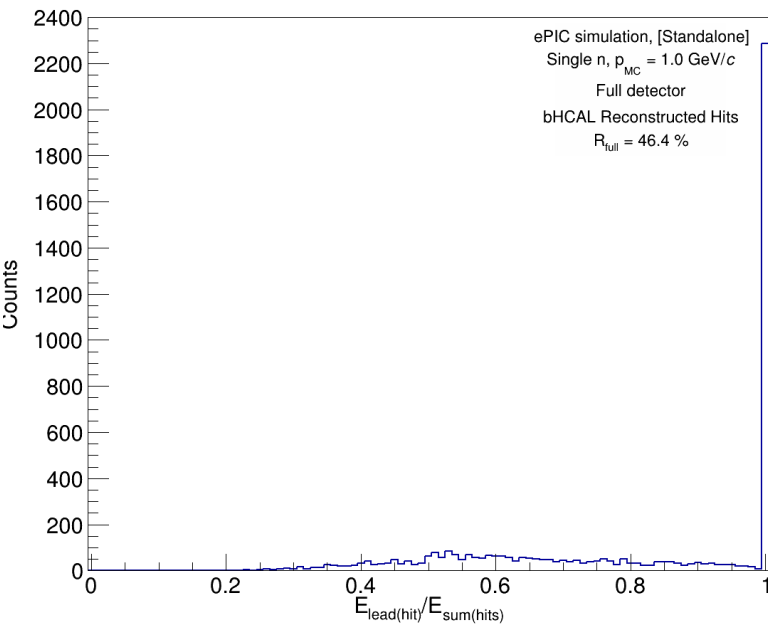
- More detailed QA of clusters and hits in bHCAL
 - Energy deposition in leading clusters and leading hits
 - Comparison of full ePIC simulation and bHCAL only simulation
 - Updated binning of distributions
 - Count statistics histograms with bin centers at integer values

SIMULATION SETUP

- Standalone simulation with default setup
 - Latest detector geometry, EICRecon, etc. inside the EIC shell container
 - Motivation: Central simulations do not contain raw bHCAL hits needed for part of this study
- Single neutrons
 - Energies: 1 GeV, 2 GeV, 5 GeV
 - Uniform in ϕ
 - $\cos \theta$ distribution in range $33.5 < \theta < 146$ deg
- **Two setups:**
 - **Full ePIC detector**
 - **bHCAL Only**

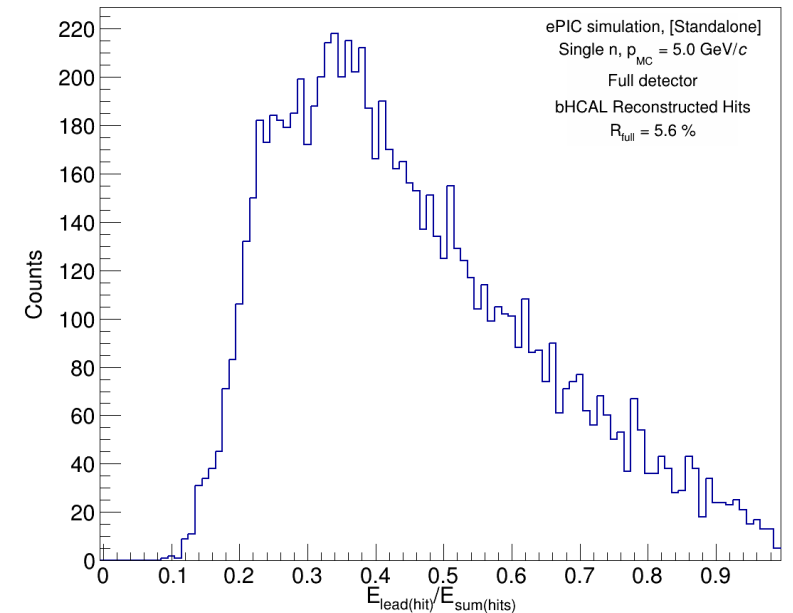
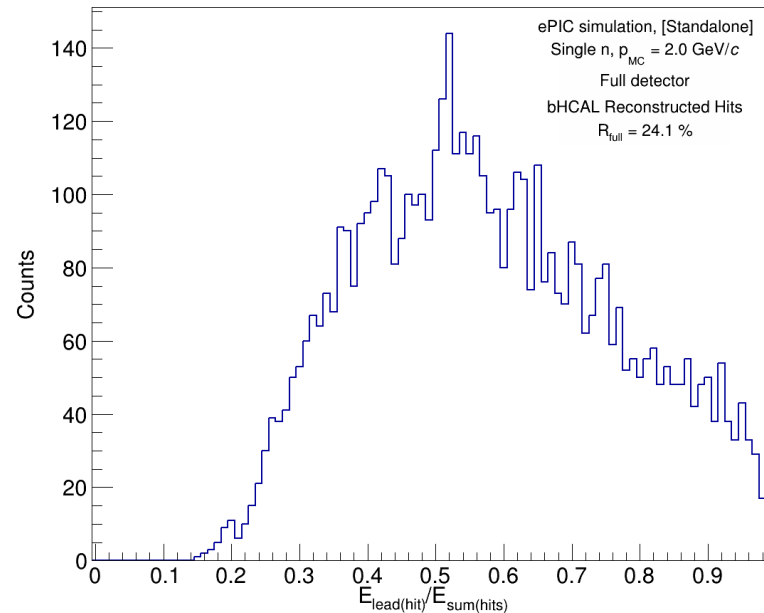
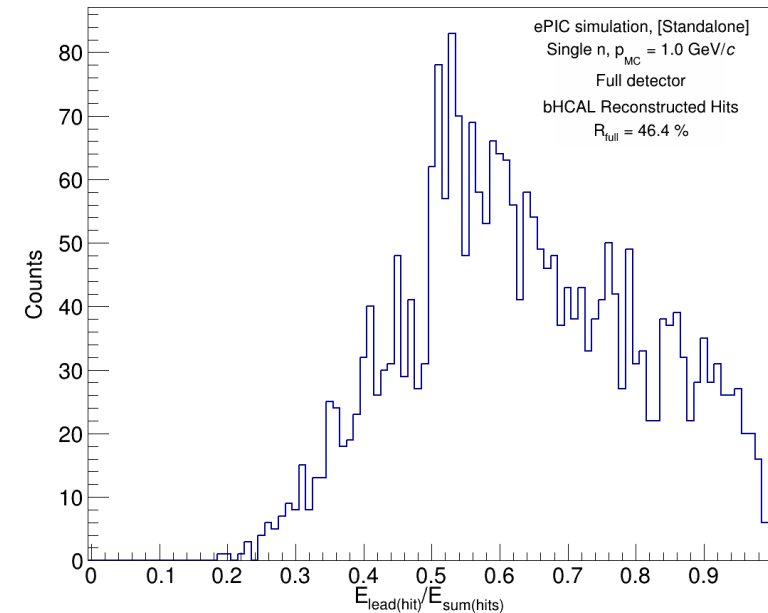
ENERGY IN LEADING HITS – FULL DETECTOR

- Figures from last week presentation with updated binning
 - Wrong label in last week presentation – not showing stats for clusters, but for hits
- Comparison of energy in **leading hit vs. sum of all hits**
 - $E_{\text{lead(hit)}}/E_{\text{sum(hits)}}$
 - Full ePIC simulation**



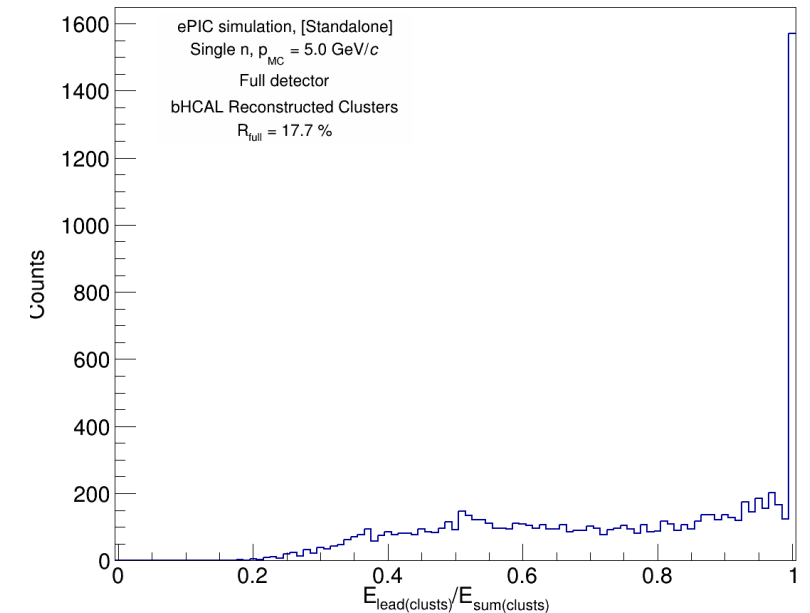
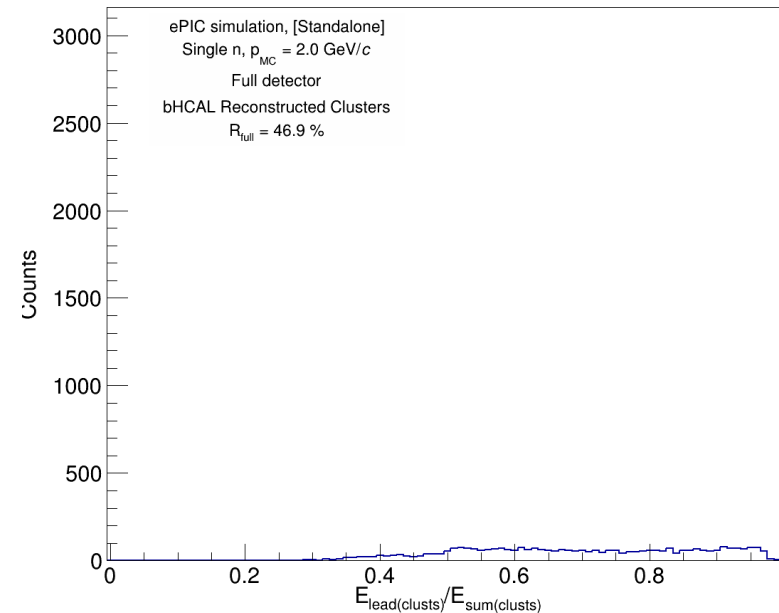
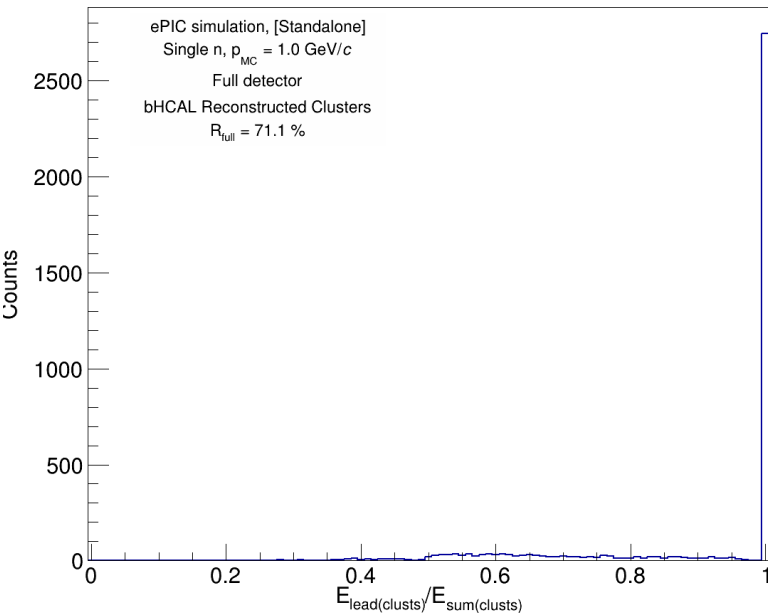
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 - Zoomed-in:** Excluding events where all energy is deposited in a single hit



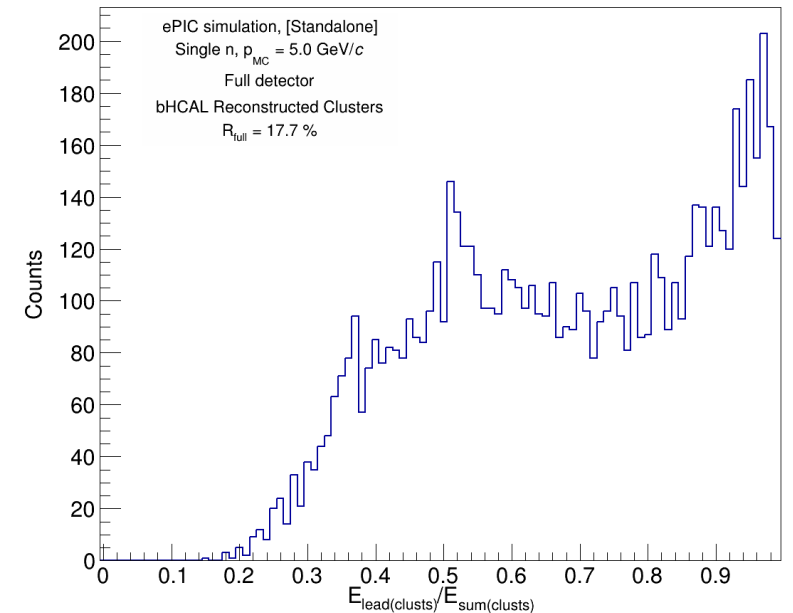
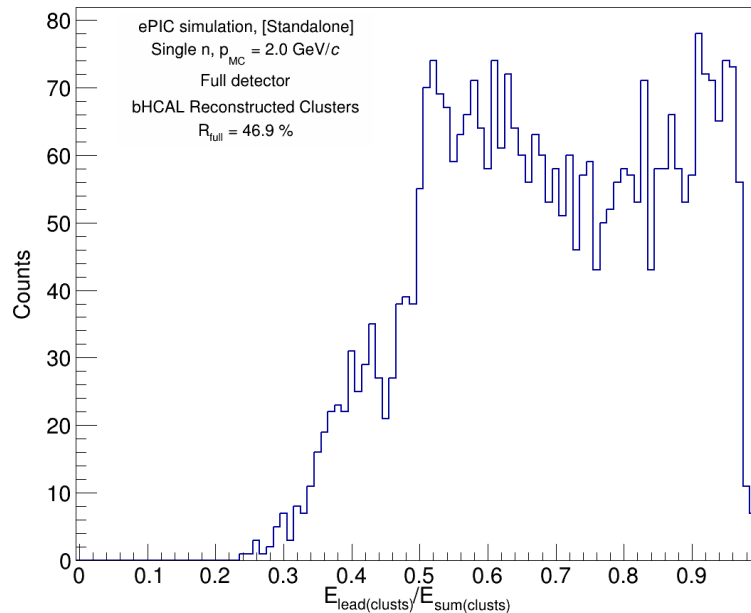
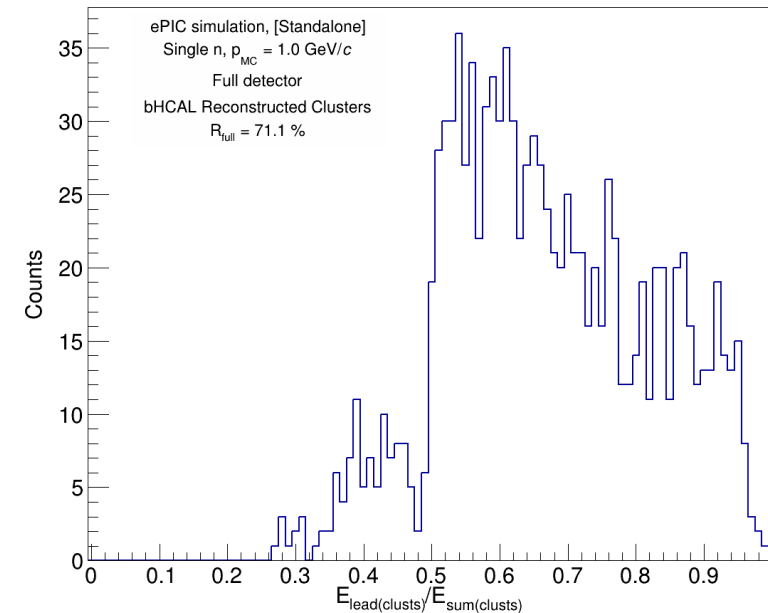
ENERGY IN CLUSTERS — FULL DETECTOR

- Comparison of energy in **leading cluster vs. sum of all clusters**
 - $E_{\text{lead}(\text{clust})}/E_{\text{sum}(\text{clust})}$
- **Relatively small number of events have all (most) energy contained in the leading cluster**
 - Conclusion from last week stands
 - **Full ePIC simulation**



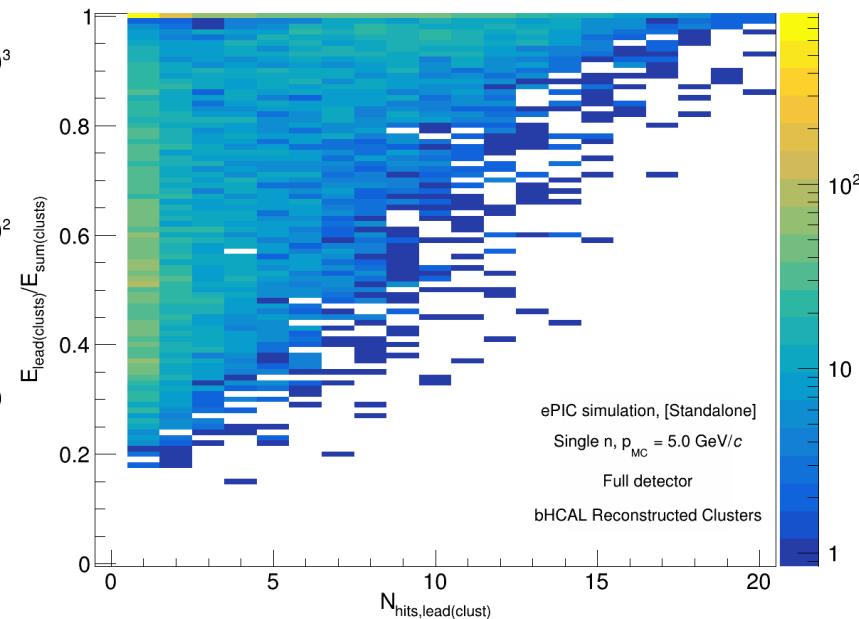
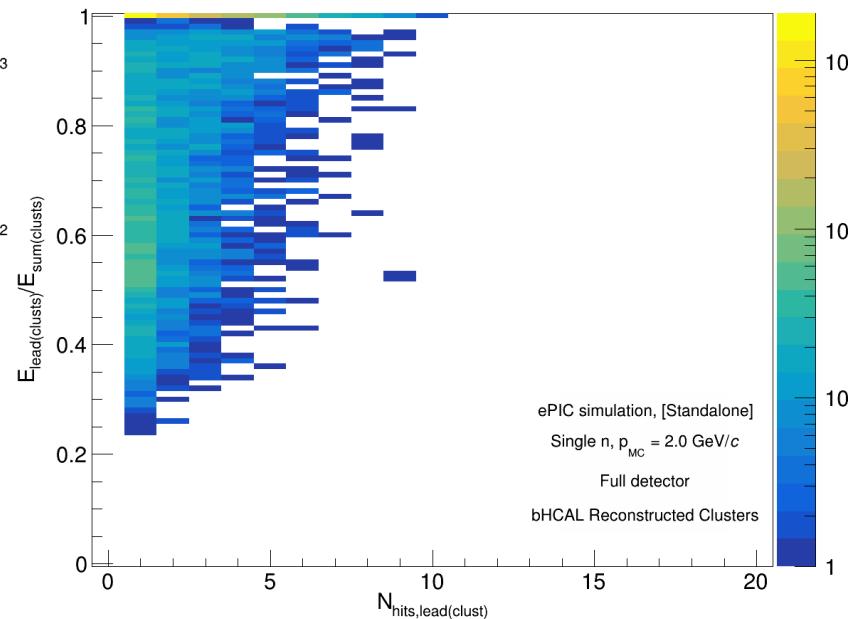
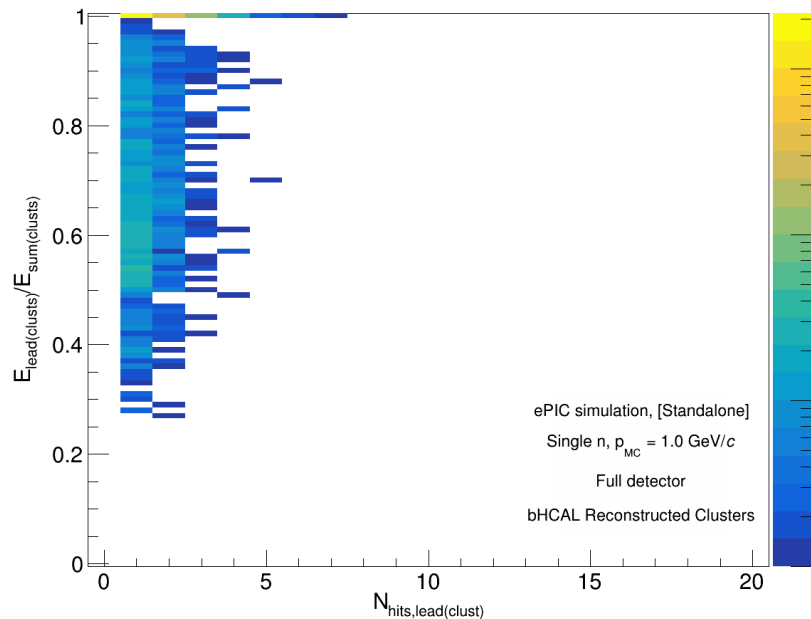
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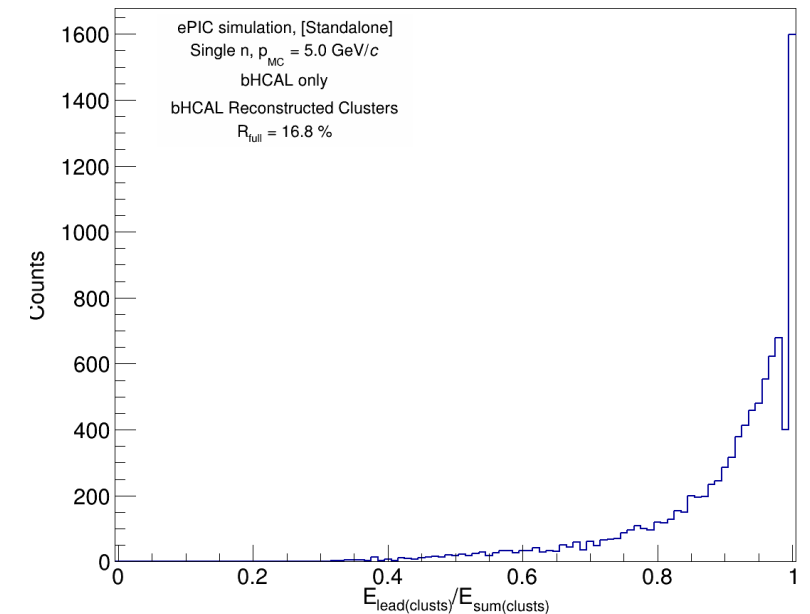
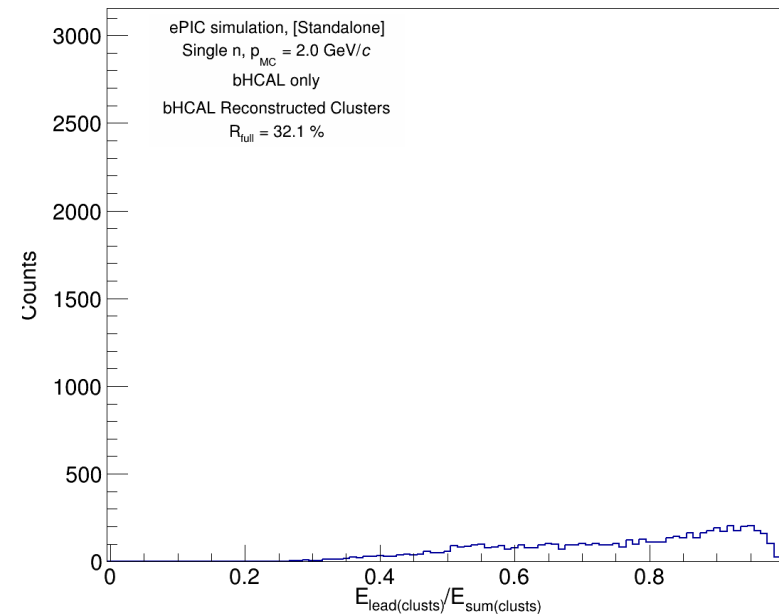
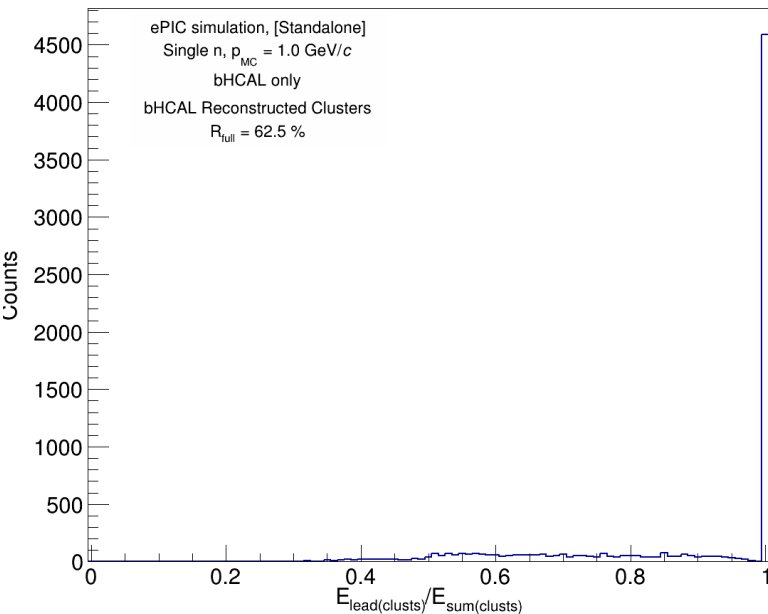
SIZE OF LEADING CLUSTERS — FULL DETECTOR

- Relative energy deposition for different leading cluster sizes
 - Horizontal axis:** Number of hits (tiles) in leading cluster, **Vertical axis:** $E_{\text{lead(clust)}}/E_{\text{sum(clust)}}$
 - Full ePIC simulation**
- Longer tail for small leading clusters**



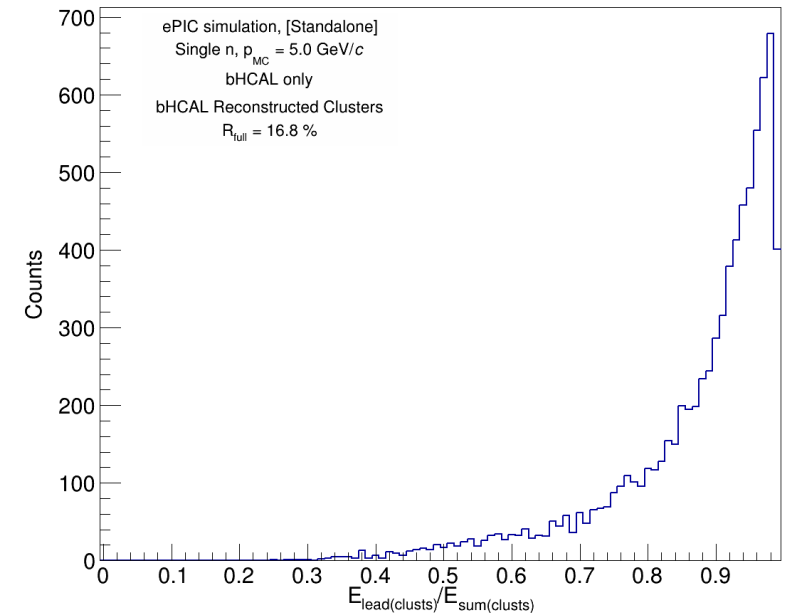
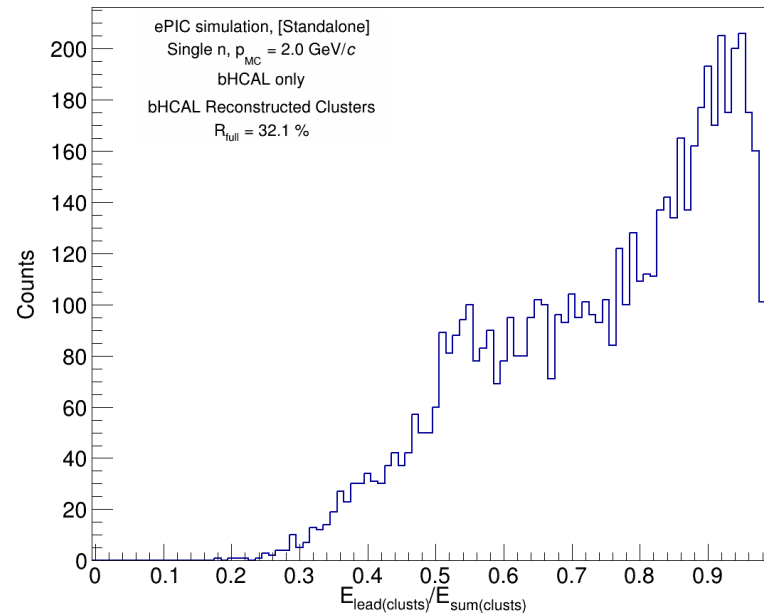
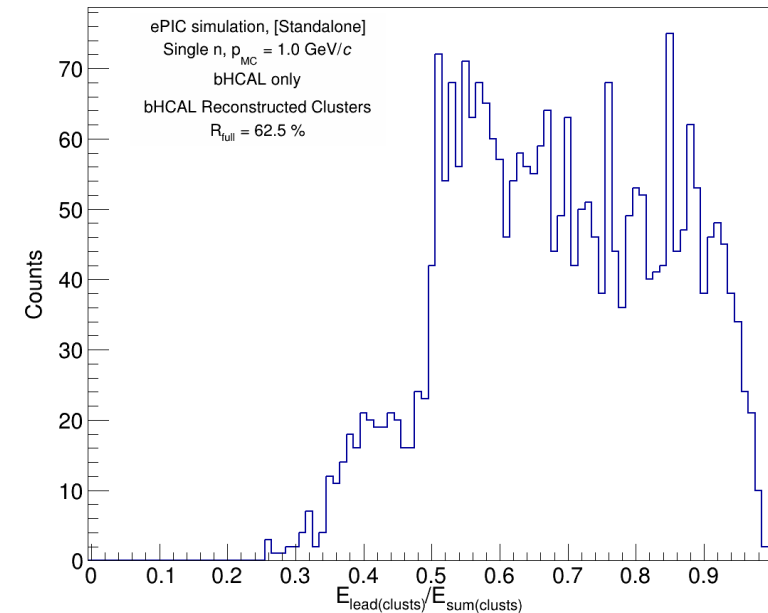
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 - More reasonable distribution for events with 2+ clusters
 - **bHCAL Only**



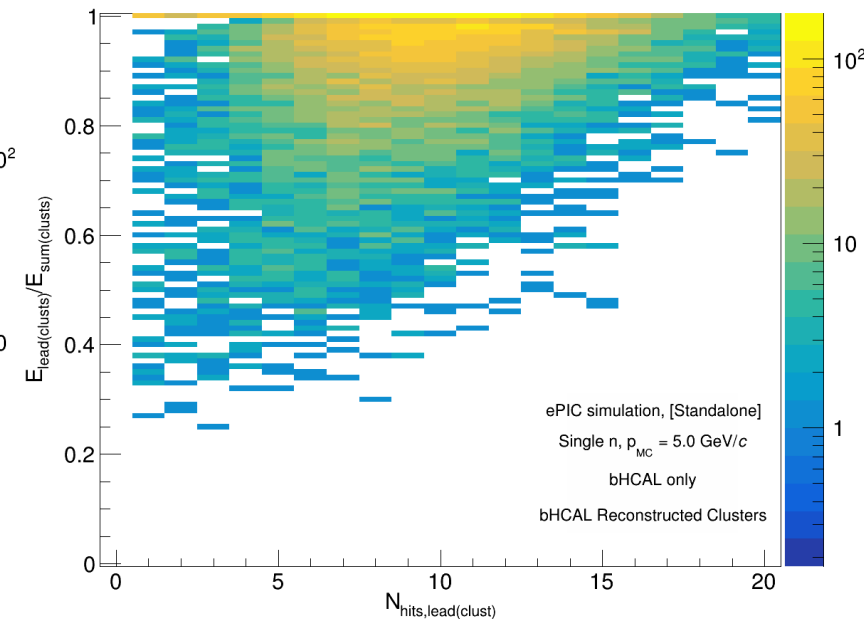
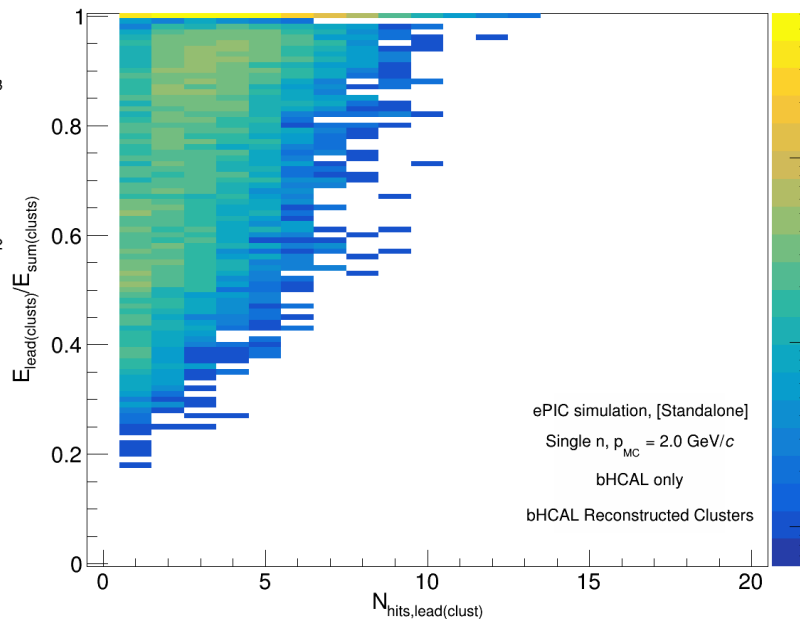
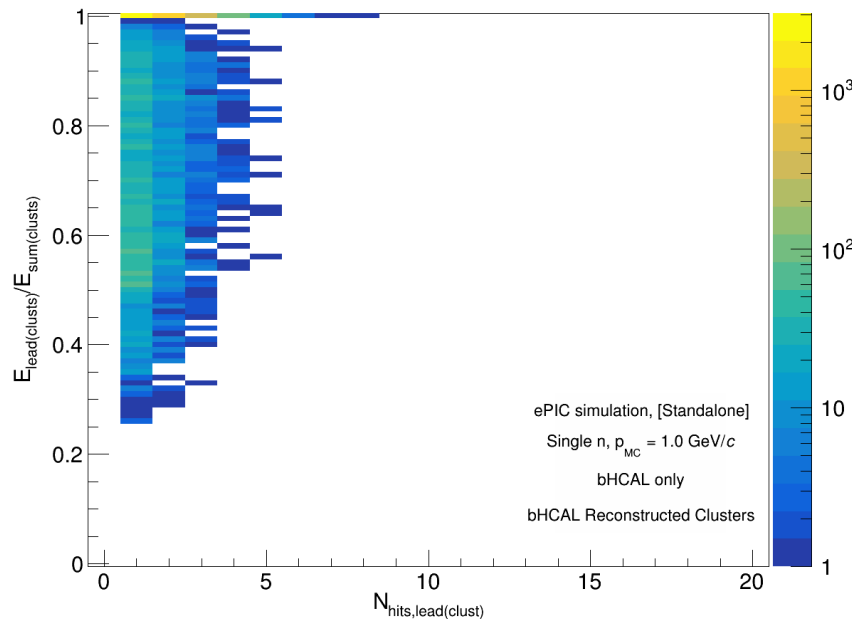
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- More reasonable distribution for events with 2+ clusters**



SUMMARY AND OUTLOOK

- Updated binning of hit/cluster stat distributions
 - Bin centers at integer value
- Added bHCAL Only simulation to evaluate hit/cluster stats
- Showers that start early (bECAL, solenoid) appear to cause observed issues with clustering in bHCAL
- **Outlook:**
 - Optimize of clustering in bHCAL
 - Compare reconstructed and truth clusters
 - Evaluate energy dependent sampling fraction for neutrons
 - Make absorber sensitive in simulation and evaluate fraction of energy seen by tiles

THANK YOU FOR ATTENTION