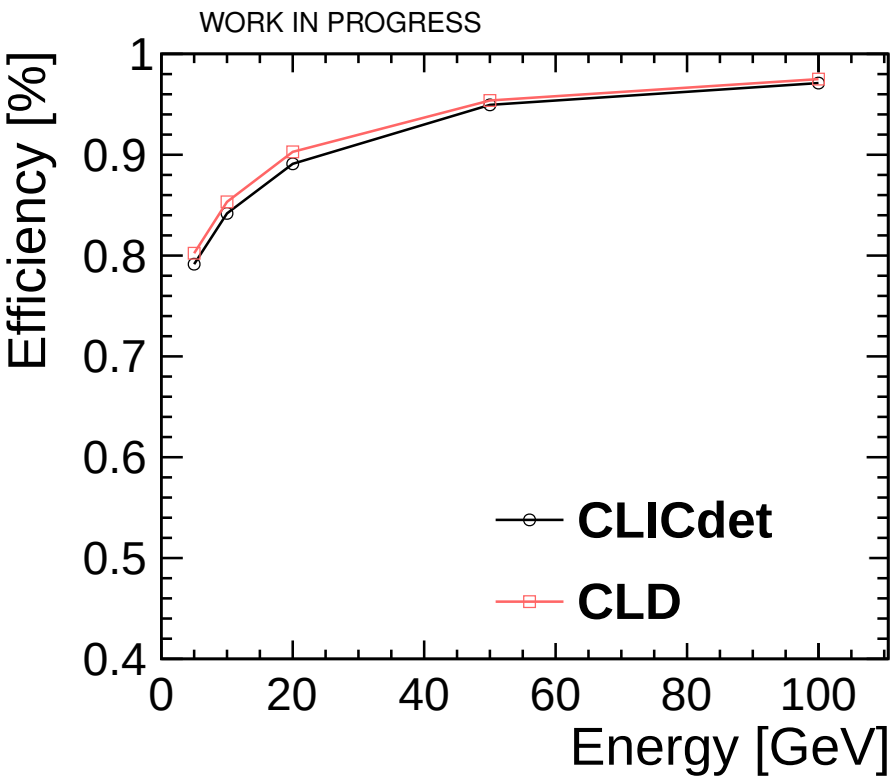
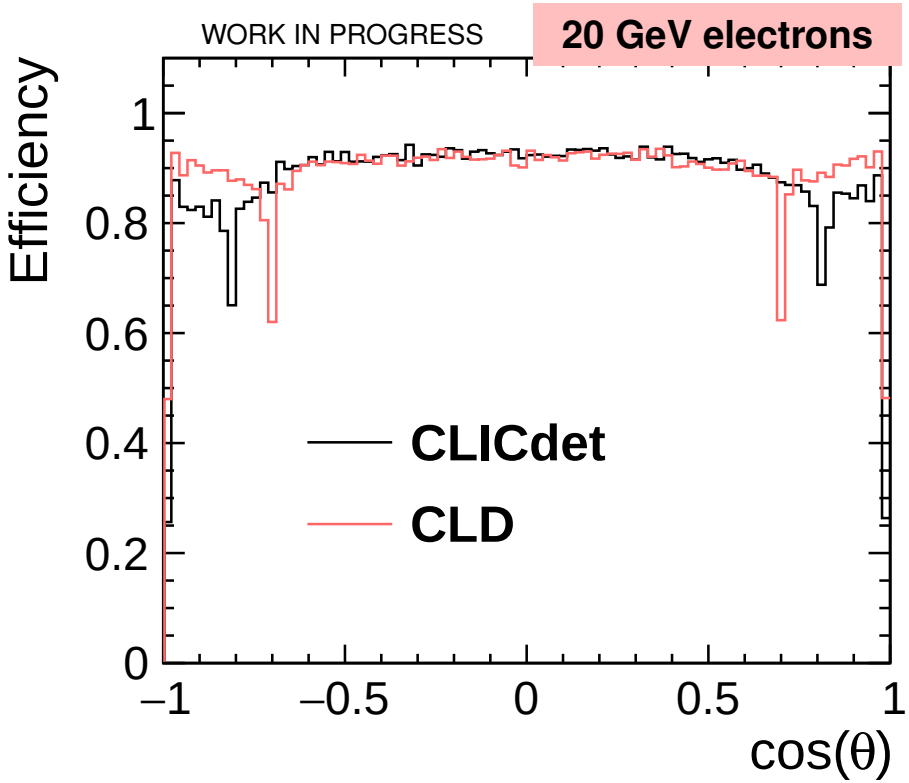
Single particle efficiency definition

- Single particle performance is studied for μ-, π-, e- and γ
- Simulate single particles with isotrop $cos(\theta)$ distribution and fixed energy: 5, 10, 20 ,50 and 100 GeV
- PID efficiency definition:
  - reconstructed PFO and true (MC) particle have to be of the same type
  - angular matching: $\Delta\theta < 0.01$ rad and $\Delta\phi < 0.02$ rad
  - energy matching:
    - charged particles: $|p_T^{truth} - p_T^{PFO}| < 5\%\ p_T^{truth}$
    - photons: $\Delta E < 5 \times \sigma(\text{ECal}) \approx 0.75 \times \sqrt{E}$

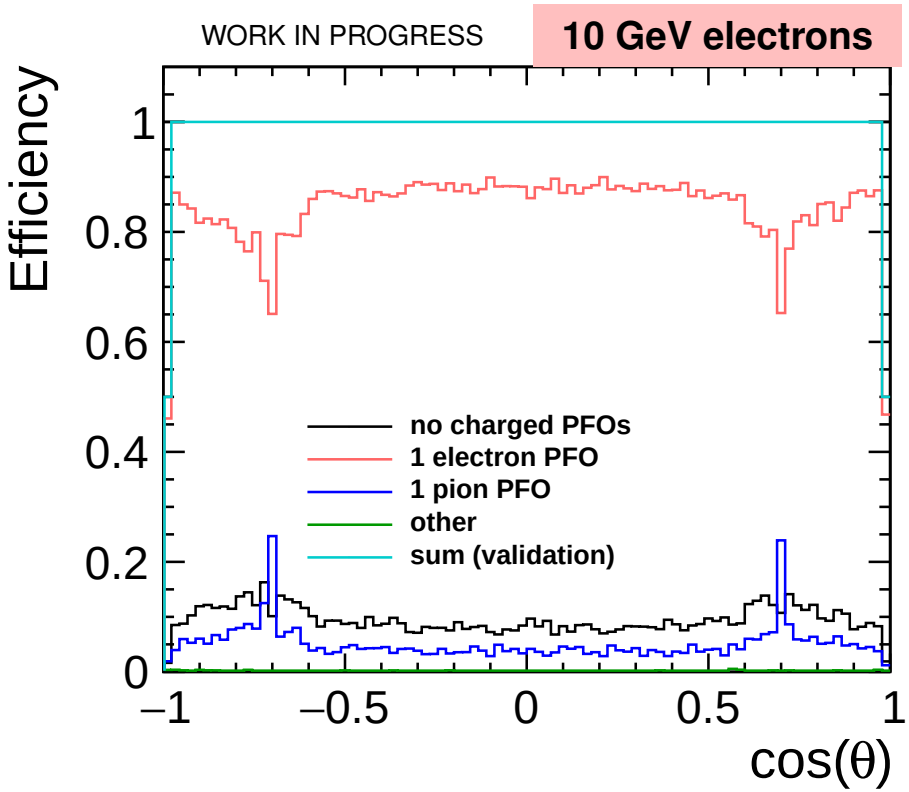
Single electron efficiency

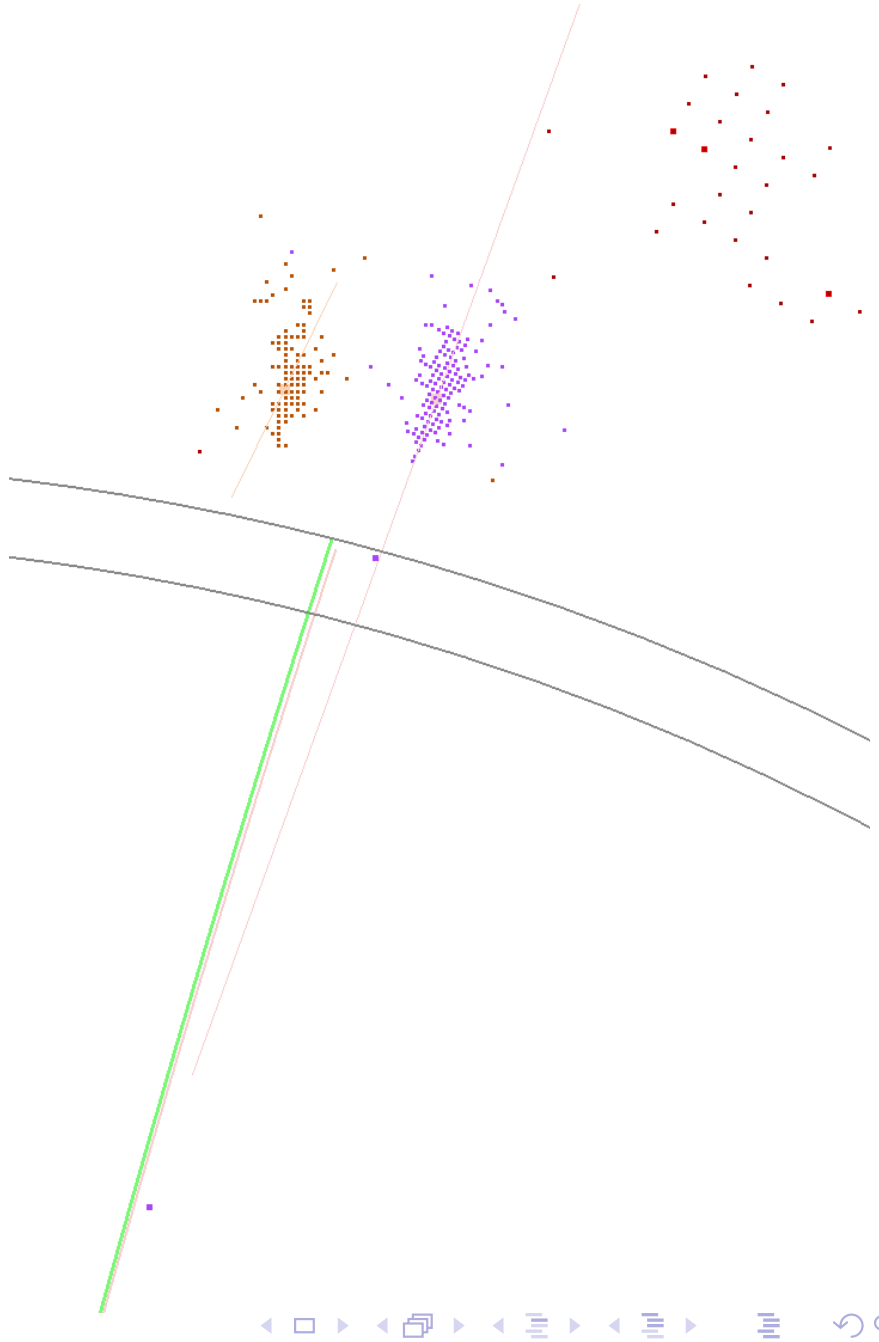




- impose only particle type matching (no angular and energy matching)
- unexpectedly low efficiency for lower energy electrons

Single electron efficiency



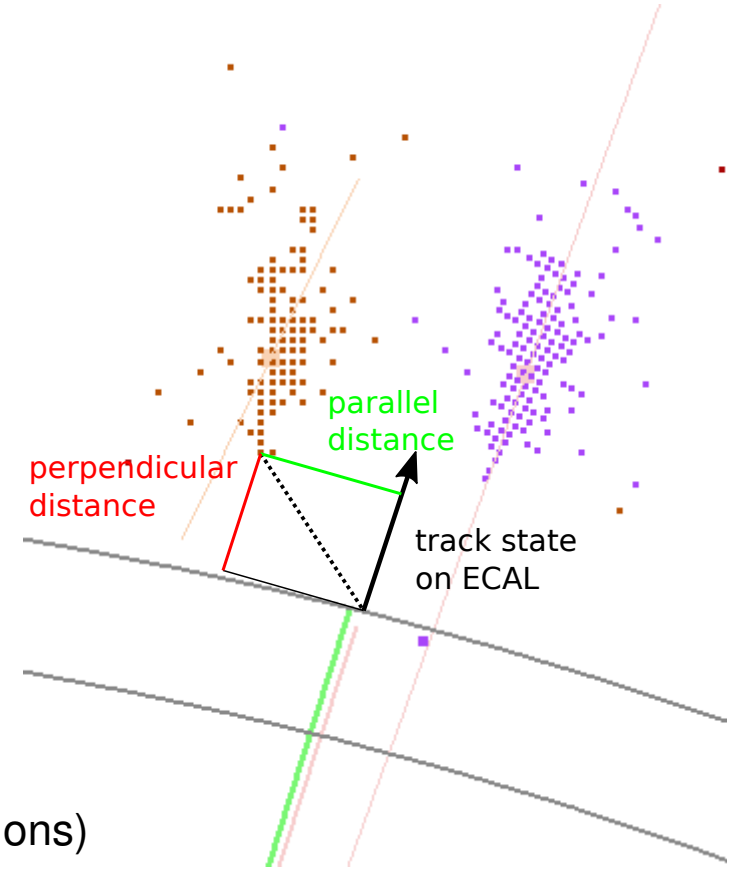


- in 10-13% of events no charged PFO is reconstructed in the event
- track-cluster association algorithm fails to attach track to cluster (as shown on the right)
- in 3-6% of events fake “pion” is reconstructed
- in calorimeter transition region a small fraction of electrons is reconstructed as “pions”

Single electron efficiency: track-cluster association

Track-cluster association algorithm in Pandora

- Get track state on ECAL inner surface
- Loop through all hits within a cluster
- Calculate perpendicular and parallel distance between calo hit and track state position with respect to track state direction
- Find hit with minimal perpendicular distance $\rightarrow$ this value is the track-cluster distance
- Default Pandora settings in electron reconstruction algorithm: the track is matched if track-cluster distance $<$ **10 mm**



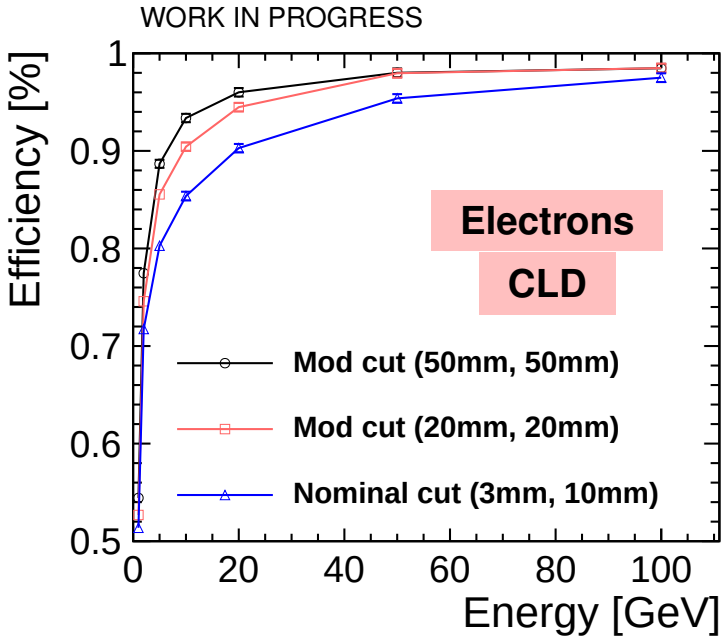
Photon reconstruction algorithm

- Second PID algorithm run by Pandora (after muons)
- if there is a track within **3 mm** - check if cluster should be discarded since it's probably an electron $\rightarrow$ the cluster is likely reconstructed as an electron
- otherwise (if track-cluster distance $>$ **3 mm**) consider EM cluster trackless and run photon ID test $\rightarrow$ the cluster is likely reconstructed as a photon

Vary these 2 parameters to investigate an effect on the electron ID efficiency

Single electron efficiency: track-cluster association

- compare 3 sets of track-cluster distance cut: (3mm, 10mm), (20mm, 20mm), (50mm, 50mm)
- Increasing of track-cluster distance requirement allows to recover efficiency
- Improvement of PID efficiency at low energies (85% $\rightarrow$ 95% for 10 GeV electrons)



- Loosening track-cluster distance requirement doesn't have a significant impact on jet energy resolution