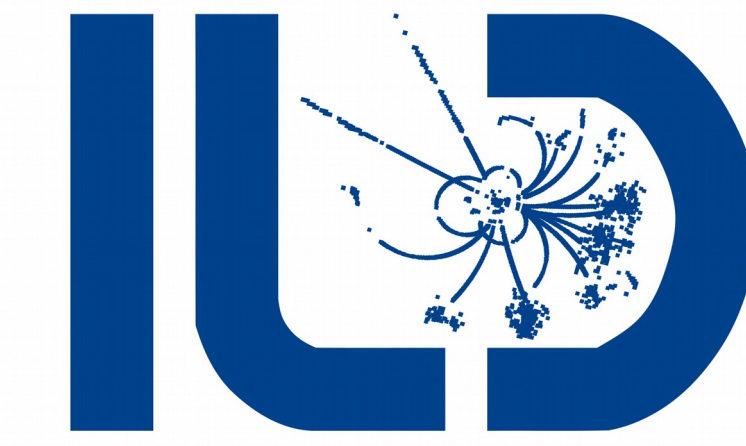
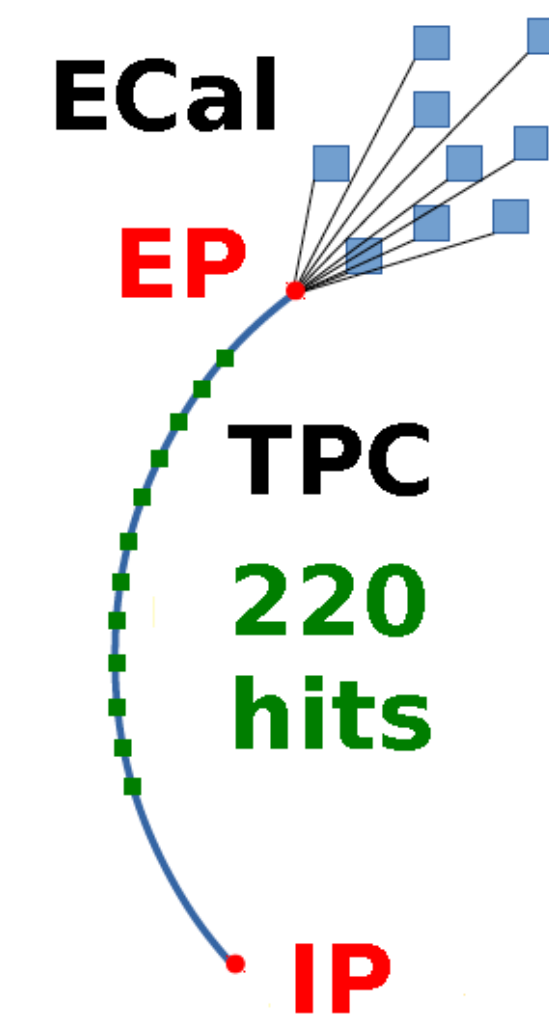
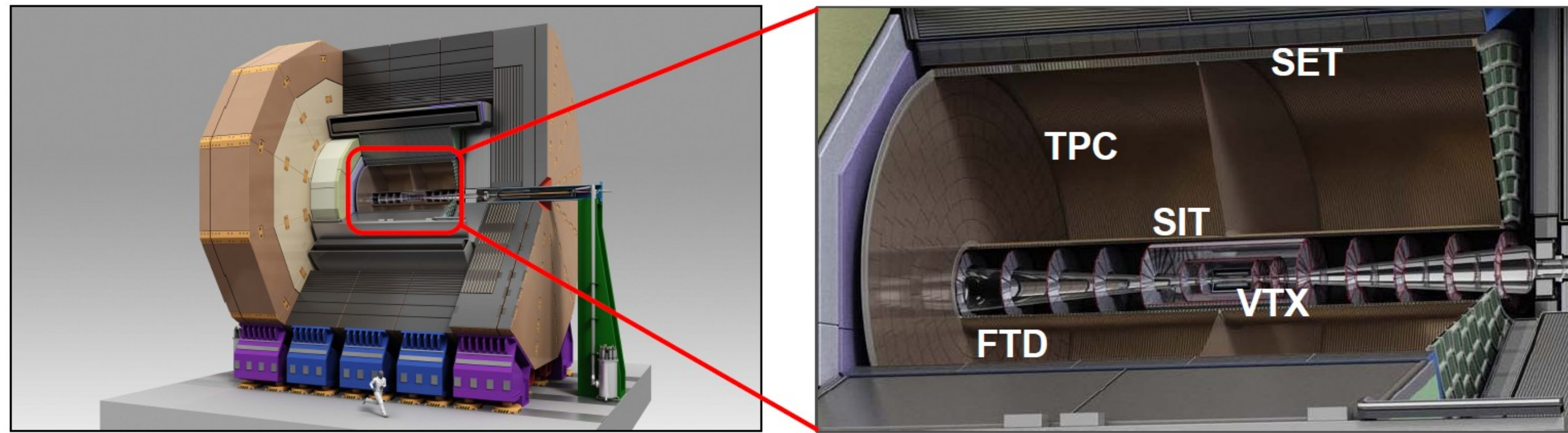


# Charged Hadron Identification with dE/dx and Time-of-Flight at Future Higgs Factories

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## The International Large Detector ILD @ILC

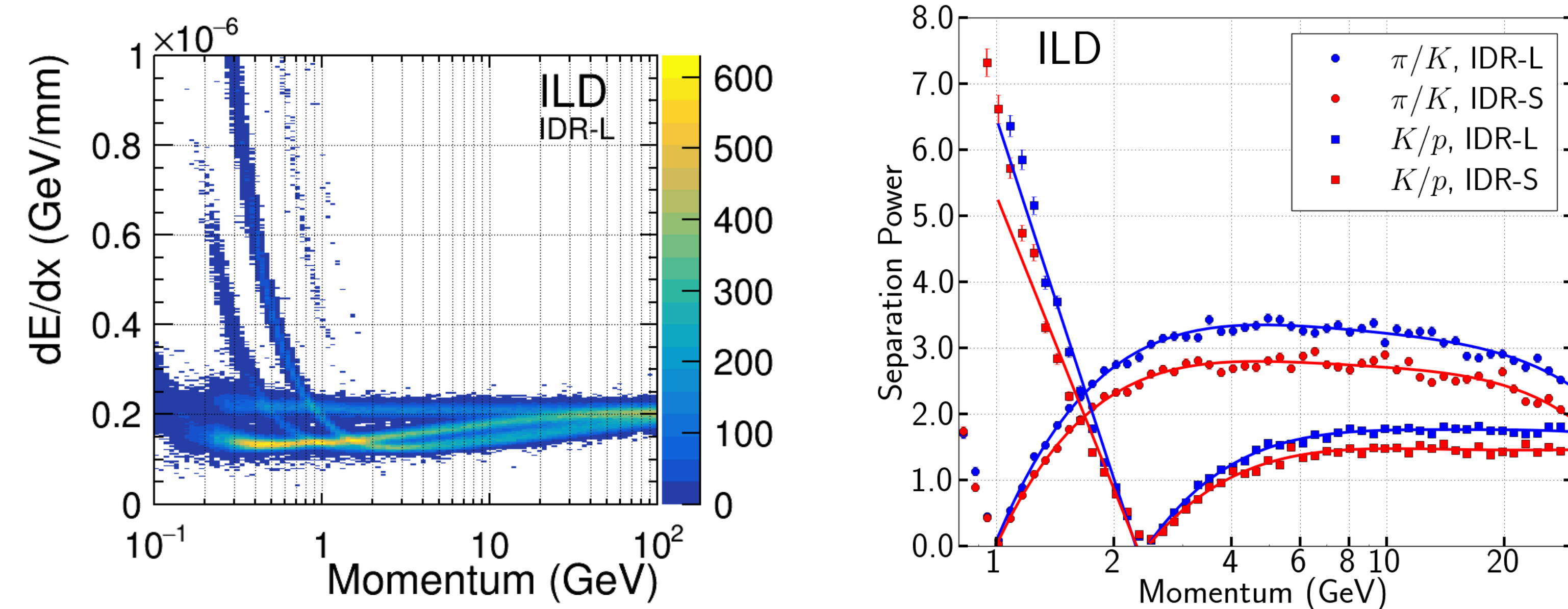


Designed for Particle Flow  
 dE/dx resolution: < 5% demonstrated, ~ 3% prospects  
 Asympt. mom. resolution:  $\sigma_{1/pt} = 2 \cdot 10^{-5} \text{ GeV}^{-1}$   
 Jet energy resolution:  $\sigma_{E, \text{Jet}} < 3.5\% \text{ over } 100 \text{ GeV}$   
 Timing resolution: under investigation, assume 50 ps/hit

## References

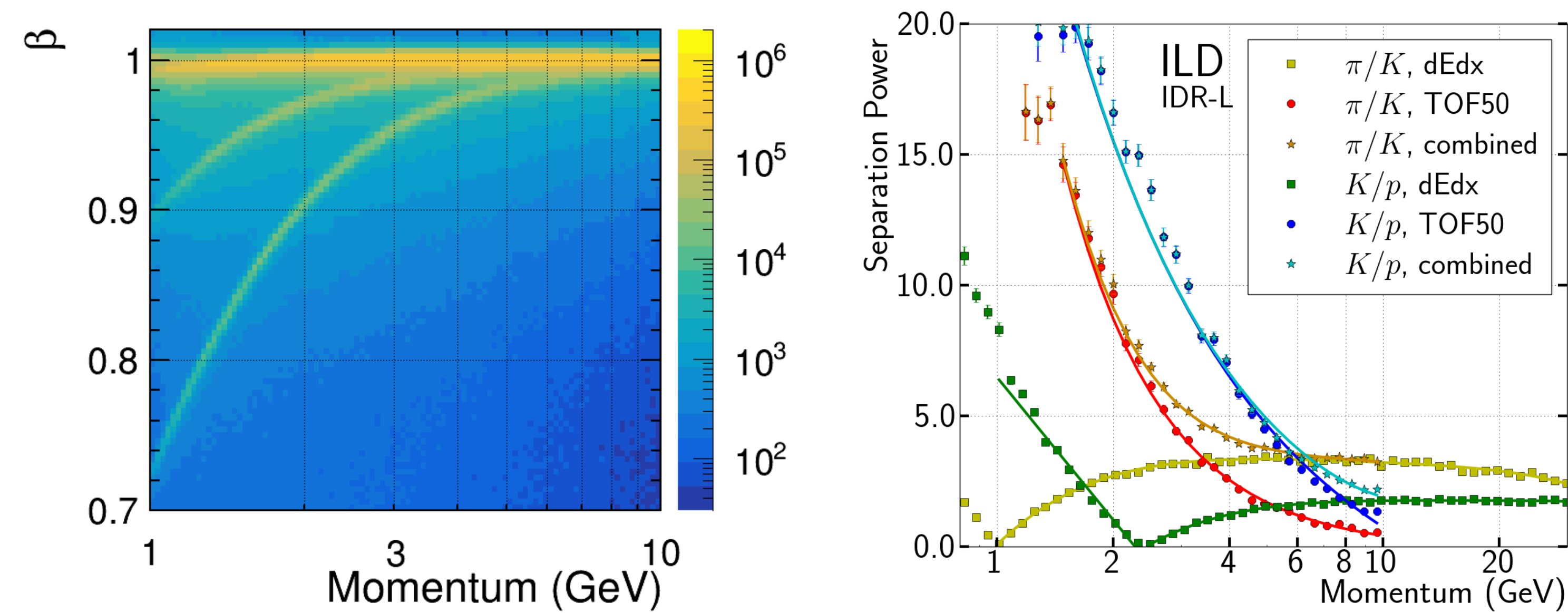
- ILD Interim Design Report, arXiv:2003.01116
- U. Einhaus: PhD Thesis, Uni Hamburg, *in prep.*
- B. Dudar et al.: Prospects of fast timing [...], arXiv:2105.12495

## Specific Energy Loss dE/dx



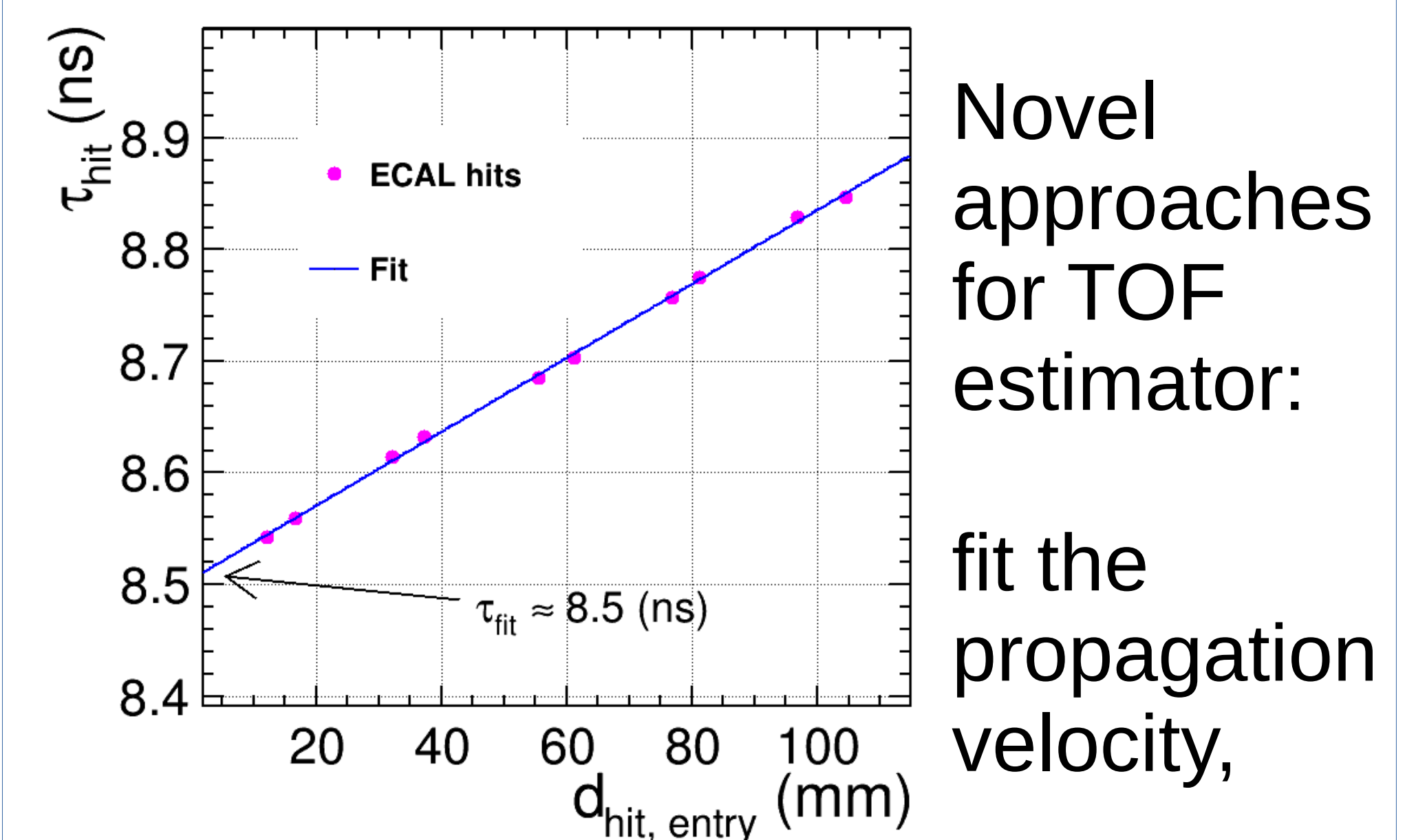
Tracks in the TPC have up to 220 hits, measure energy loss/flight distance (70% trunc. mean). Calculate distance between Bethe-Bloch bands: separation power.

## Time-of-Flight



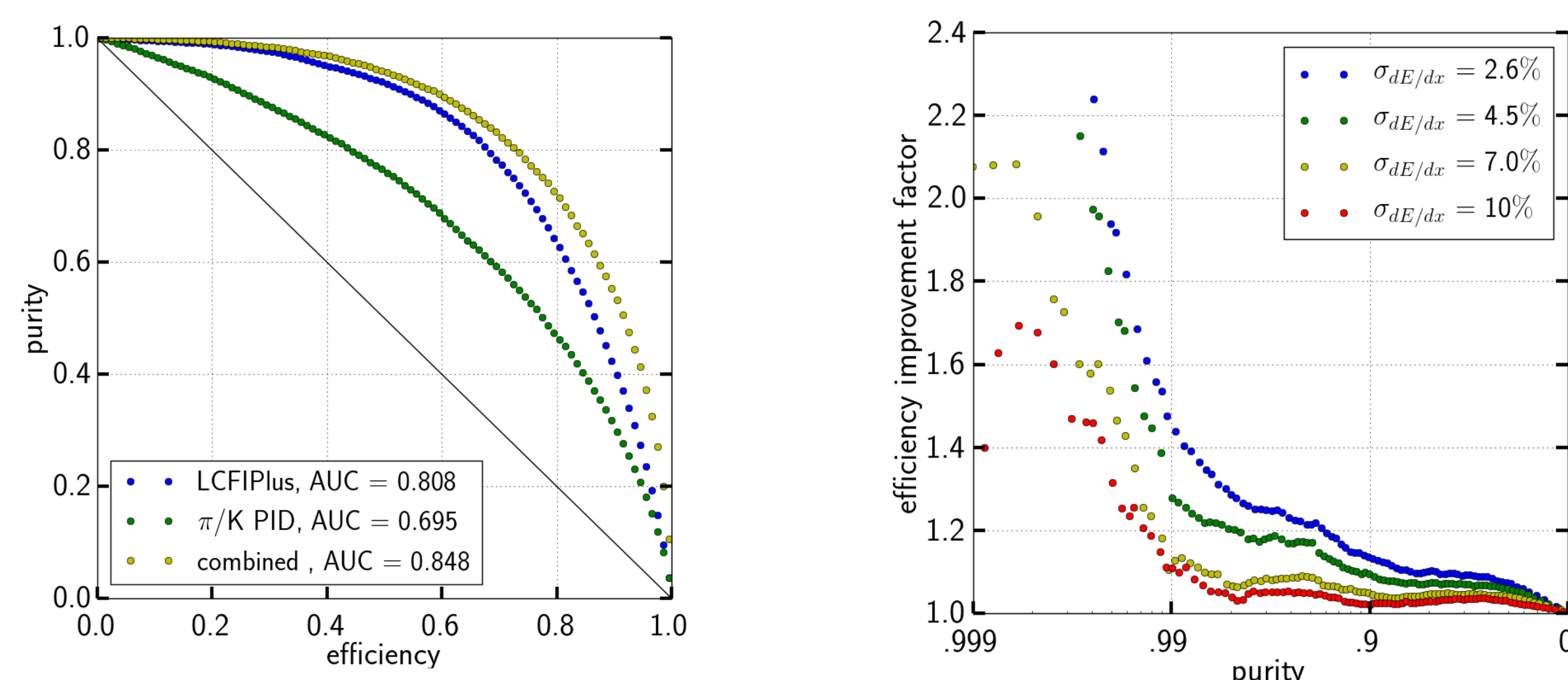
Measure timing from IP to ECal entry point  $\rightarrow$  velocity  $\beta$ . ECal time: average of 10 hits closest to track. Get separation power, covers dE/dx blind spots.

## TOF: Ongoing Development



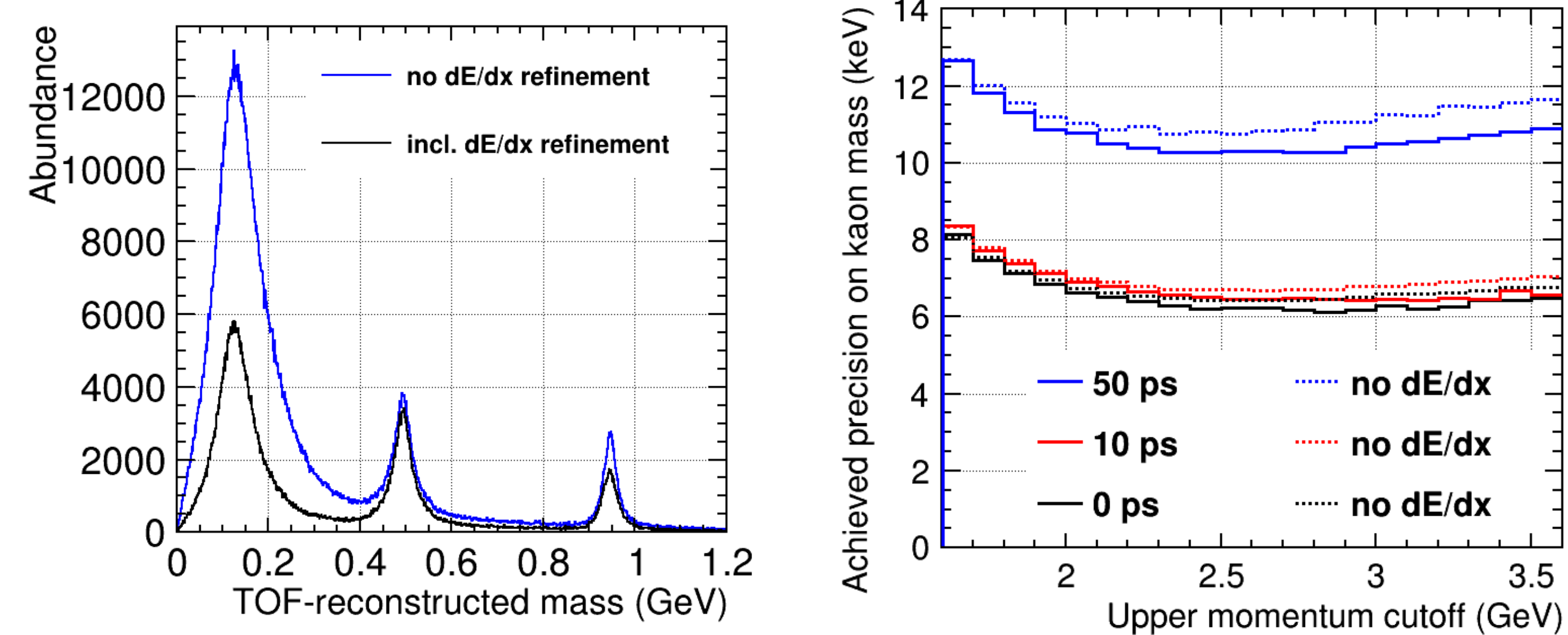
calibrate wrt. number of hits in showers, assess p at IP or EP.

## dE/dx Example: Had. W-decay Separation

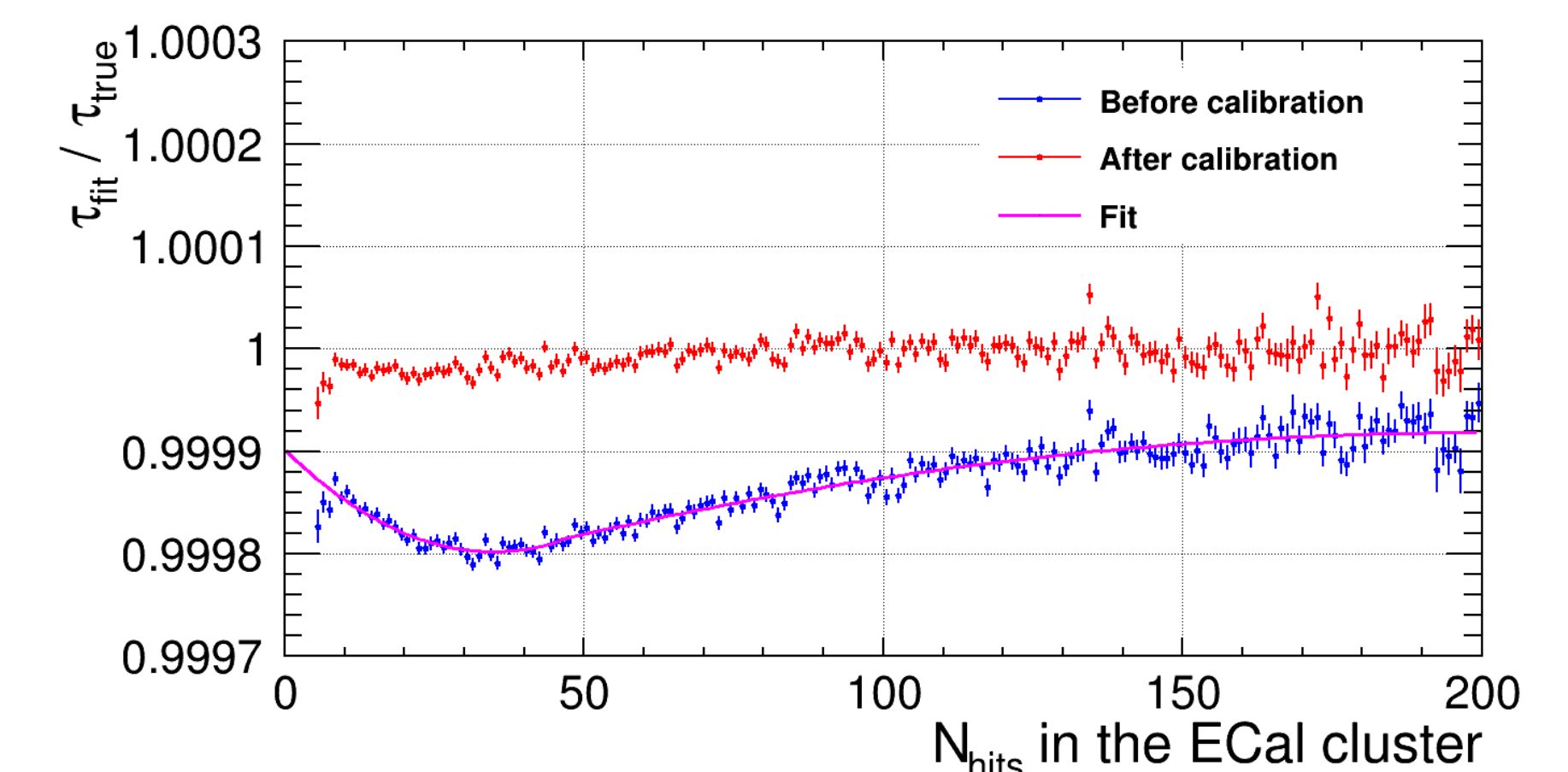


Separate  $W \rightarrow d+u$  from  $W \rightarrow s+c$  via abundance and momentum of kaons vs. pions, compare to default flavour tag. Helps determination of CKM matrix, in particular  $V_{cs}$ .

## TOF Example: Kaon Mass



Translate  $\beta$  into mass, use dE/dx to reduce background, fit mass. ILC  $2 \text{ ab}^{-1}$  @500 GeV gives stat. precision of 10 keV, better than current PDG uncert. of 13 keV.



Shows improvement of reco mass.

