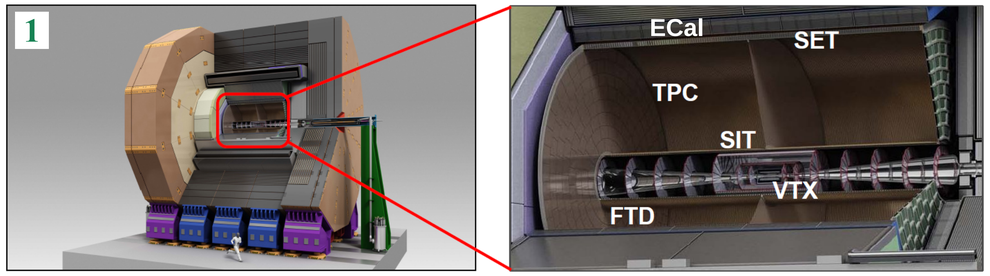
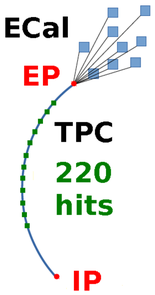
Charged Hadron Identification with dE/dx and Time-of-Flight at Future Higgs Factories

Uli Einhaus on behalf of the ILD Concept Group, ulrich.einhaus@desy.de

The International Large Detector ILD @ILC





Designed for Particle Flow

Asympt. mom. resolution:
$\sigma_{1/pt} = 2 \cdot 10^{-5}$ GeV^{-1}

Jet energy resolution:
$\sigma_{E,Jet} < 3.5\%$ over 100 GeV

dE/dx resolution:
< 5% demonstrated,
~ 3.5% prospects

Timing resolution:
under investigation,
assume 50 ps/hit

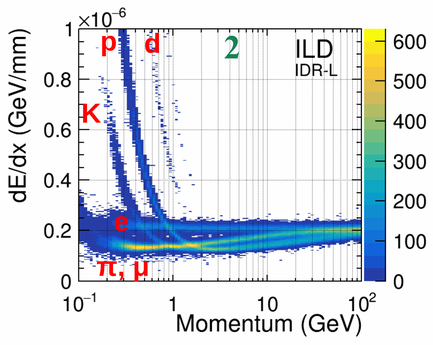
References

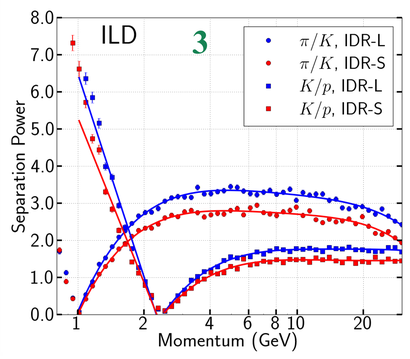
ILD Interim Design Report, arXiv:2003.01116

U. Einhaus: PhD Thesis, Uni Hamburg, *in prep.*

B. Dudar et al.: Prospects of fast timing […], arXiv:2105.12495

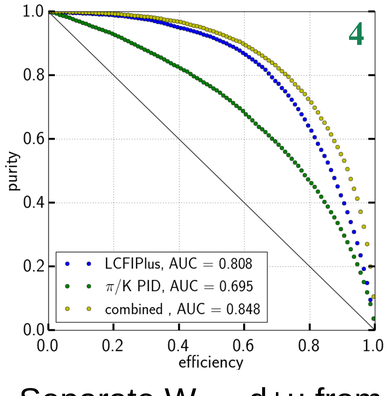
dE/dx Performance

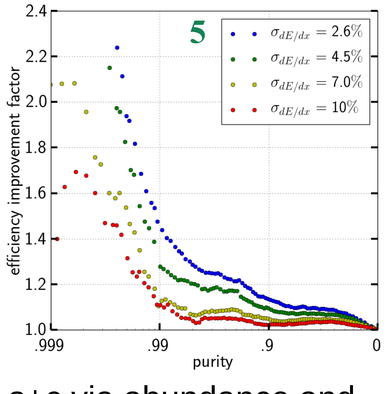




Tracks in the TPC have up to 220 hits, measure energy loss/flight distance (70% trunc. mean). Calculate distance between Bethe-Bloch bands: separation power.

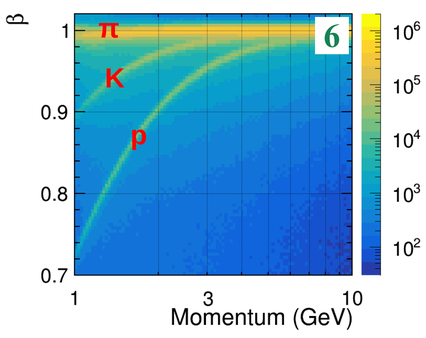
dE/dx Appl. Ex: Had. W-decay Separation

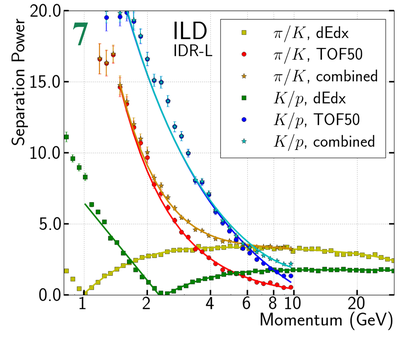




Separate W → d+u from W → s+c via abundance and momentum of kaons vs. pions, compare to default flavour tag. Helps determination of CKM matrix, in particular V_{cs}.

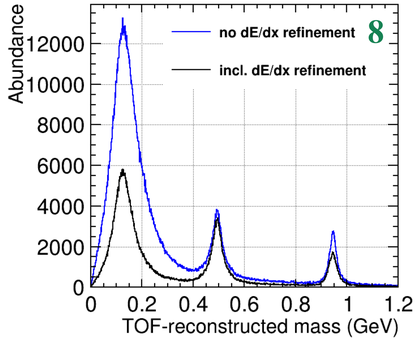
Time-of-Flight Performance

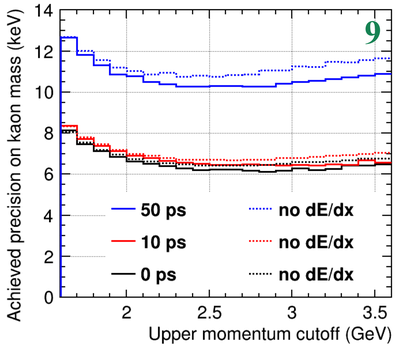




Measure timing from IP to ECal entry point → velocity β.
ECal time: average of 10 hits closest to track.
Get separation power, covers dE/dx blind spots.

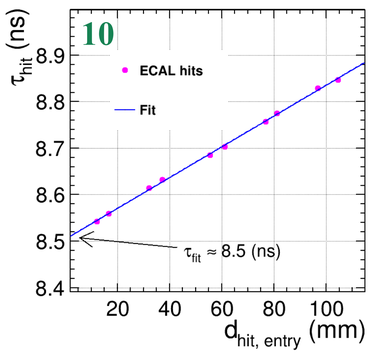
Time-of-Flight Appl. Ex.: Kaon Mass





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

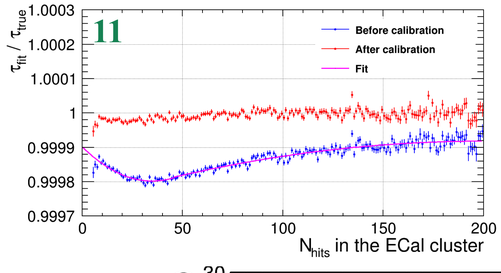
Time-of-Flight: Ongoing Development



Novel approaches for TOF estimator:

fit the propagation velocity,

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



Shows improvement of reco mass.