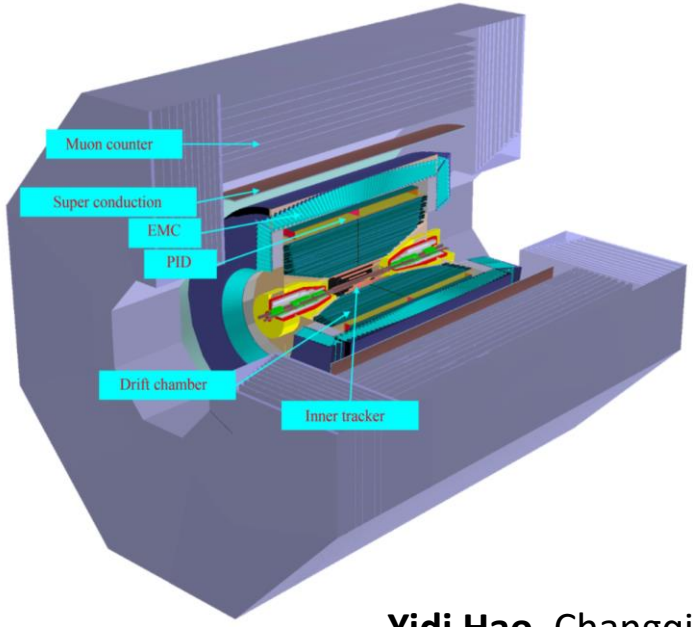
# A 3D track reconstruction algorithm for the pre-research of STCF MDC L1 trigger

- Super τ-Charm Facility (STCF)
  A new generation of high-luminosity electron-positron collider
  CME: 2-7 GeV
  Peak luminosity: >0.5×$10^{35}$ $cm^{-2}s^{-1}$ at 4 GeV

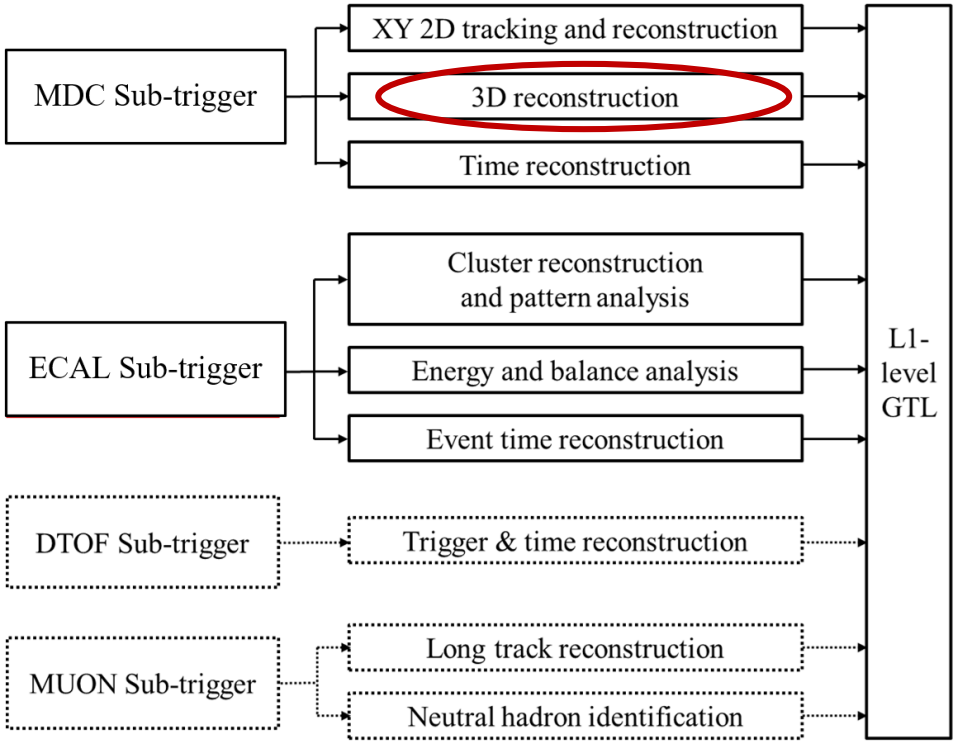



**High luminosity** generates:

- High physics event rate: over **400 kHz**
- High background: ~ **400 kHz**/channel in MDC

**Good background suppression capability**

**Low latency**

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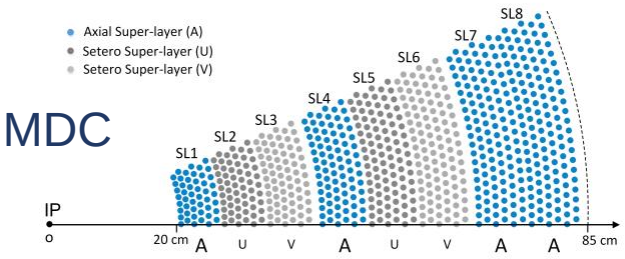
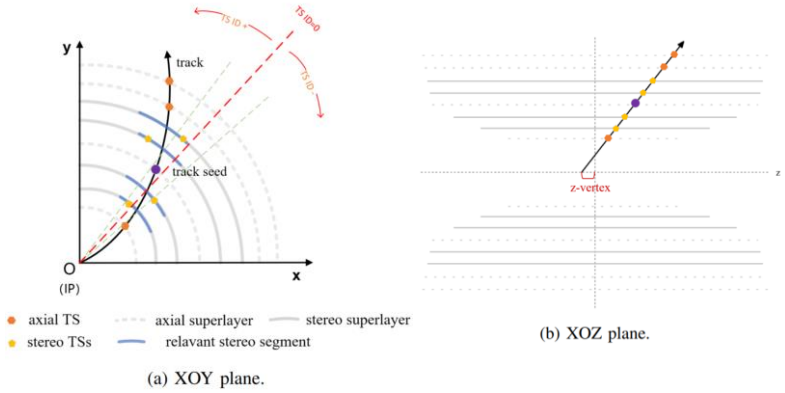
## 3D track reconstruction algorithm

### Preprocessing




Track segment (TS) finding

2D reconstruction (axial layer TSs and $p_t$) & stereo TSs matching



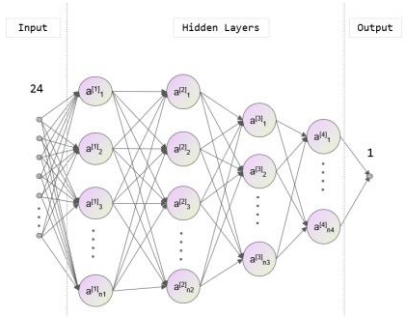

(a) XOY plane.

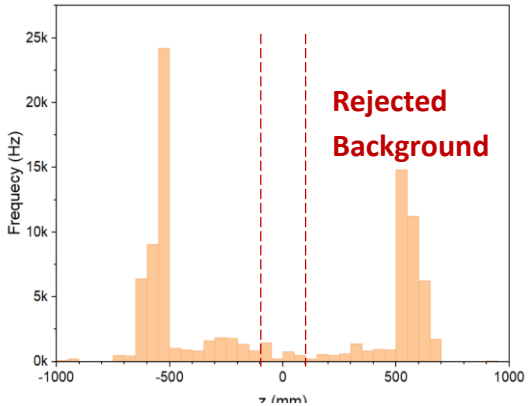
(b) XOZ plane.

### MLP training

24 input: TS ID & TDC timing of 12 TSs
1 output: z-vertex estimation

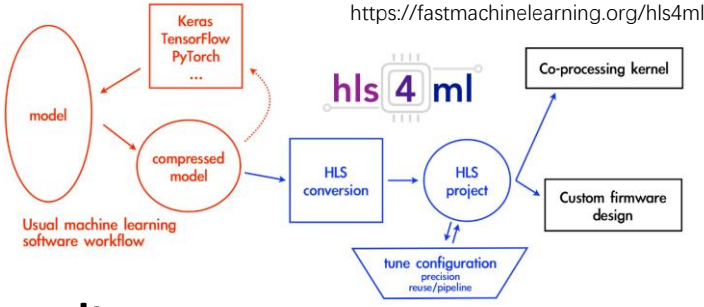
**Qkeras**---train fixed-point models
**Pruning**---reduce model's size



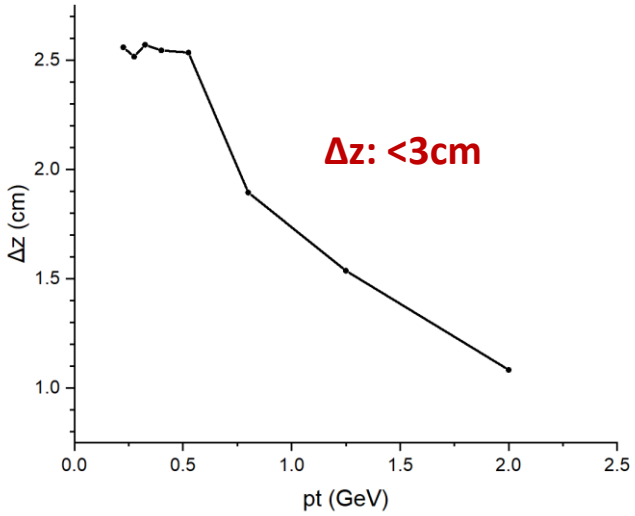

### FPGA implementation

https://fastmachinelearning.org/hls4ml




### Test result

Test data set: 100k clear single tracks
MLP structure: 24-48-32-16-8-1 Sparsity: 0.4
CLK: 400MHz FPGA: XCKU060
Dead time: 4 clks **Latency**: 30clks

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