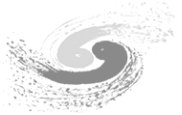


Recent progress and requirement on MRPC and fast timing

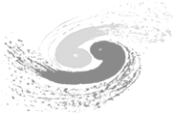
Elec. Group, EPC of IHEP

2014/02/12

TOF Upgrade of BESIII EndCap

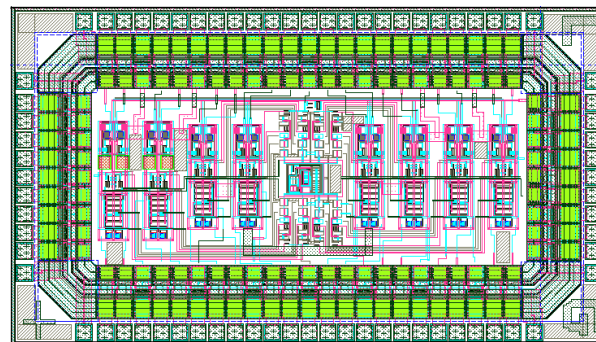
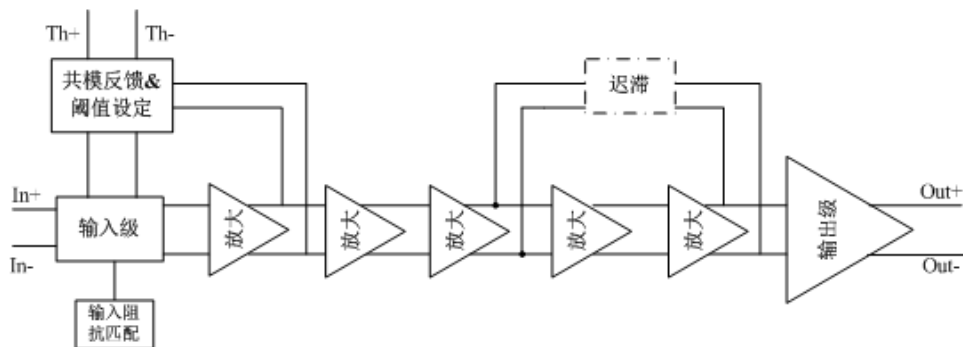
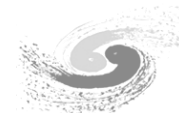


- **Upgrade scheme for EndCap Time-of-Flight in BESIII**
 - MRPC as the detector
 - NINO like frontend chip + HPTDC as the electronics
- **Timing resolution requirement**
 - Measured time resolution of NINO: $< 10\text{ps}$
 - Time resolution of HPTDC now: 25ps
 - Can not meet the timing requirement for frontend
- **Better timing resolution is expected for TOF in future**
 - Frontend: $< 5\text{ps}$ with better chip
 - Required time resolution of TDC: $< 5\text{ps}$



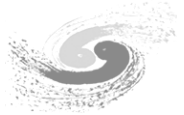
- **Analysis of high-Z material**
 - Muon from cosmic ray will deflect when go through high-Z material, so can be detected by imaging
 - Spatial resolution: 1mm → corresponding time resolution: 6ps
- **Use multi-layer MRPC (> 4layers)**
 - Intrinsic resolution: ~30ps
 - Can be almost eliminated by dual-end readout
 - Frontend electronics: NINO like chip
 - Expected time resolution: 5ps
 - Backend electronics: high precision TDC
 - Timing requirement: < 3ps

Recent Progress on MRPC fast FEE

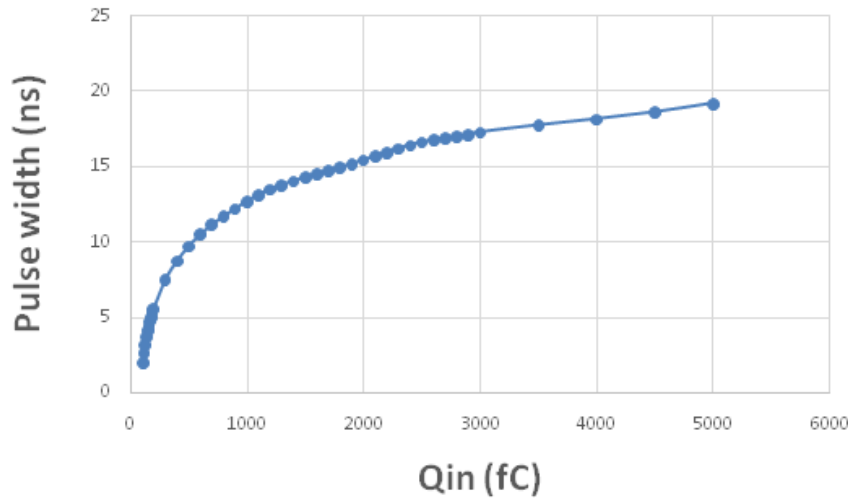


- **A Fast Front-end ASIC was designed for MRPC**
- **Based on multiple stages fast amplification, a Time-over-Threshold pulse generated, output by LVDS**
- **Leading edge: timing info.**
- **Pulse width: Current Amplitude info.**
- **A 8-channel chip was designed and tested**

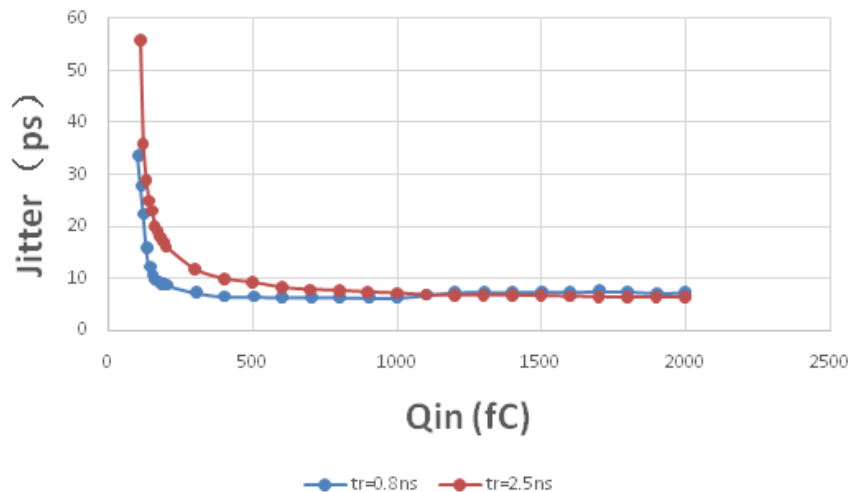
Recent Progress on MRPC fast FEE



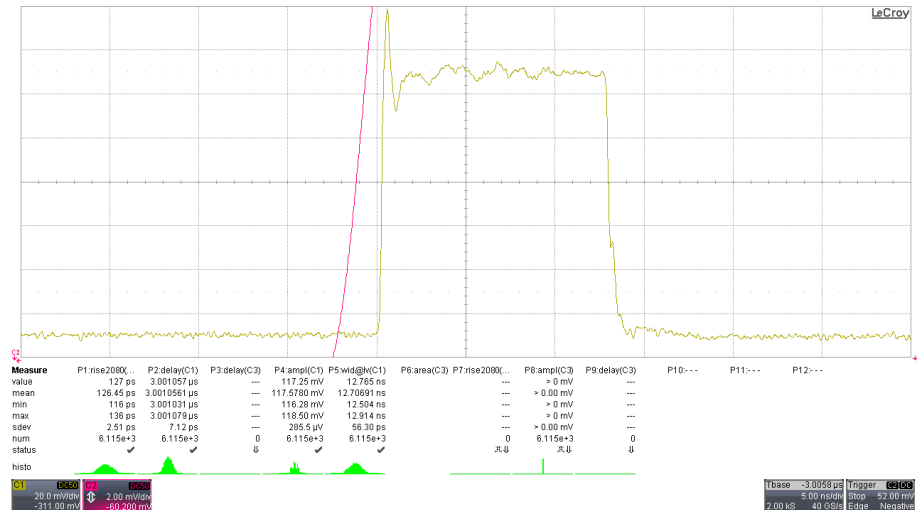
Width vs Q_{in}



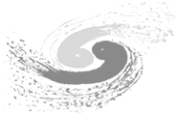
Jitter vs Q_{in}



- Measured pulse width vs Q_{in} showed linearity for $Q_{in} > 1pC$
- Measured jitter of leading edge $\sim 7ps$ for $Q_{in} > 1pC$
- Input by generator with rise time of 0.8ns and 2.5ns respectively



Conclusion



- **New high precision TDC is needed**
 - Expecting a time resolution $< 5\text{ps}$
- **Beneficial projects:**
 - TOF upgrade in BESIII
 - Multi-layer MRPC
- **We are preparing related frontend chips and electronics for the next generation TDC**

Thank you!