
Status of Muon system & Performance of double stack MRPCs

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MID status

- MID(Muon Identifier: continuously readout)
 - Goal: Slow down RPC ageing
 - New FE with preamp.: FEERIC reduces operating voltage.
 - 3~5 times smaller charge deposit than before
 - No longer provides L0 trigger, Readout data continuously
 - Upgrade
 - Front-end card → Fast FEE(FEERIC card)
 - New fast readout electronics(Regional & Local boards)
 - Independent threshold control on RPCs: new wireless threshold distribution system
 - Done: 2384 FEERIC have been installed and commissioned

MID plan for 2020

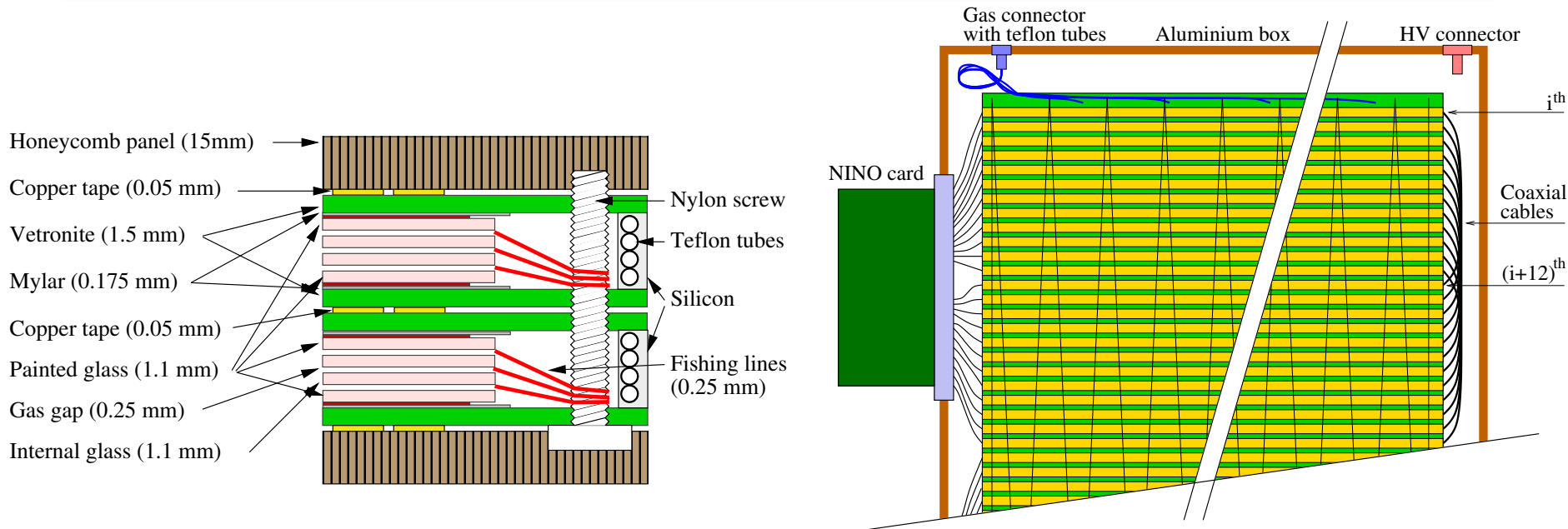
- Readout electronics installation
- CRU(common Readout Unit)
 - Full chain tests: MID-ro full crate
- Standalone commissioning:
 - Test and optimization of the MID ro/SW/DCS/QC chain
- Cosmic test
 - With complete detector
 - RPC HV on + flammable gas mixture
- Manpower
 - Start shifts during cosmic runs

MRPC R&D

- Readout at both ends
 - Sealed gap: operating in a lower gas flow

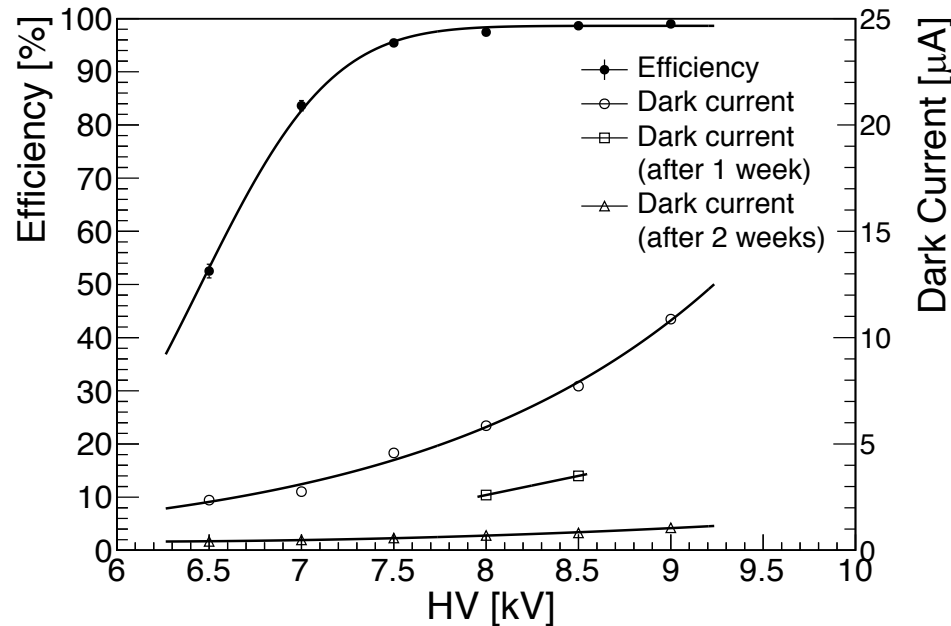
- Single-ended readout
 - Sealed gap: operating in a lower gas flow
 - Front-end cards were mounted only on one side

Description of MRPCs



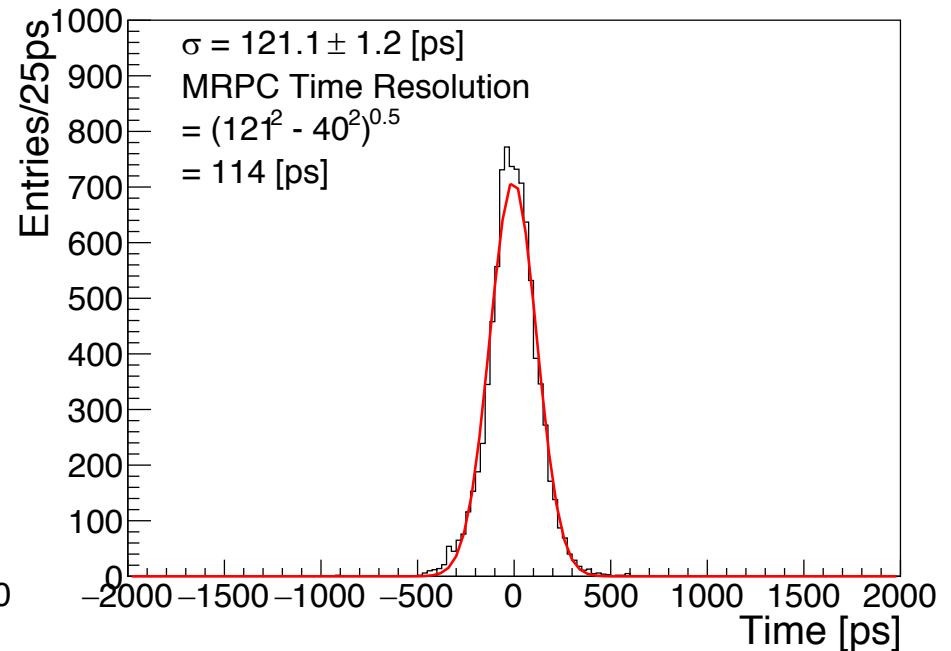
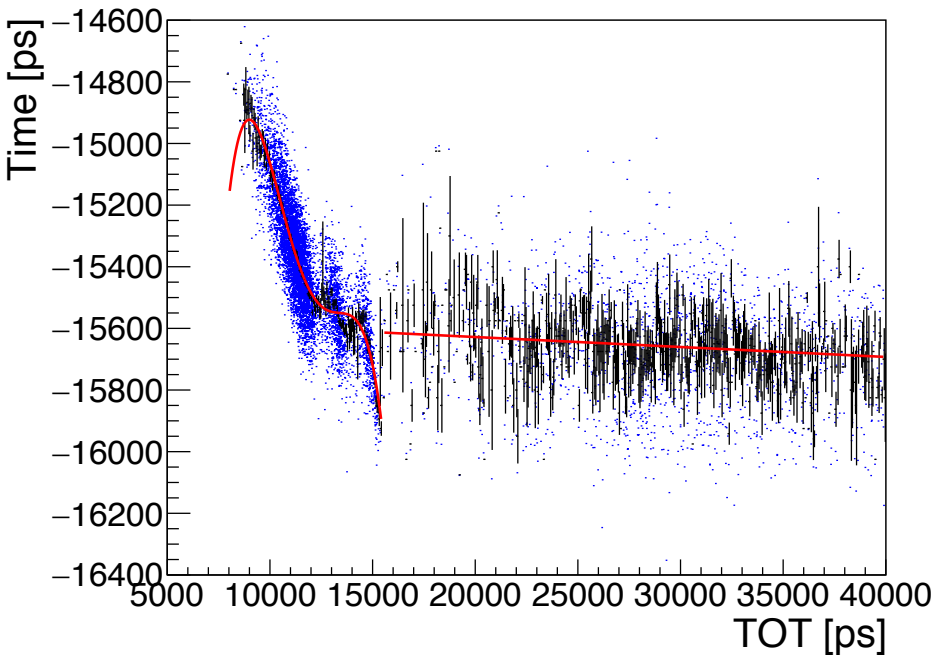
- Double stack to reduce operating voltage
- $250\mu\text{m} \times 6$ gaps, 9mm wide copper tape for readout(11 mm pitch)
- Sensitive area: $85 \times 85 \text{ cm}^2$
- Sealed gap to reduce gas consumed
- Readout:
 - Both ends
 - Single ended: Installation condition & cost saving

Efficiency



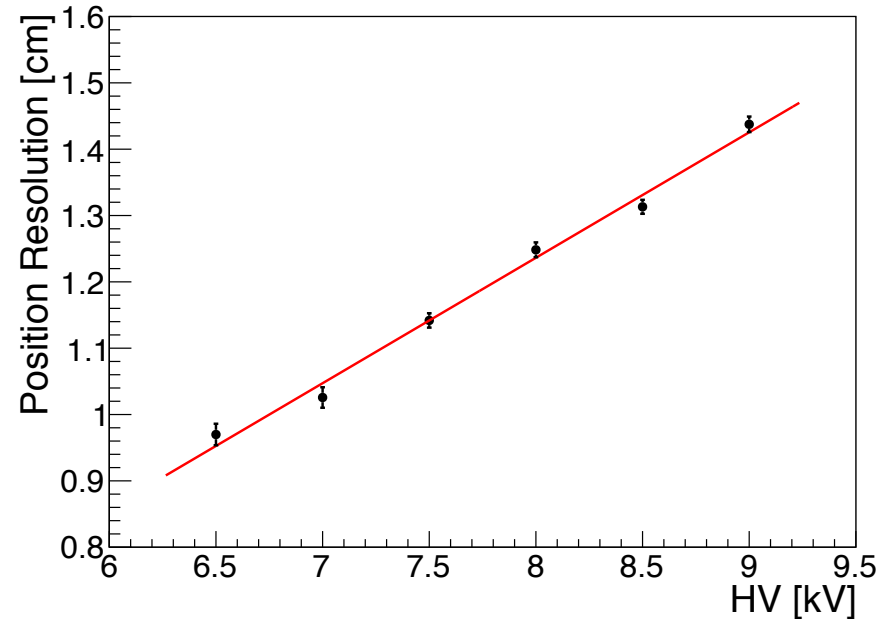
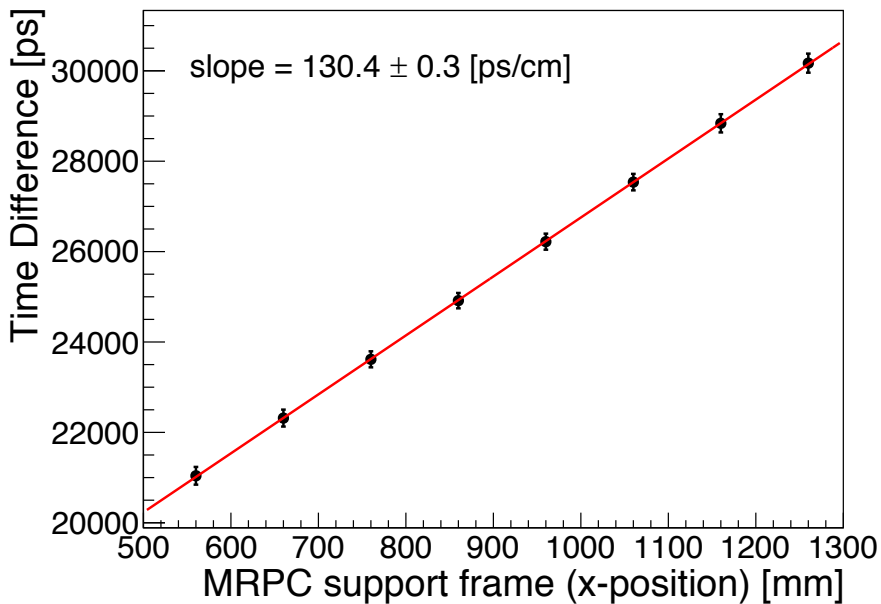
- Gas mixture: $C_2F_4H_2/SF_6$ (95/5%)
- HV@8kV: $6\mu A$ (beam test) \rightarrow $3\mu A$ (1 week after) \rightarrow below $1\mu A$ (2 weeks after)

T-A correction & σ_{time}



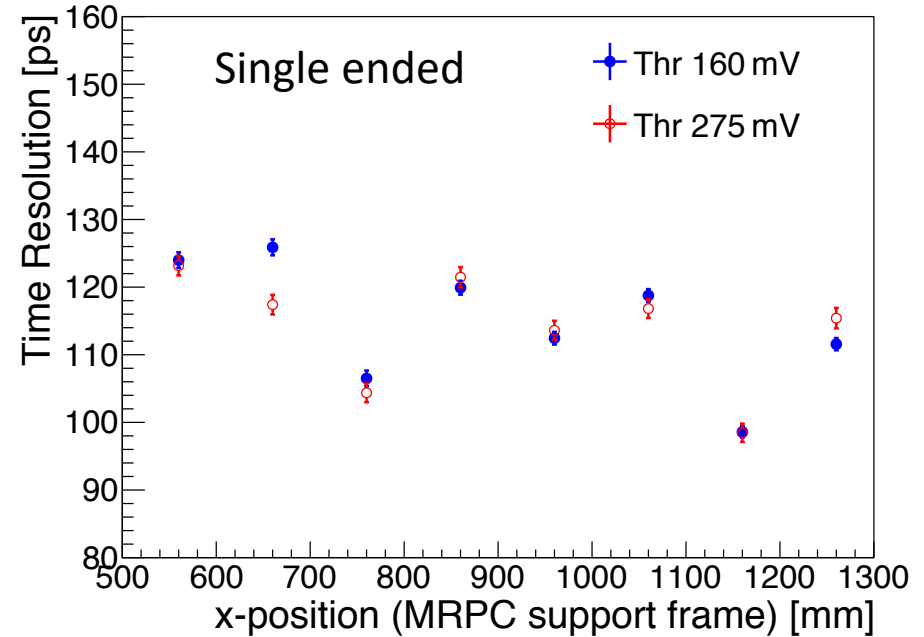
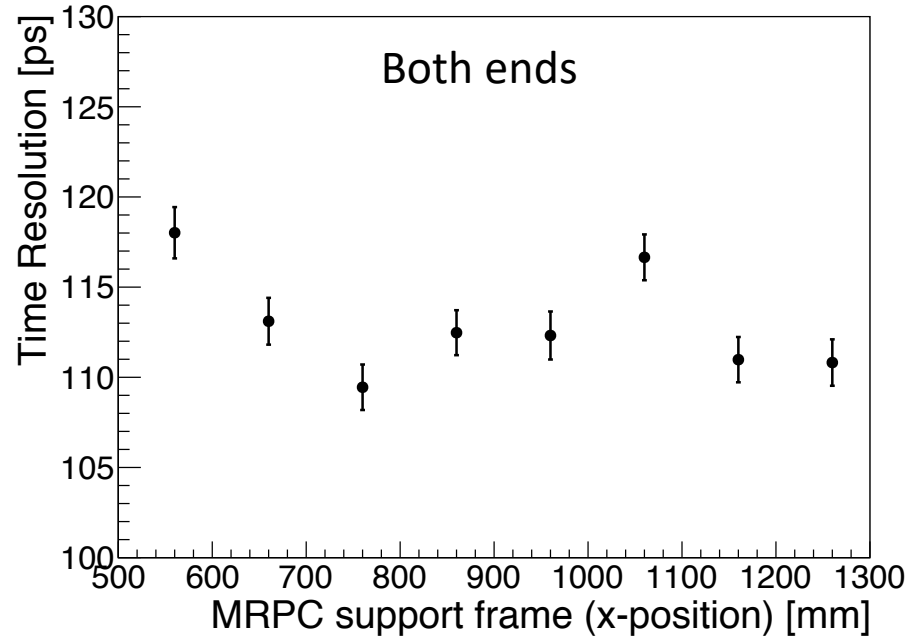
- FEE(NINO)
 - TimeOverThreshold(TOT) technique
 - $\sigma_{\text{time}} = 114\text{ps}$, after subtracting 40ps of $\sigma_{t_{\text{ref}}}$

Position resolution



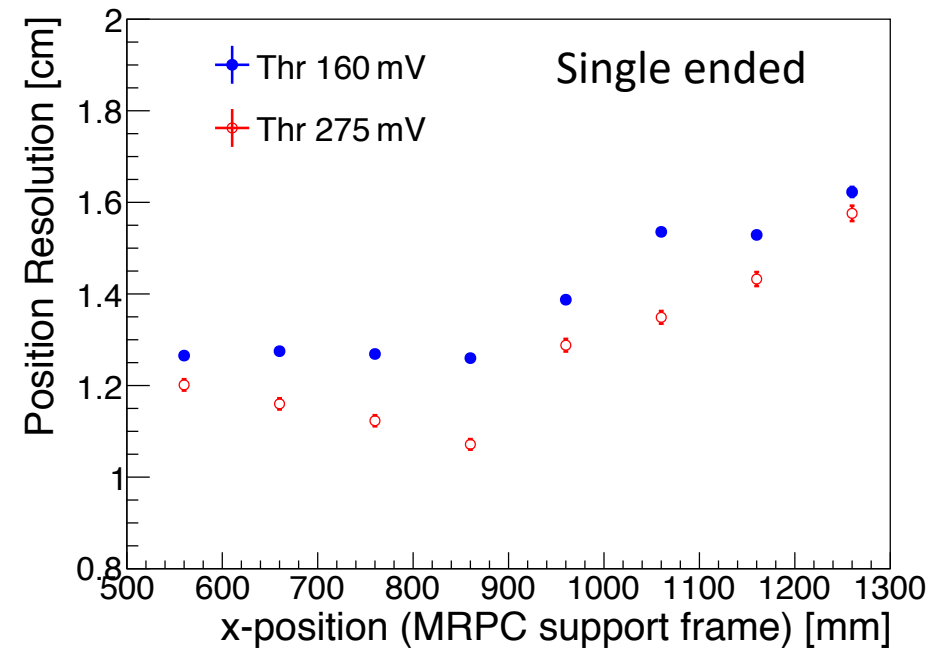
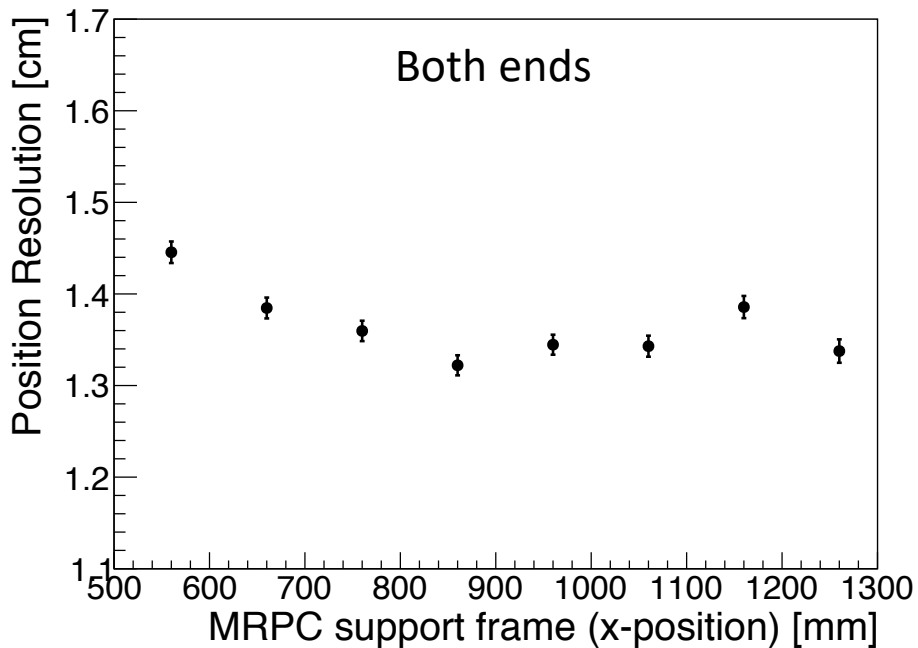
- Speed of signal: $65\text{ps/cm} \sim 0.5$ speed of light
- $\sigma_{\text{time_diff}} @ 8.5\text{kV} = 172\text{ps} = 1.35\text{ cm}$

x-scan: Time resolution



- Avg. Time resolution ~ 115 ps
- Fluctuation: both ends $<$ single ended

X-scan: position resolution



- Position resolution $\sim 1.35\text{cm}$
- Single-ended: asymmetric position resolution impedance mismatching (coax cable)

Summary

- Readouts
 - Both ends & Single-ended readout
 - Similar performance
 - time resolution & position resolution
- Plan
 - Low gas flow test using cosmic