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Hadron & Nuclear Physics Lab

Development of a Beam Hodoscope(BH2) with Fast Scintillators and MPPC Readout for J-PARC E42

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BH2 for J-PARC E42

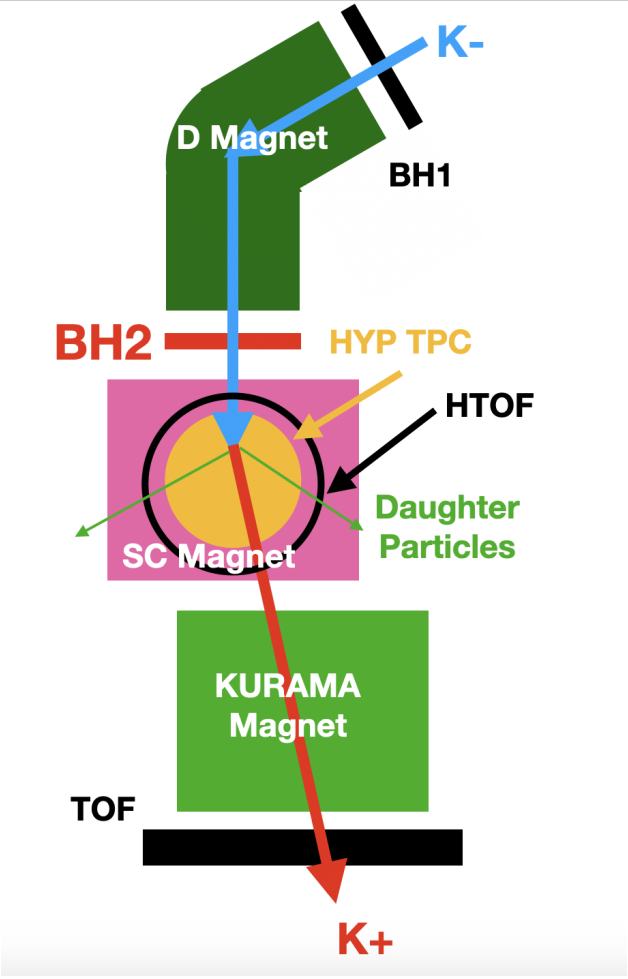


Figure: K1.8 Beamline

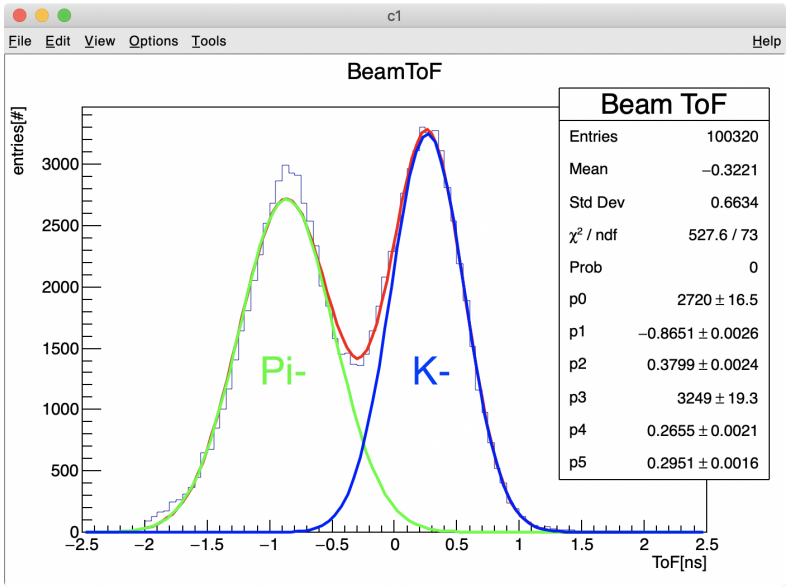
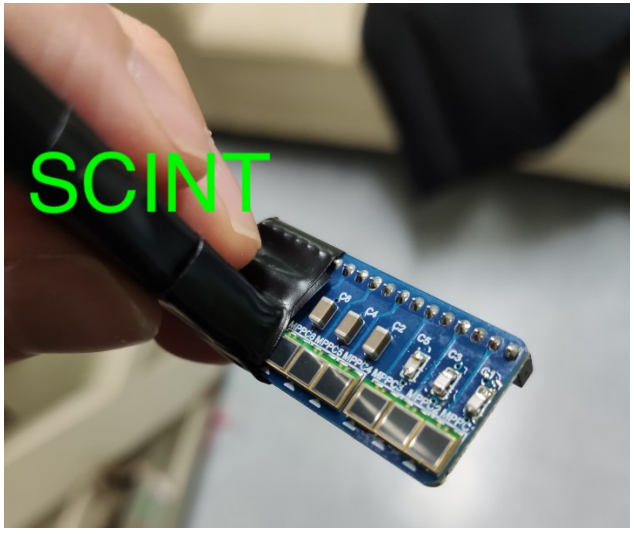


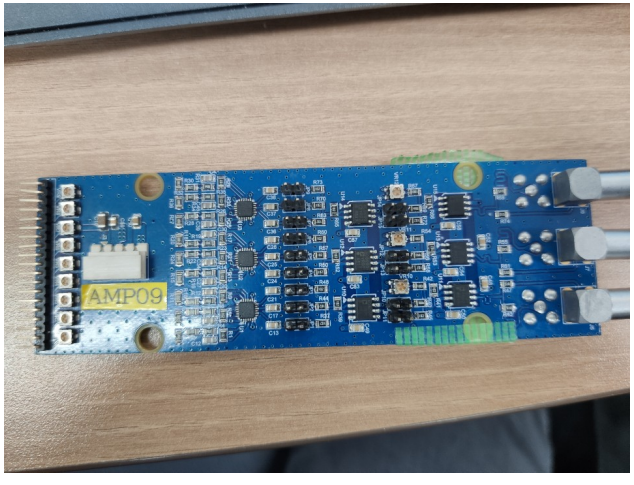
Figure: ToF of the Beam.

$$T_{Beam} = T_{BH2} - T_{BH1}; \quad T_{Scat} = T_{HTOF} - T_{BH2}$$

- J-PARC E42 searchs for the H-dibaryon, by (K^-, K^+)reaction at ^{12}C target.

What is BH2?





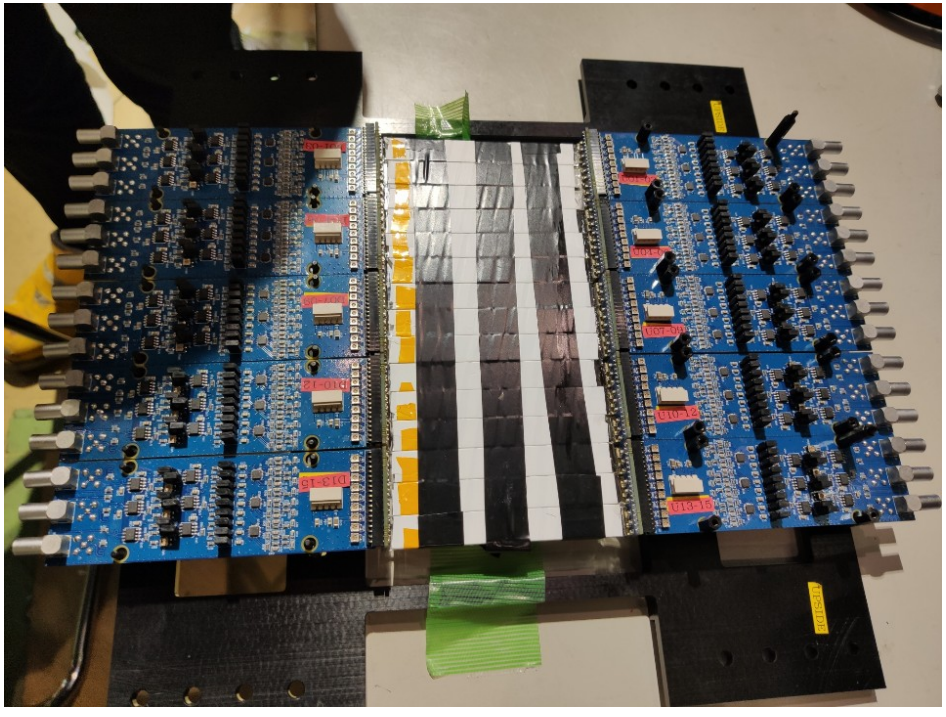
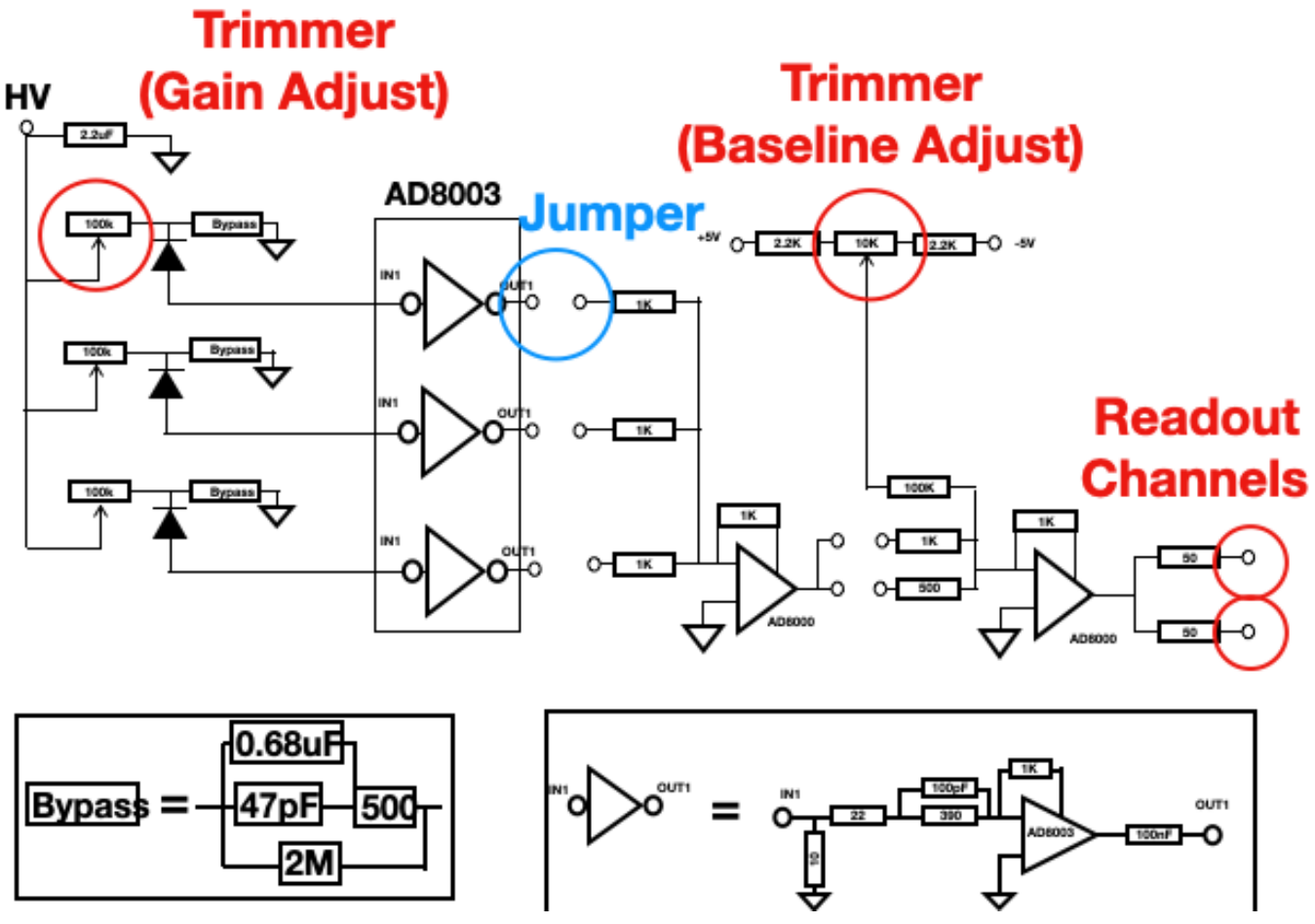


Figure: BH2 at J-PARC.

- BH2 is a Scintillation counter using MPPC
- MPPC and Signal Amplifying circuit is on separate board.

MPPC Readout Logic



- AD8003 contains 3 AD8000 OPAmp.
- 3 MPPC reads 1 scintillator (13mm)output.
- 2 Output channels are required for ADC/TDC

PCB Design to Avoid MPPC Crosstalk

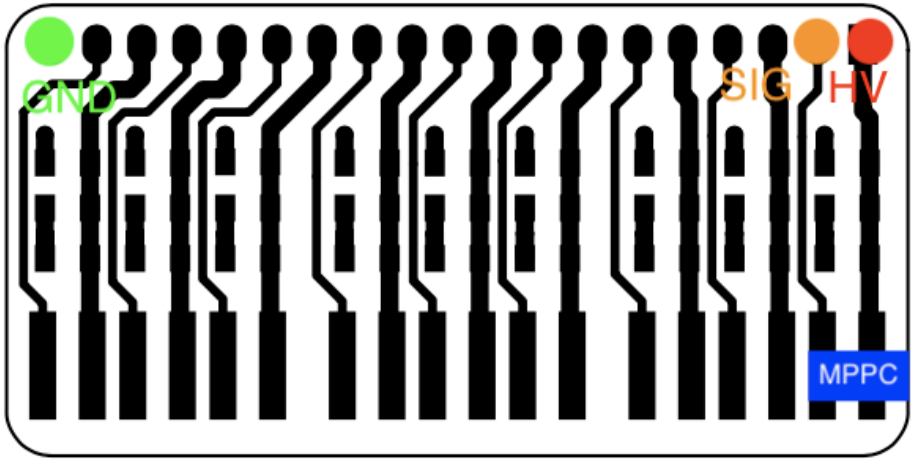


Figure: Front side

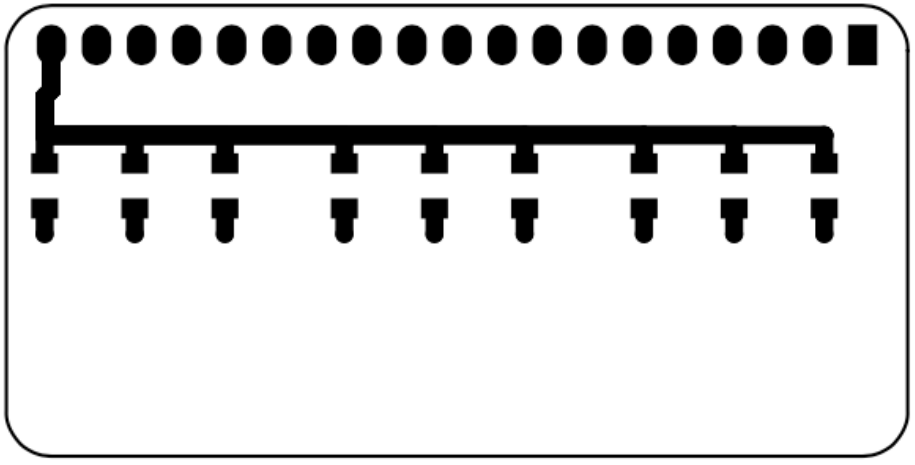
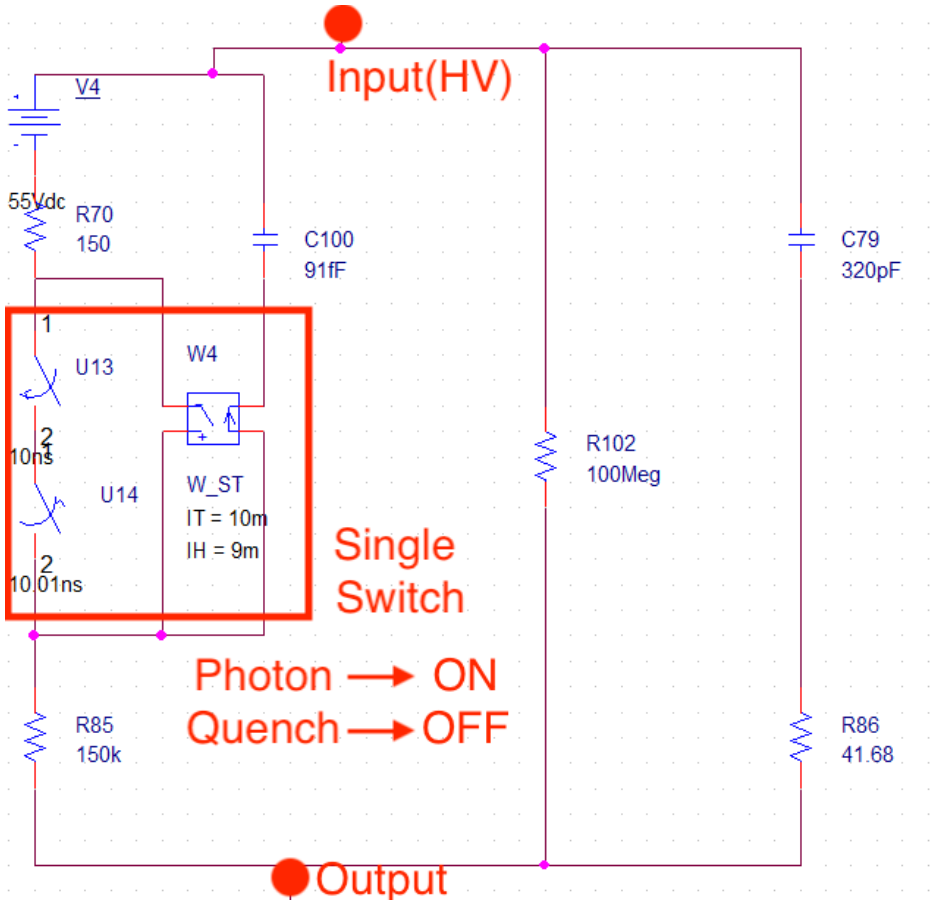
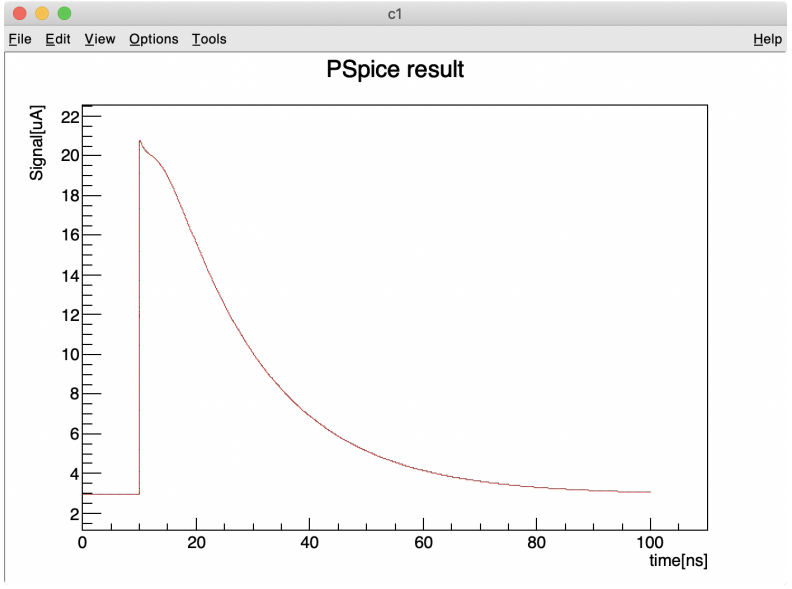


Figure: Back Side

- MPPC is placed on separate board, to bend the circuit.
- Placing conductor under middle of MPPC causes Crosstalk.

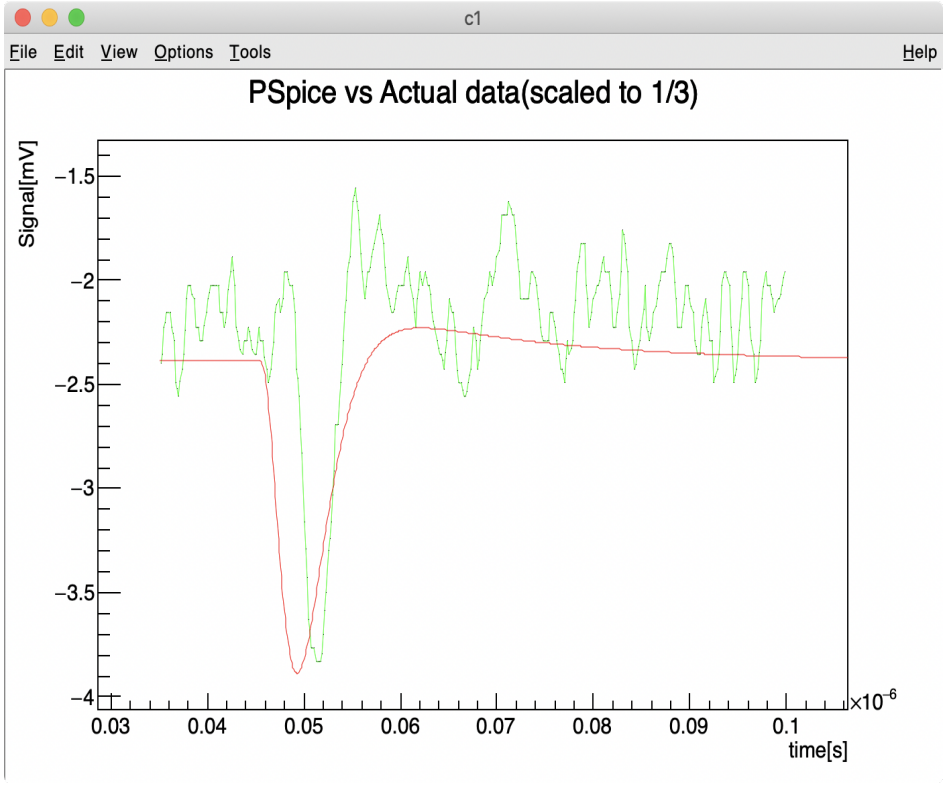
MPPC on PSpice





- R102 for Dark current($\sim 0.5\mu A$)
- Unfired pixels are implemented(C79-R86 line)
- MPPC Intrinsic risetime is very fast.

PSpice VS Oscilloscope



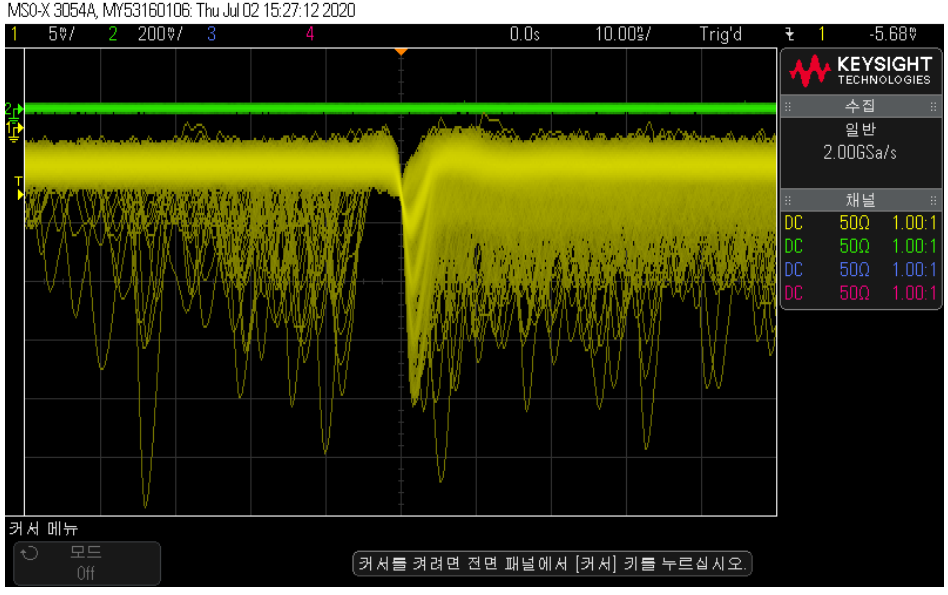


Figure: Red: PSpice, Green: Real circuit

- Dark counts can be seen.

Selection of Scintillator

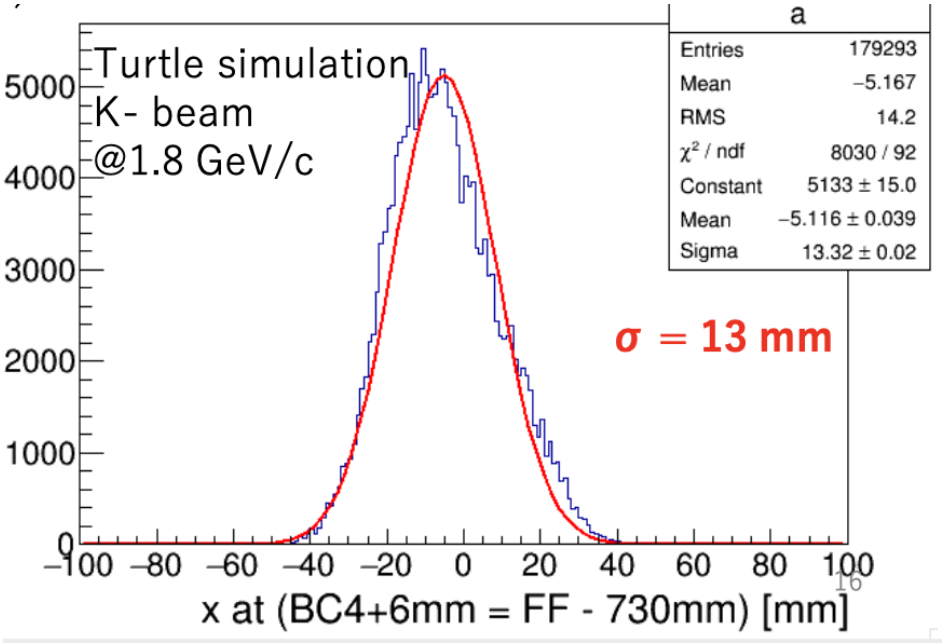


Figure: Simulation result: 1σ ~0.5 MHz

- Time resolution gets worse, if rate/slat$>$ 0.5MHz$\rightarrow$ Slat width$\leq$13 mm
- Slat height=Height of Drift Chamber(100 mm), to use for Magnet tuning
- EJ232 was sellected, for fast rise/decay time(0.35ns/1.4 ns)

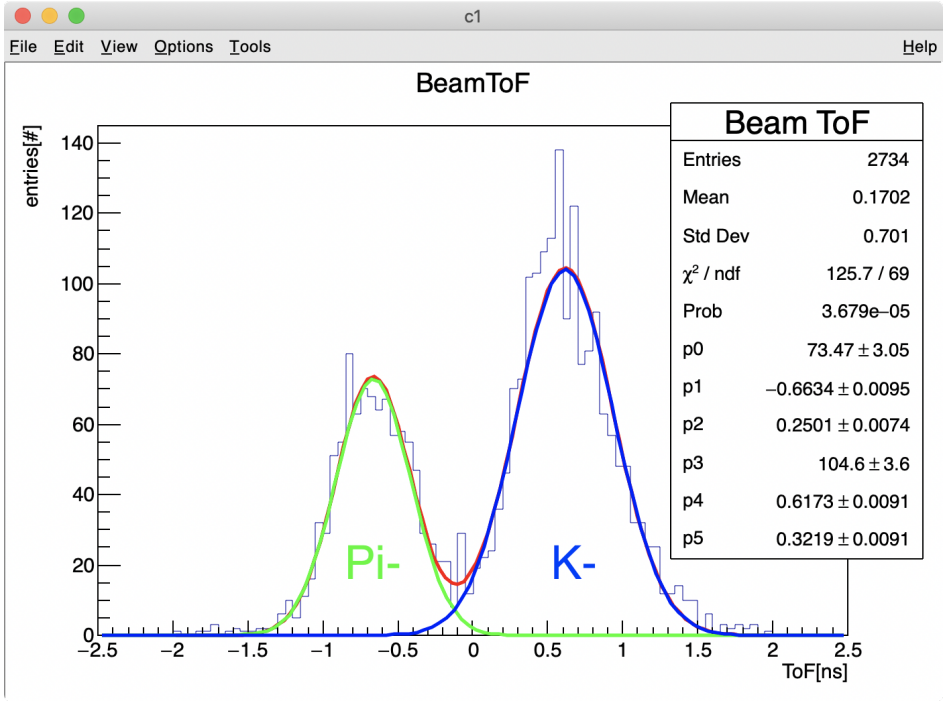
Scintillator Selection

T \ W	9 mm	13 mm
5 mm	71.3±6.9 ps	52.8±3.6 ps
3 mm	-	66.3±2.8 ps

Table: Time resolution table of candidate scintillators. Length= 100 mm

- 3 candidate scintillators with different dimensions were tested, before producing BH2 Circuit.
- $100^{L}13^{W}5^{T}$ EJ232 was sellected for BH2
- Time resoulition of BH2 with new circuit: 69.2±2.6 ps.

Beam data at J-PARC



- New BH2 can separate K^- and π^- beam.
- Time resolution is not analyzed yet.