# Degradation of HRPPD performance in B-field

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# HRPPD in Superconducting magnet

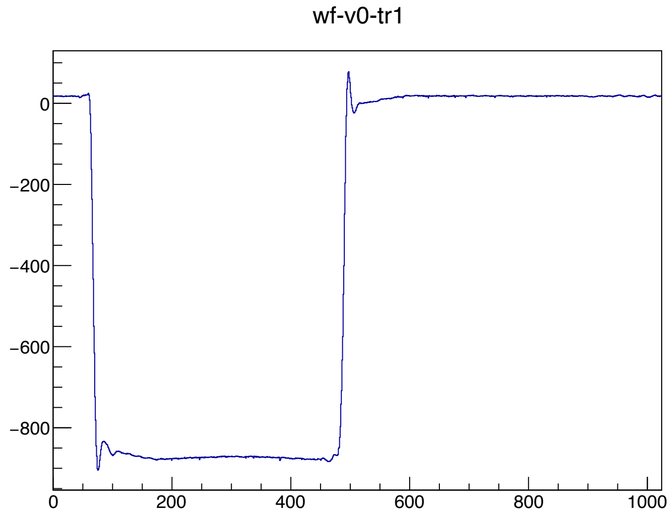
- The superconducting magnet at SMD can provide a B-field up to 1.8 T.
- The **B-field** of ePIC at EIC has a strength 1.7 T at the center, and around 1.3-1.4 T at pfRICH.
- Also HRPPD **tilts** from 30 degrees to -30 degrees.
- Parameters of interest: Gain, Timing, after-pulse rate.

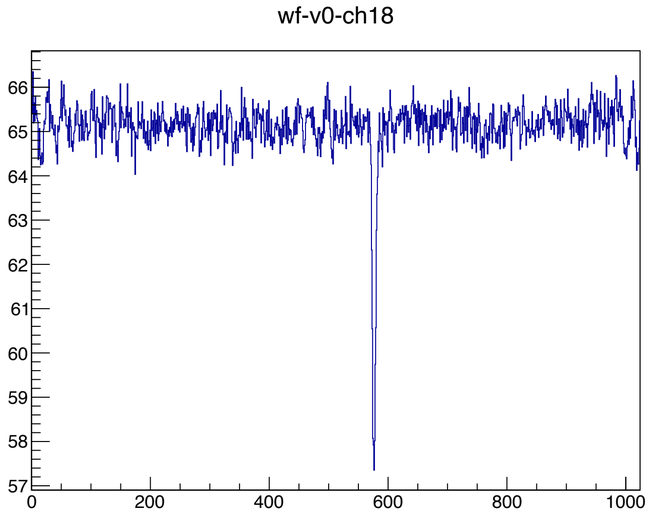
# Overview

- ~1,000 runs are taken. 1 run contains 100k events with ~5% of which have signals.
- Most of them are taken for different B-field or tilting angle.
- In addition, two more sets of data are taken:
- 1, different laser repetitions to study whether HRPPD is saturated due to signal rate (laser repetition x fraction of signal events)
- 2, asymmetric HV setting for two MCP in HRPPD. (e.g., 675 V on the first, 800V on the second.)

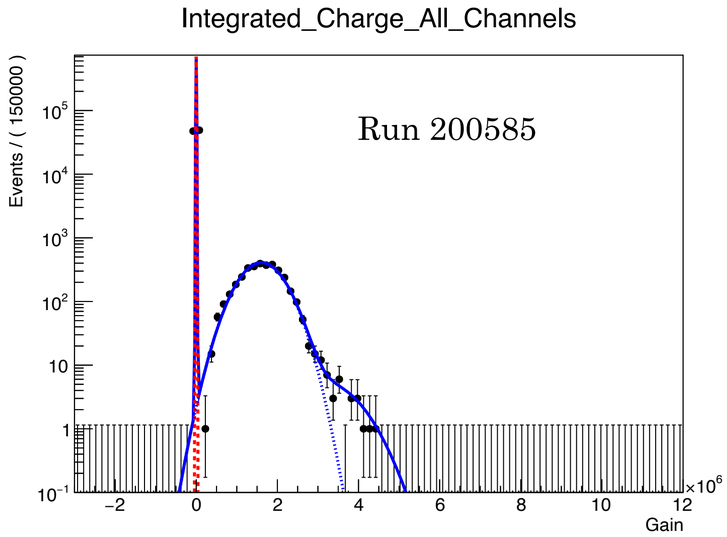
# Signal selection

- Peak-searching in a narrow time window (15 bins, 3 ns) with respect to trigger.

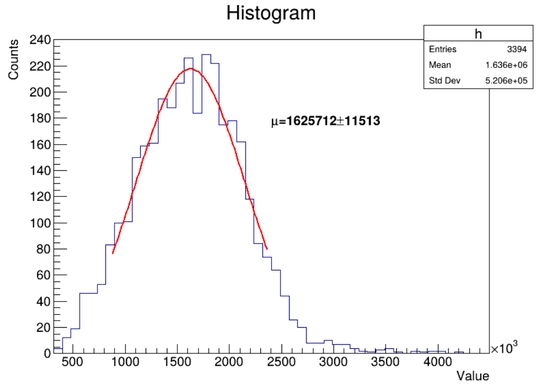


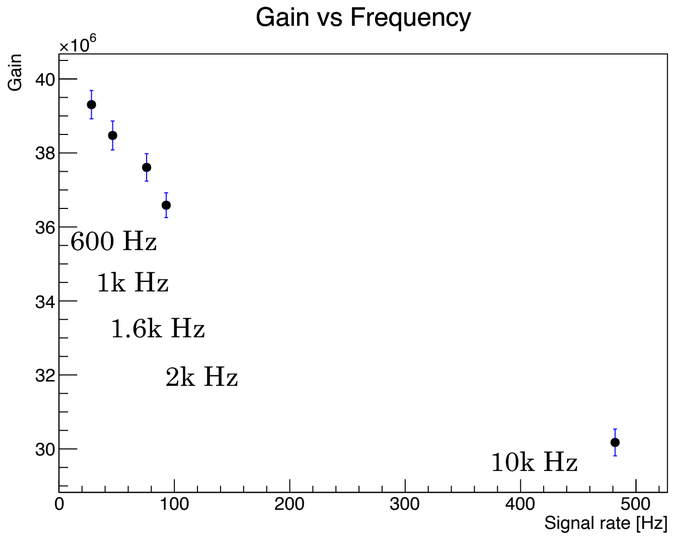



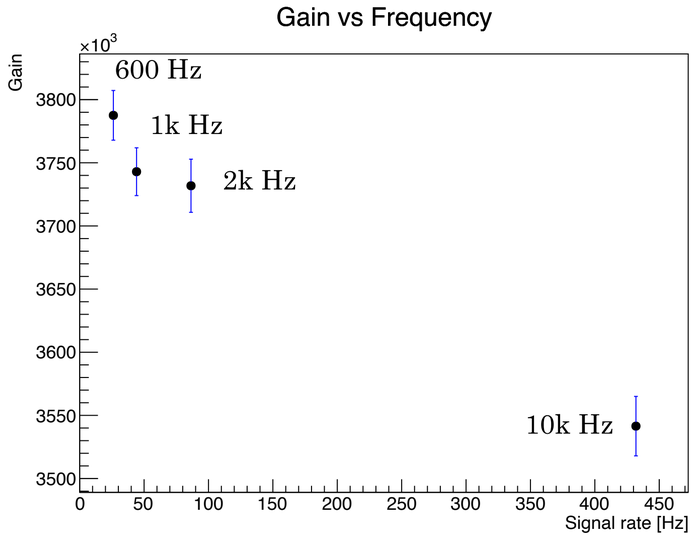

```
if (list[ix] < pedestal - cut) and list[ix-4] <
pedestal and list[ix-3] < pedestal and list[ix-2] <
pedestal and list[ix-1] < pedestal and list[ix] <
pedestal and list[ix+1] < pedestal and list[ix+2] <
pedestal and list[ix+3] < pedestal and list[ix+4] <
pedestal and list[ix] < list[ix-1] and list[ix-1] <
list[ix-2] and list[ix-2] < list[ix-3] and list[ix-3] <
list[ix-4] and list[ix] < list[ix+1] and list[ix+1] <
list[ix+2] and list[ix+2] < list[ix+3] and list[ix+3]
< list[ix+4] and (pedestal - list[ix]) < 2*(pedestal -
list[ix-1]) and (pedestal - list[ix]) < 2*(pedestal -
list[ix+1])
```

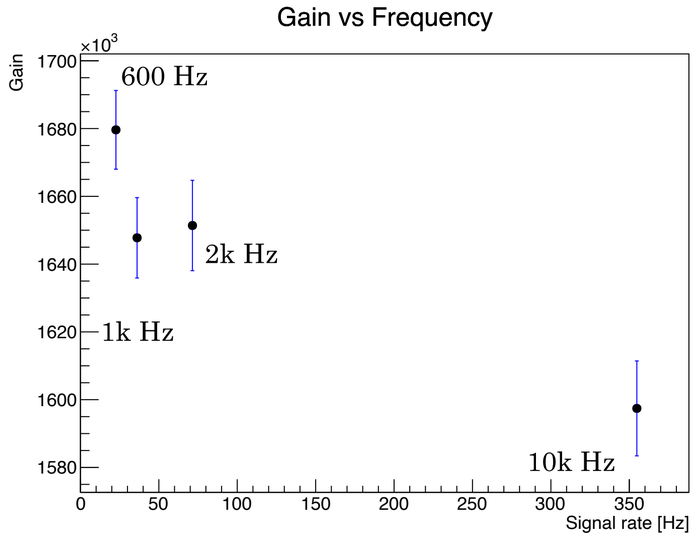


# Gain vs Signal Rate



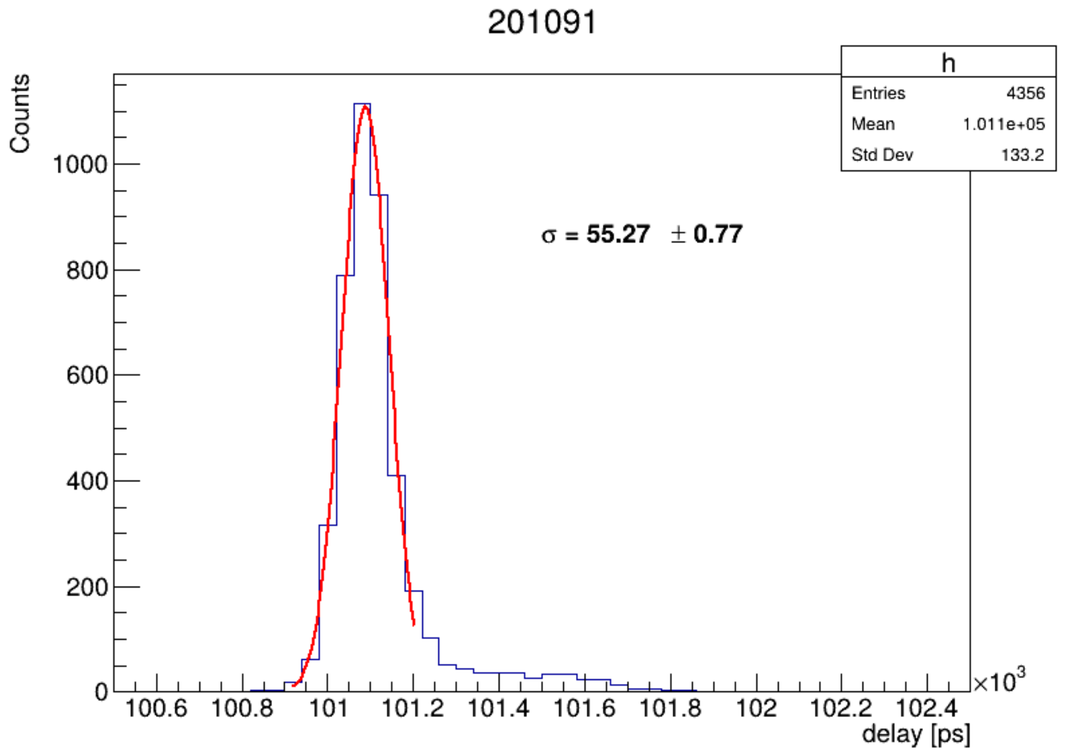




- Tiny saturation, a few%. HV setting: 200-675-200-675-200. B-field : 0 T (left), 1.2 (middle), 1.8 T(right)

# Timing resolution




- In a 1.2 T magnetic field, 200-675-200-675-200 achieves average 54 ps timing.
- Subtracting 30 ps of laser, 12 ps of NIM trigger, leads to 43 ps (HRPPD+V1742).

# Asymmetric HV

| MCP#2(V) | MCP#1(V) | Timing (ps) | Afterpulse | Gain | APR/G |
|---|---|---|---|---|---|
| 675 | 675 | 60.37 ± 1.10 | 15/3394 | 1625712 | 2.72E-09 |
| 700 | 675 | 57.90 ± 1.06 | 23/3469 | 2185603 | 3.03E-09 |
| 725 | 675 | 57.71 ± 0.93 | 35/3681 | 2683976 | 3.54E-09 |
| 750 | 675 | 59.21 ± 0.98 | 25/3773 | 3214770 | 2.06E-09 |
| 775 | 675 | 55.18 ± 0.90 | 46/3727 | 3749164 | 3.29E-09 |
| 800 | 675 | 57.52 ± 0.93 | 85/3699 | 4255947 | 5.40E-09 |
| 825 | 675 | 58.79 ± 0.95 | 144/3645 | 4573970 | 8.64E-09 |
| 850 | 675 | 58.69 ± 1.00 | 195/3743 | 4974388 | 1.05E-08 |
| 675 | 675 | 61.98 ± 1.11 | 16/3281 | 1577448 | 3.09E-09 |
| 675 | 700 | 58.23 ± 0.95 | 32/3523 | 2159672 | 4.21E-09 |
| 675 | 725 | 56.10 ± 0.95 | 58/3762 | 2784123 | 5.54E-09 |
| 675 | 750 | 55.00 ± 0.87 | 118/3786 | 3528183 | 8.83E-09 |
| 675 | 775 | 54.34 ± 0.89 | 163/3900 | 4212718 | 9.92E-09 |
| 675 | 800 | 55.50 ± 0.85 | 275/3992 | 4761142 | 1.45E-08 |
| 675 | 825 | 57.16 ± 0.87 | 379/3911 | 5218927 | 1.86E-08 |
| 675 | 850 | 61.14 ± 0.93 | 506/3960 | 5576693 | 2.29E-08 |
| 675 | 675 | 60.65 ± 1.03 | 19/3217 | 1560199 | 3.79E-09 |
| 700 | 700 | 57.86 ± 0.93 | 55/3613 | 2735169 | 5.57E-09 |
| 725 | 725 | 56.60 ± 0.87 | 82/3817 | 4065286 | 5.28E-09 |
| 750 | 750 | 55.62 ± 0.89 | 185/3853 | 5436071 | 8.83E-09 |
| 775 | 775 | 55.38 ± 0.93 | 370/3975 | 6529633 | 1.43E-08 |
| 800 | 800 | 54.95 ± 0.90 | 791/3872 | 7581680 | 2.69E-08 |

- Higher HV (up to 775 V) leads to better timing.
- Afterpulse ratio = events that have afterpulse (in next 350 bins, 70 ns) / events that have a signal.
- Here the B-Field is 1.8 T.
- Hypothesis that ions from the second MCP is blocked by the first MCP is consistent.
- Worth to investigate the time separation.