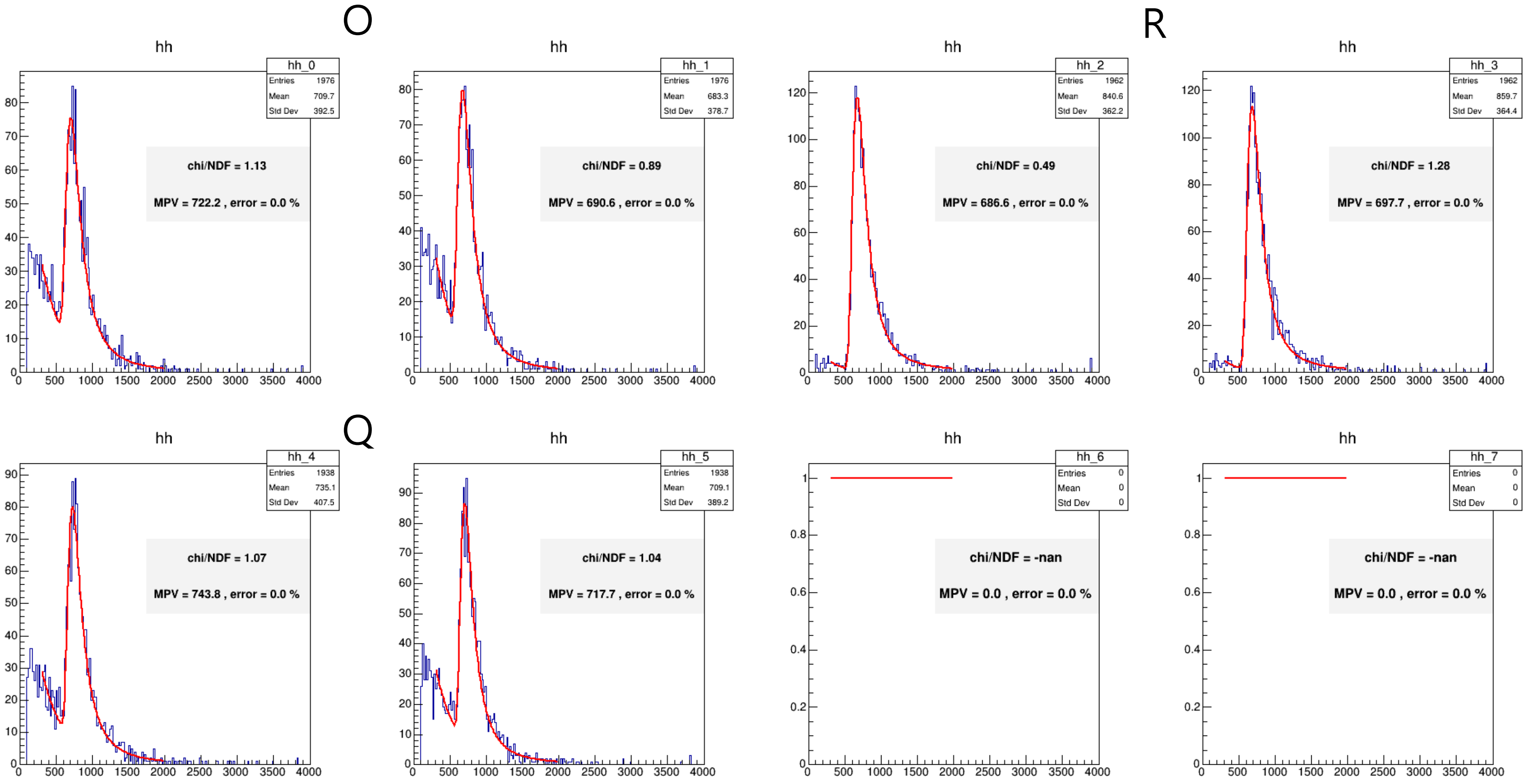
Gain adjustment

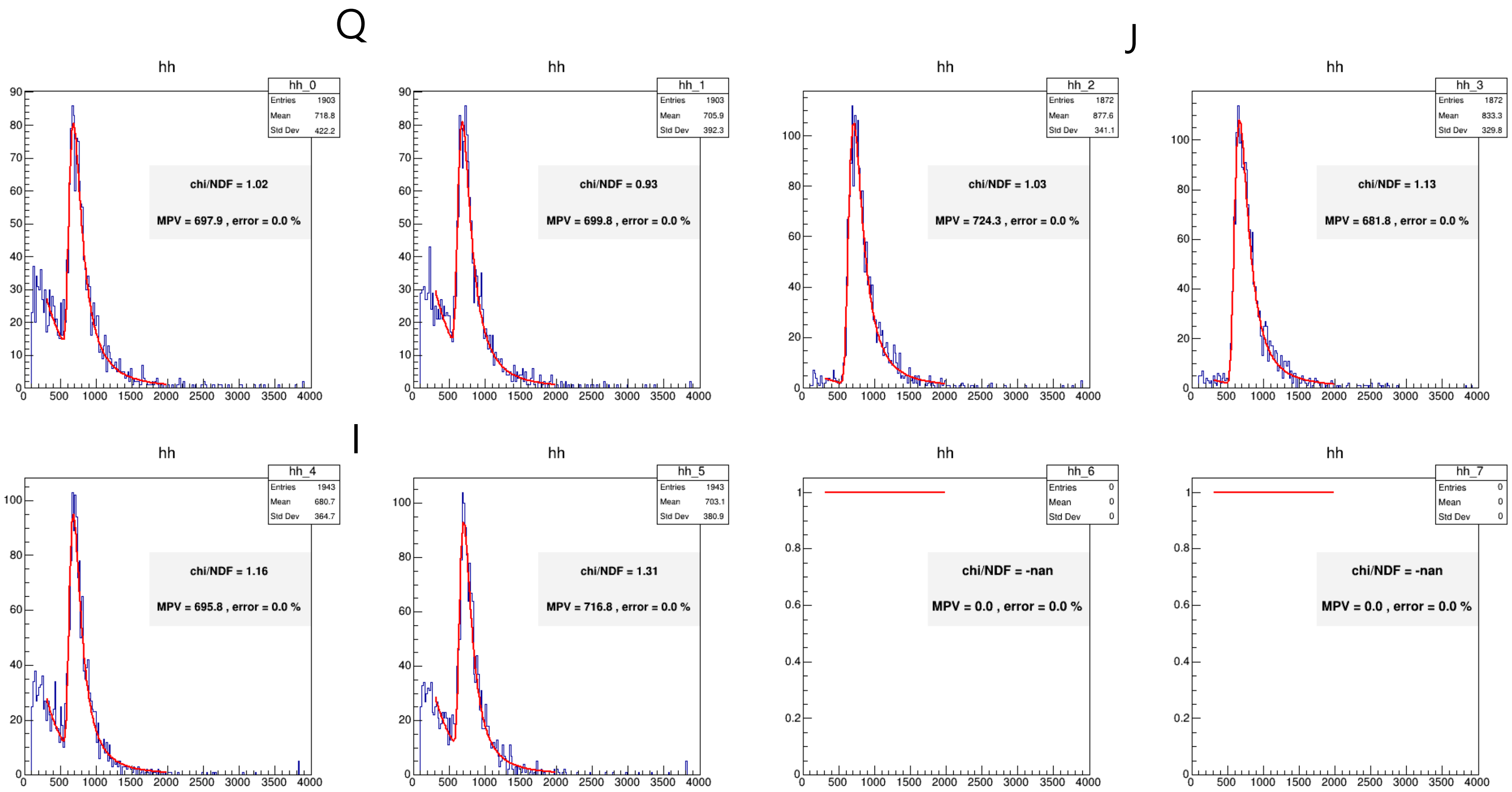
- Gain of I, J, O, R, Q bars are set to about 700.

Bar	L HV	R HV
I	1460	1515
J	1520	1437
O	1475	1413
R	1510	1460
Q	1475	1413

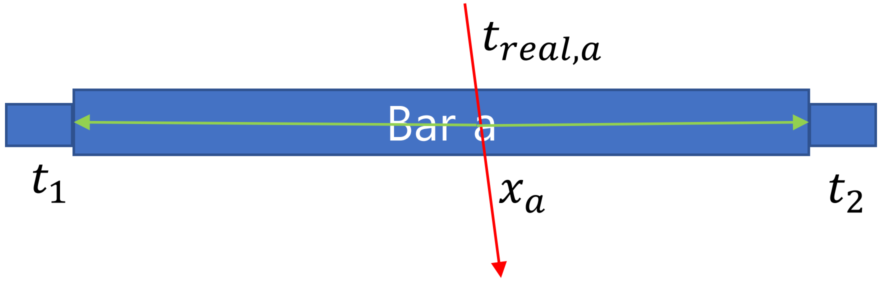
O, R, Q Gain


O
R
Q
hh
hh_0
Entries 1976
Mean 709.7
Std Dev 392.5
chi/NDF = 1.13
MPV = 722.2 , error = 0.0 %
hh_1
Entries 1976
Mean 683.3
Std Dev 378.7
chi/NDF = 0.89
MPV = 690.6 , error = 0.0 %
hh_2
Entries 1962
Mean 840.6
Std Dev 362.2
chi/NDF = 0.49
MPV = 686.6 , error = 0.0 %
hh_3
Entries 1962
Mean 859.7
Std Dev 364.4
chi/NDF = 1.28
MPV = 697.7 , error = 0.0 %
hh_4
Entries 1938
Mean 735.1
Std Dev 407.5
chi/NDF = 1.07
MPV = 743.8 , error = 0.0 %
hh_5
Entries 1938
Mean 709.1
Std Dev 389.2
chi/NDF = 1.04
MPV = 717.7 , error = 0.0 %
hh_6
Entries 0
Mean 0
Std Dev 0
chi/NDF = -nan
MPV = 0.0 , error = 0.0 %
hh_7
Entries 0
Mean 0
Std Dev 0
chi/NDF = -nan
MPV = 0.0 , error = 0.0 %

Q, J, I Gain


Q
J
I
hh
hh_0
Entries 1903
Mean 718.8
Std Dev 422.2
chi/NDF = 1.02
MPV = 697.9 , error = 0.0 %
hh_1
Entries 1903
Mean 705.9
Std Dev 392.3
chi/NDF = 0.93
MPV = 699.8 , error = 0.0 %
hh_2
Entries 1872
Mean 877.6
Std Dev 341.1
chi/NDF = 1.03
MPV = 724.3 , error = 0.0 %
hh_3
Entries 1872
Mean 833.3
Std Dev 329.8
chi/NDF = 1.13
MPV = 681.8 , error = 0.0 %
hh_4
Entries 1943
Mean 680.7
Std Dev 364.7
chi/NDF = 1.16
MPV = 695.8 , error = 0.0 %
hh_5
Entries 1943
Mean 703.1
Std Dev 380.9
chi/NDF = 1.31
MPV = 716.8 , error = 0.0 %
hh_6
Entries 0
Mean 0
Std Dev 0
chi/NDF = -nan
MPV = 0.0 , error = 0.0 %
hh_7
Entries 0
Mean 0
Std Dev 0
chi/NDF = -nan
MPV = 0.0 , error = 0.0 %

About Timing Calibration



- $t_1 = t_{real,a} + \frac{x_a}{v_a} + \Delta t_1$ where $\Delta t_1 = \Delta t_{cable} + \Delta t_{electronics} + \Delta t_{PMT}$
- $t_2 = t_{real,a} + \frac{L - x_a}{v_a} + \Delta t_2$
- $t_{real.a} = \frac{t_1 + t_2}{2} - \frac{\Delta t_1}{2} - \frac{\Delta t_2}{2} - \frac{L}{v_a}$
- Similarly, $t_{real.b} = \frac{t_3 + t_4}{2} - \frac{\Delta t_3}{2} - \frac{\Delta t_4}{2} - \frac{L}{v_b}$

About Timing Calibration

- Assume that relative electronic time shifts about a certain channel are always same even though the configuration of bars are changed.
- If one sets Δt_1 as an offset and represent other Δt_is in terms of Δt_1, dt between bars can be presented as follows :
- $t_{real.a} - t_{real.b} = (\frac{t_1+t_2}{2} - \frac{\Delta t_1}{2} - \frac{\Delta t_1+s_2}{2} - \frac{L}{v_a})$ - $(\frac{t_3+t_4}{2} - \frac{\Delta t_1+s_3}{2} - \frac{\Delta t_1+s_4}{2} - \frac{L}{v_b})$

$= \frac{t_1+t_2}{2} - \frac{t_3+t_4}{2} + \frac{L}{v_a} + \frac{L}{v_b} - \frac{s_2-s_3-s_4}{2}$

- No dependence on the offset

About Timing Calibration

- To obtain s_i
- 1st idea : Using function generator

 -> cannot apply PMT to calibration

- 2nd idea : set bar arrays as follows and use dt between LR PMTs and real dt between bars

->Even if we use speed of light, there would be O(1ps) error.

(10cm/c) = 333.6 ps , (10cm/0.99c) = 336.9 ps