# Time Resolution Simulation

## Lab Meeting

## Benard

Friday 2018-08-31

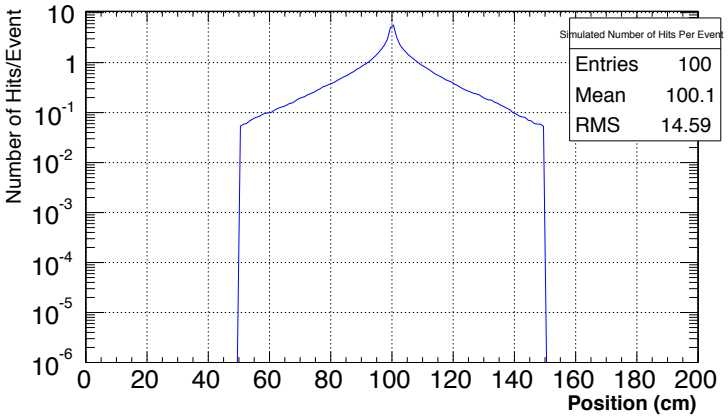
# Last Meeting

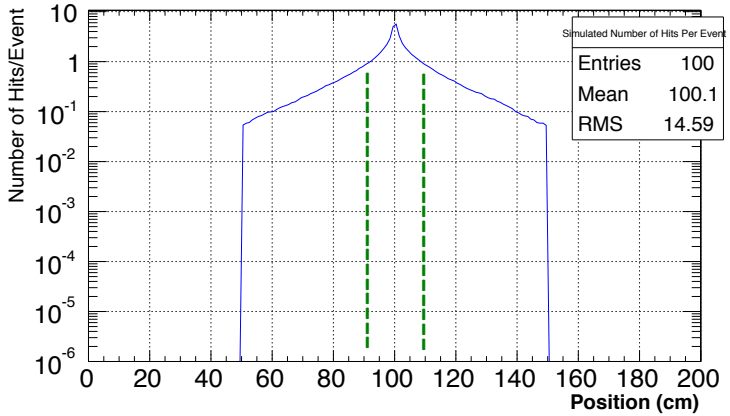
## Main issues raised:

- Show diagrams of both hit position and time conditions for classifying hits.
- Clarification of entries displayed in the statistics box of hit time distributions was demanded.

# Classifying hits by Position Condition

◎ High energy neutron beam collimated at the center of the 2 m long scintillator bar.




→

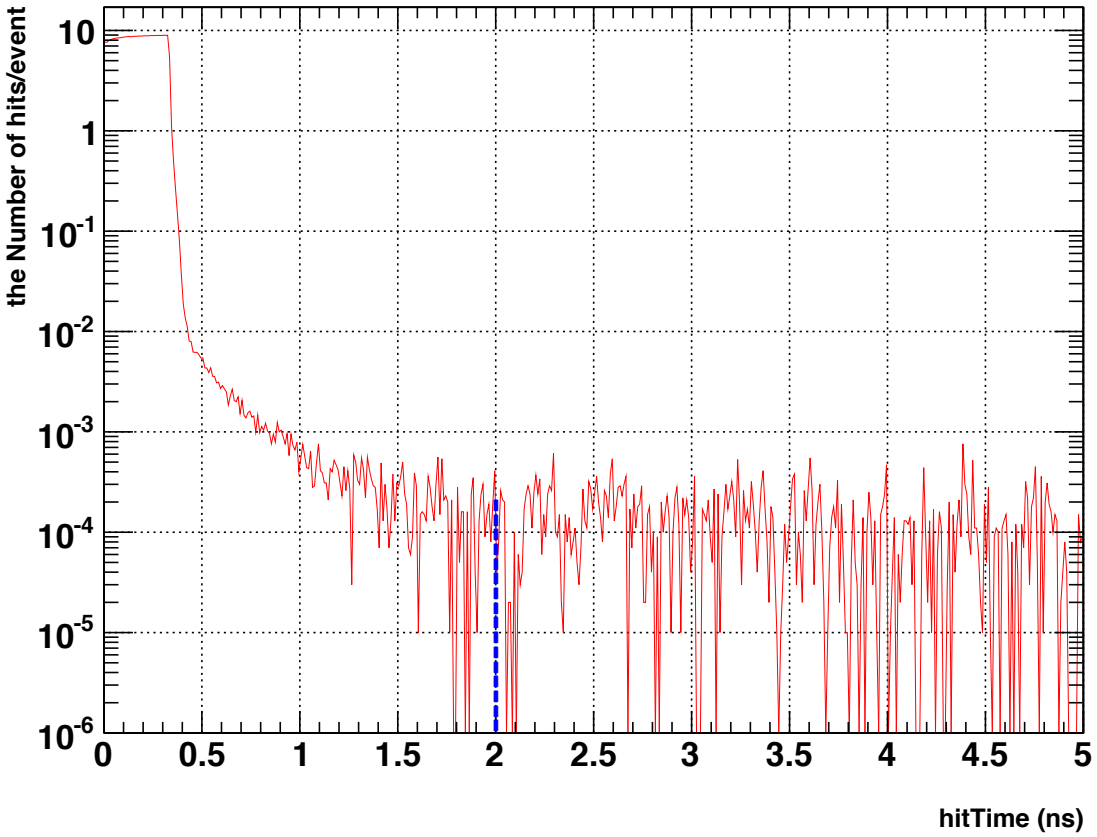
Result 1: Simulated hit position with most hits occurring within [100±10] cm

Condition 1 for classifying hits:

◎ 98 % of all neutron hits occurring within [100 ± 10] cm

# Classifying hits by Time Condition

◎ Condition 2 for classifying hits



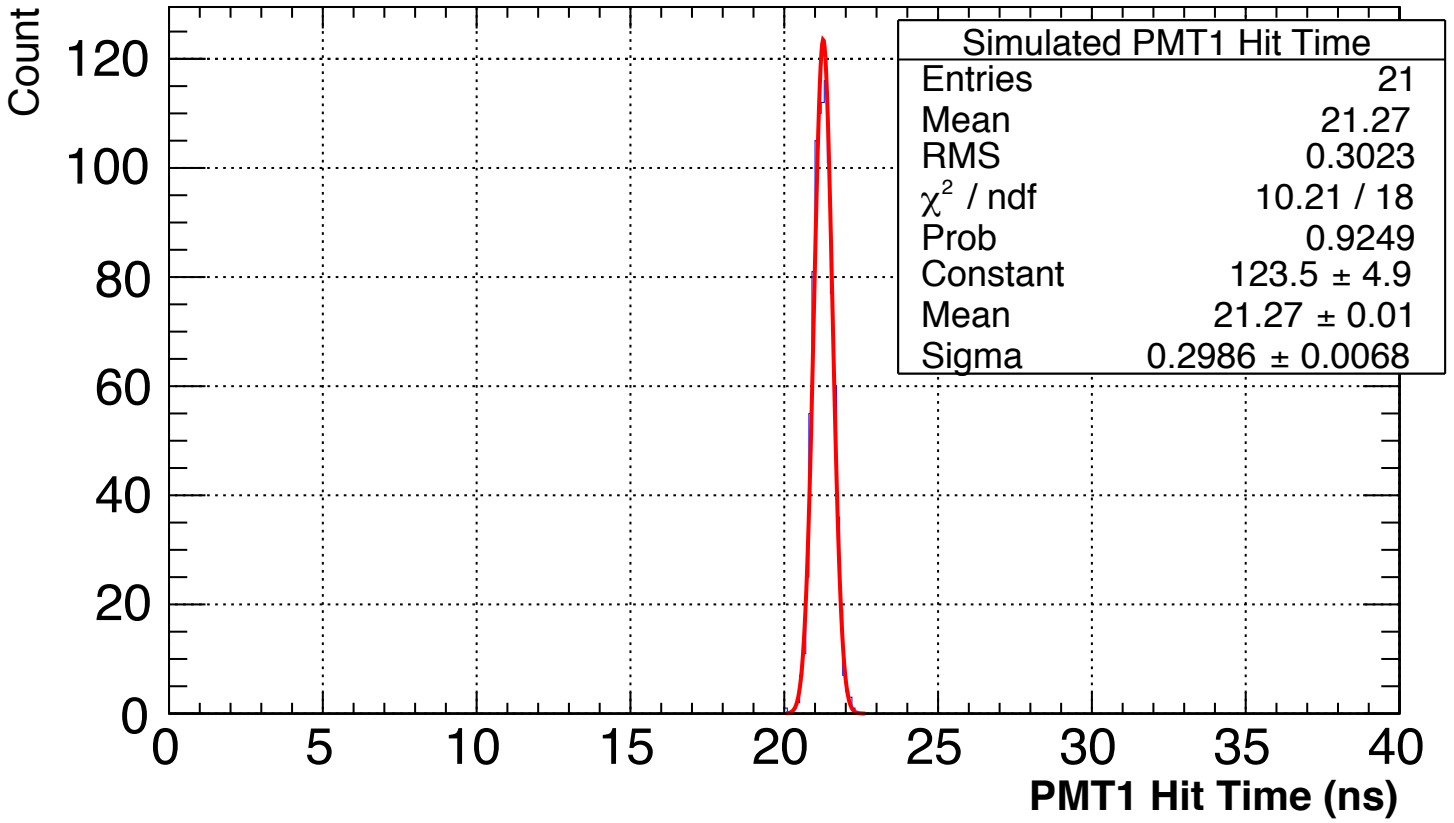

Separated two hits by requiring:

◎ A separation time longer than 2 ns.

# Hit Time and Resolution

## Simulation Result

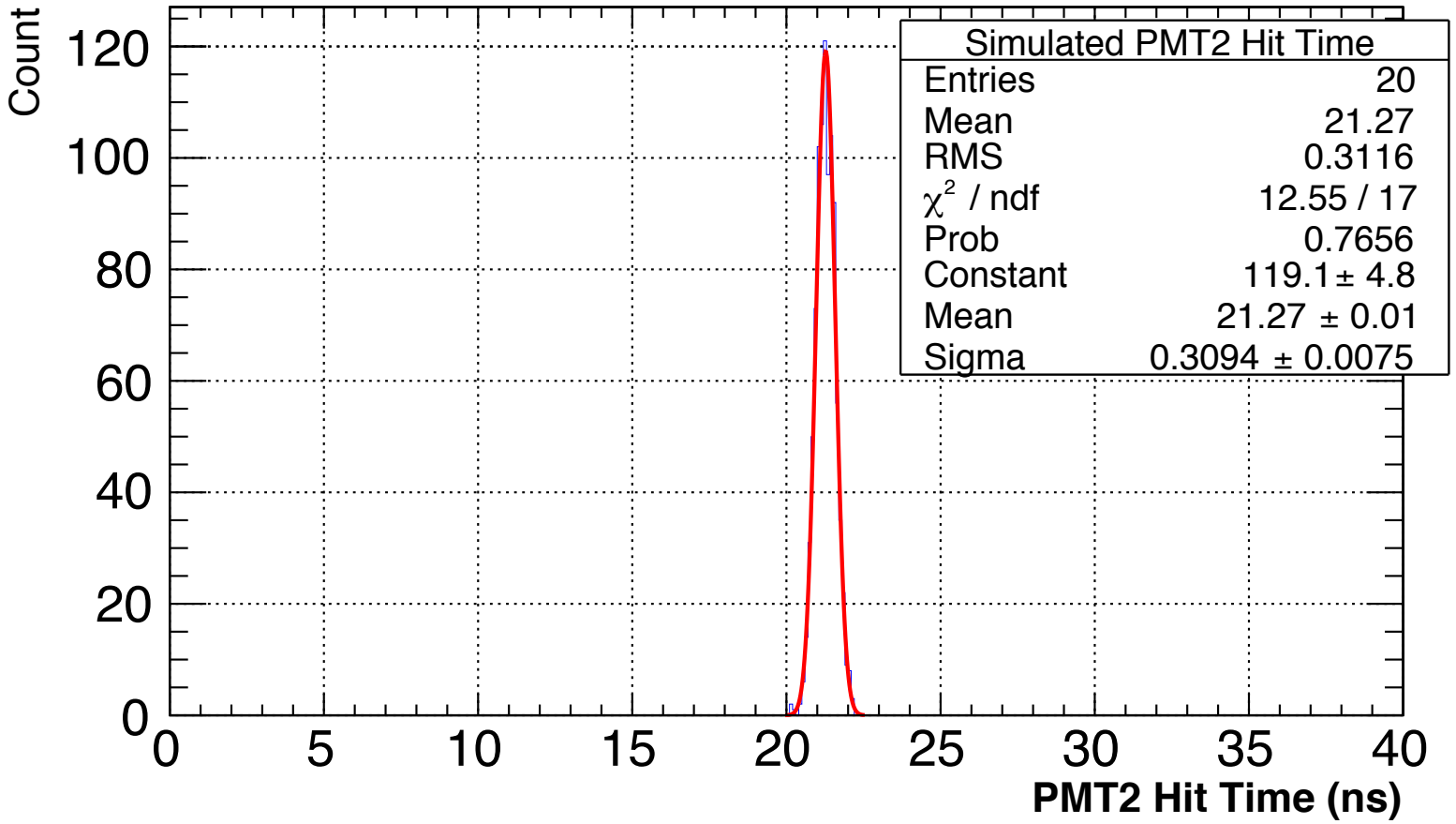
Hit time for left photomultiplier tube with
sigma value = 298.6 *ps*



# Hit Time and Resolution

## Simulation Result

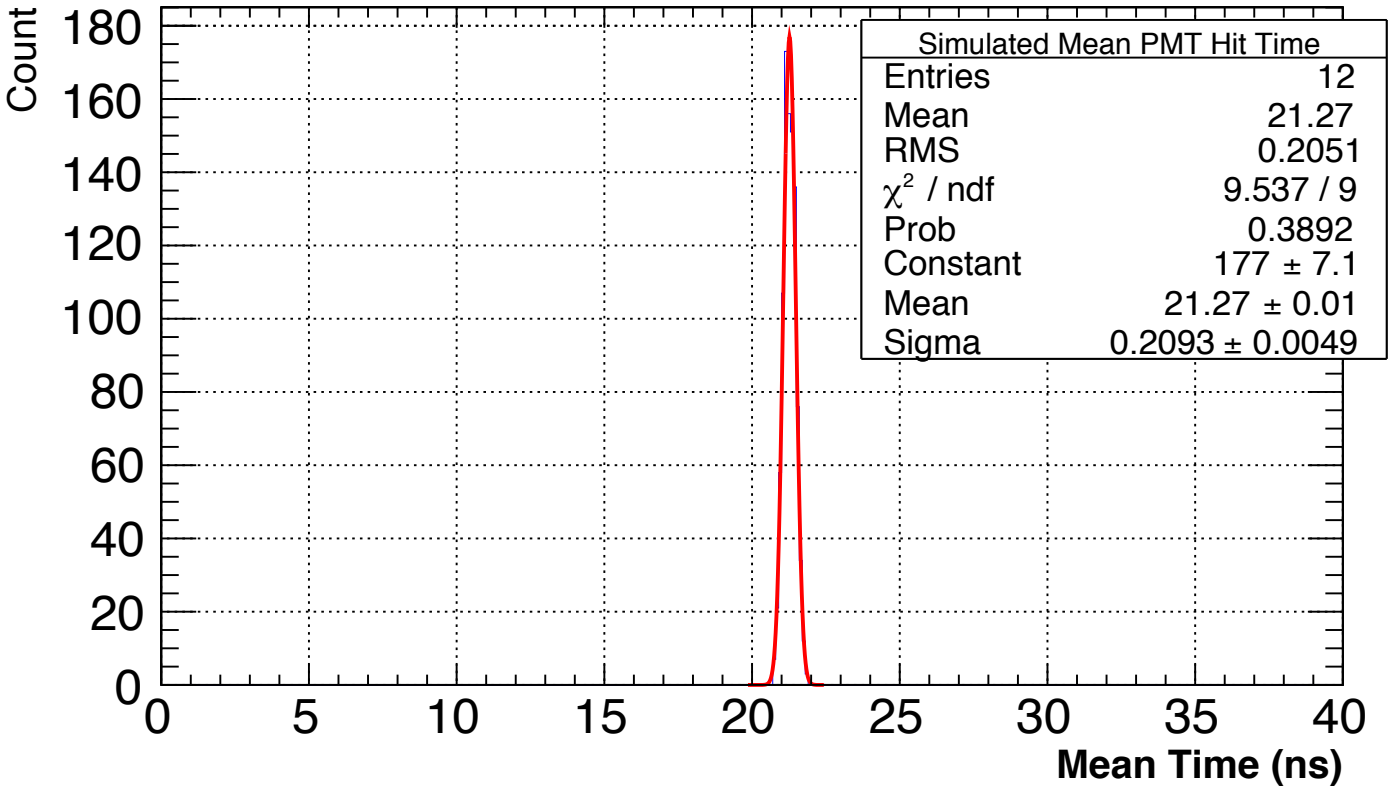
Hit time for right photomultiplier tube with
sigma value = 309.4 *ps*



# True Hit Time and Resolution

## Simulation Result

True hit time sigma value = 209.3 *ps*

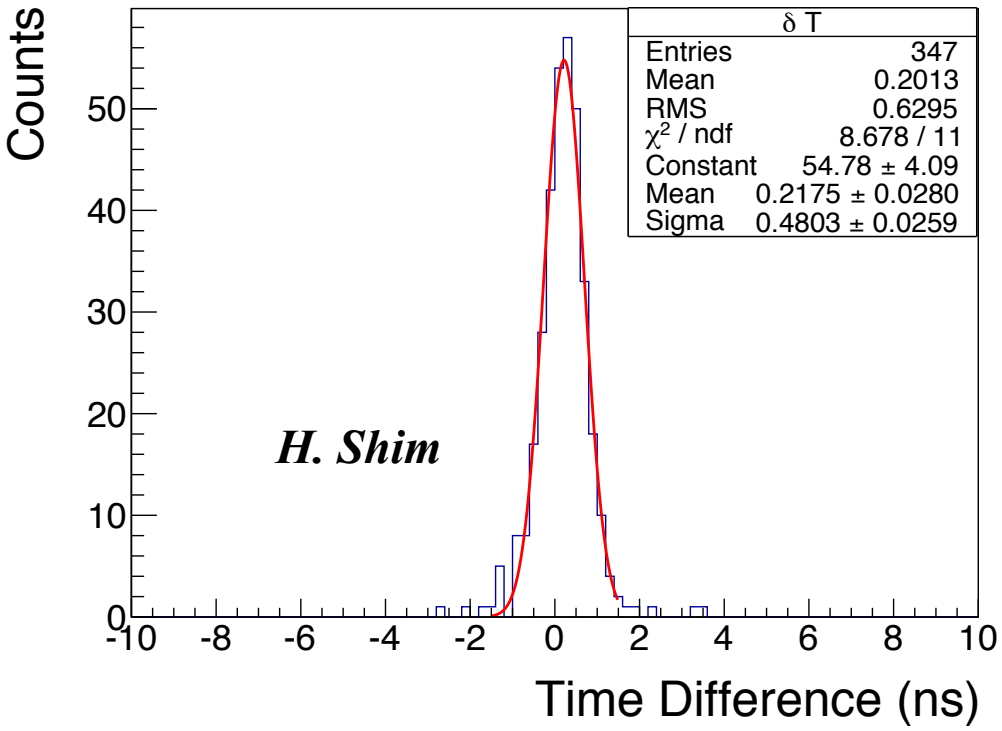



$$\sigma^2_{T_{mean}} = 0.5^2 * \sigma^2_{T_1} + 0.5^2 * \sigma^2_{T_2} + 2 * 0.5^2 \sigma_{T_1T_2} \therefore \sigma_{T_{mean}} = 0.5 * \sqrt{\sigma^2_{T_1} + \sigma^2_{T_2} + 2 * \sigma_{T_1T_2}} \approx 304.0 \pm 7.1 ps$$

# Backup1: Time Resolution

## Data

True Hit time with sigma value = 369.6 *ps*



# Backup2: Simulated Pulse shape

Useful function:

f (x) = [0](exp(-(x[0]-par[1])/[2])-exp(-(x[0]-[1])/[3]))/([2]-par[3])

[0] = Pulse start time [ns] = -15 ns

[1] = Amplitude = normalized to 1 to compare with experimental data

[2] = Rise time [ns] = 0.9 ns : Rise time of BC-408 scintintillator

[3] = Decay time [ns] = 2.1 ns : Decay time of BC-408 scintillators