BL4S Playground Challenge

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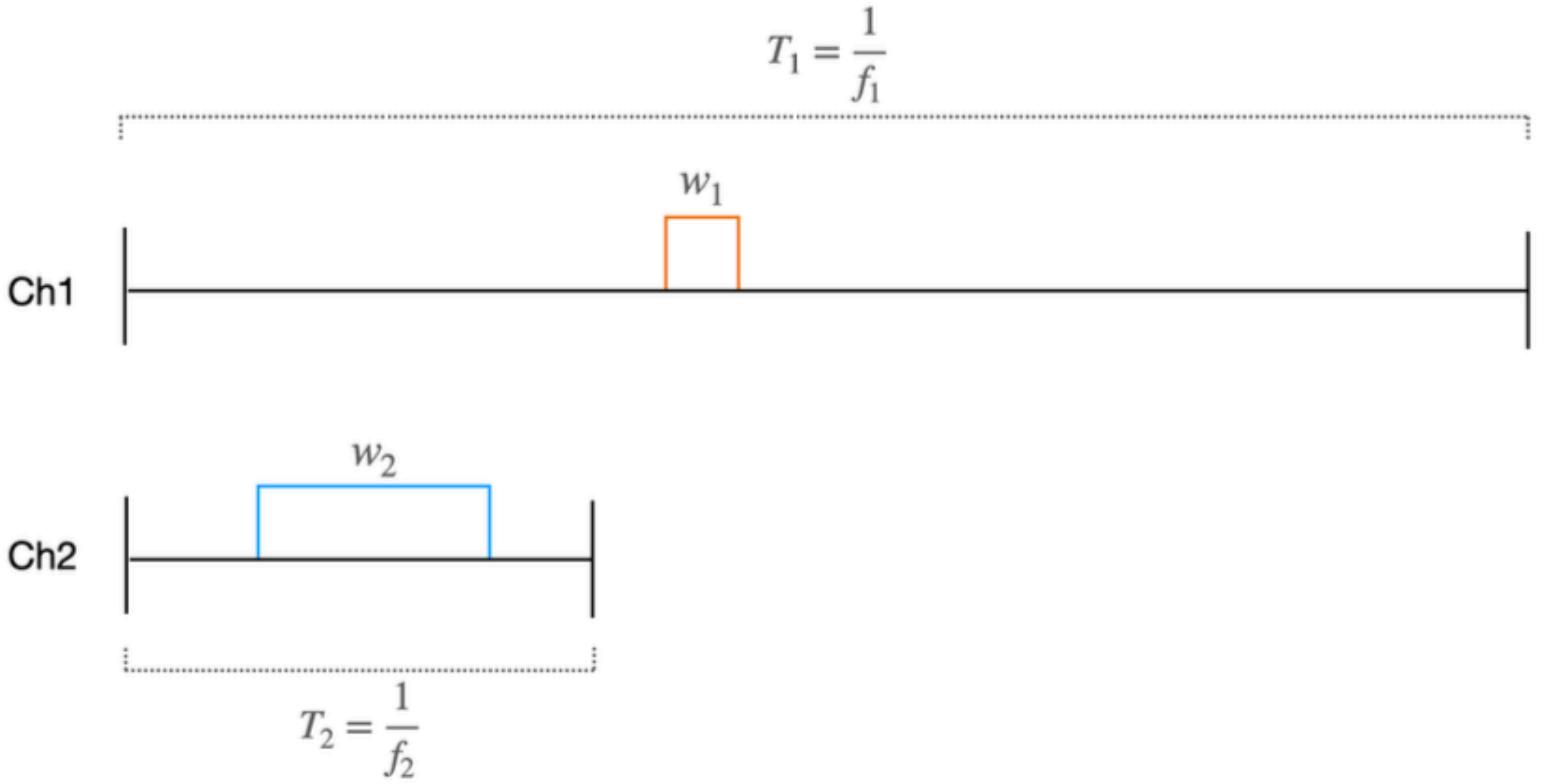
1. Which parameters matter for the frequency of random coincidences?

- Frequency of noise pulse in Ch1 scintillator - found by subtracting theoretical muon rate (roughly 9 μ/s) from total measured rate.
- Frequency of noise pulse in Ch2 scintillator - found using the same method as above.
- Width of Ch1 digitized noise pulse - found from oscilloscope.
- Width of Ch2 digitized noise pulse - also found from oscilloscope.

2. Devise a formula to compute the frequency of random coincidences

- Consider noise pulses in Ch 1 and 2 at rates of f_1 and f_2 pulses per second with widths of w_1 and w_2 seconds, respectively.

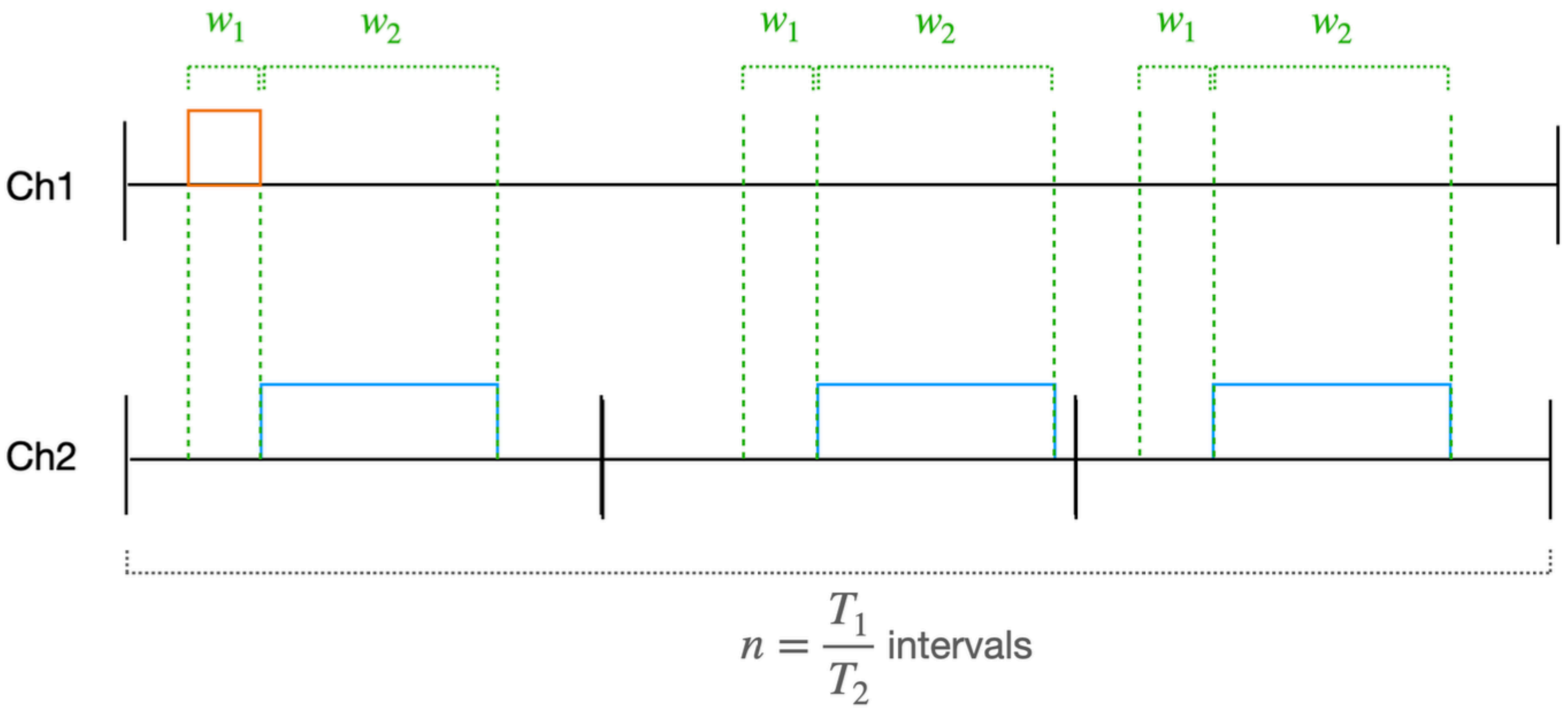
- On average, in a time interval $T_1 = 1/f_1$, one noise pulse will occur in Ch 1. Likewise, in a time interval $T_2 = 1/f_2$, on average one noise pulse will occur in Ch 2.



2. Devise a formula to compute the frequency of random coincidences (cont'd)

- The total width of the "overlap ranges" as a fraction of the total interval is $\dfrac{\frac{T_1}{T_2}(w_1 + w_2)}{T_1} = \dfrac{w_1 + w_2}{T_2} = f_2(w_1 + w_2)$, which serves as the probability of a random coincidence within the interval $T_1 = 1/f_1$.

- Effectively, we can say that we observe on average $f_2(w_1 + w_2)$ random coincidences per T_1 seconds. This gives an average random coincidence frequency of $\dfrac{f_2(w_1 + w_2)}{T_1} = f_1 f_2(w_1 + w_2)$.



3. How can the setup be modified to measure the frequency of random coincidences?

- A μ coming from above would not be able to pass through both S1 and S2.
- "Double-μ coincidence" rate can be subtracted from the total coincidence rate using $f_1 f_2 (w_1 + w_2)$ with $f_1 = f_2 \approx 9\ \mu/\mathrm{s}$.