

Status Report

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mPMT Japan meeting

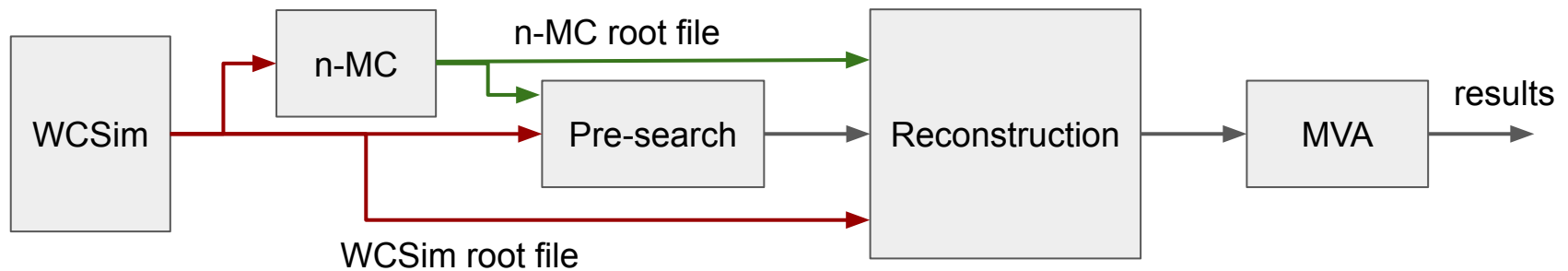
Update

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- n-tagging:
 - Implemented reconstruction-part roughly
← now under debugging and improving
- Here all plots are very preliminary, there might be lots of bug.
- But I would like to share what I am planning and doing

Overview of n-tagging-framework

- MC:
 - mPMT hybrid WCSim: 2.2 MeV gamma-ray
 - For neutron capture: simplified model
- Pre-selection: mainly N10 method
 - Considering to use coincidence of mPMT and large PMT
- Variable reconstruction
 - To use LEAF
- MVA
 - First goal: Reproduce Harada-san's result

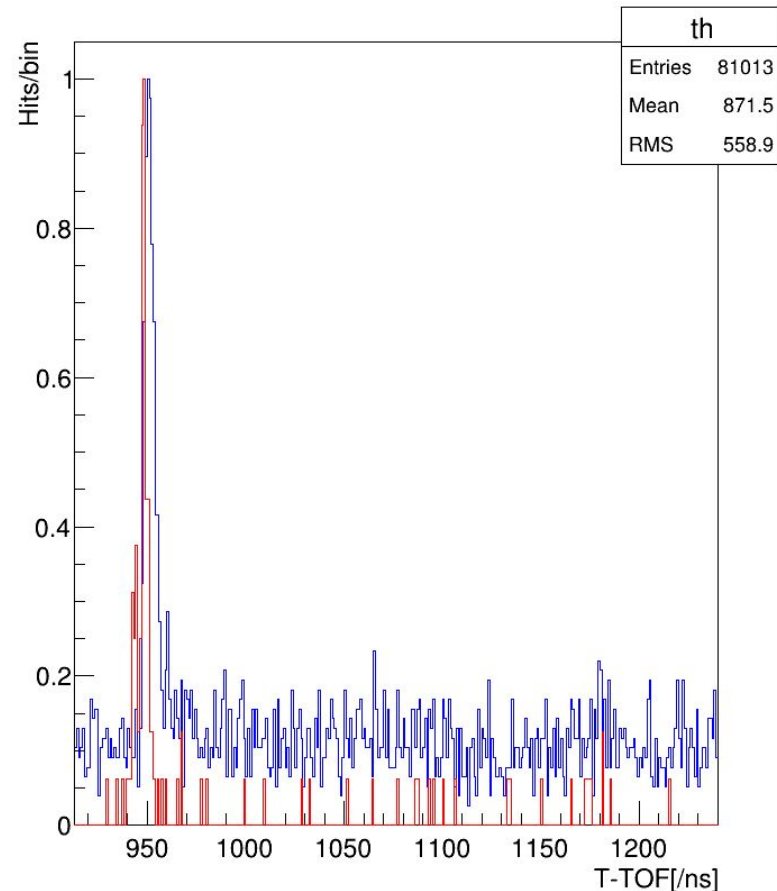


Tools and file flow (plan)

- WCSim: 2.2 MeV gamma
 - HK mPMT hybrid version: 20k B&L PMTs and 10k mPMTs
 - Darkrate: 4.2 kHz (B&L), 100 Hz (3-inch PMTs in mPMT)
 - Particle: 2.2 MeV gamma-ray
 - Vertex distribution: flat in the tank volume
 - Direction: isotropy
- n-MC: implemented by myself
 - Generally we know only primary vertex of nu-interaction in uncertainty of reconstruction. And vertex of neutron capture differs with nu-interaction vertex.
 - In order to handle this, I threw random number with 2 parameter: eff-length, lifetime.
 - Vertex position of nu-int.: distributing around n-capture vtx. with gaussian-law of σ = “eff-length”
 - Vertex time of nu-int.: distributing according to exponential law of τ = “lifetime (204 us).”
 - For now, I set “eff-length” = 0. On the other words, nu-int vtx. are same with n-capture point.

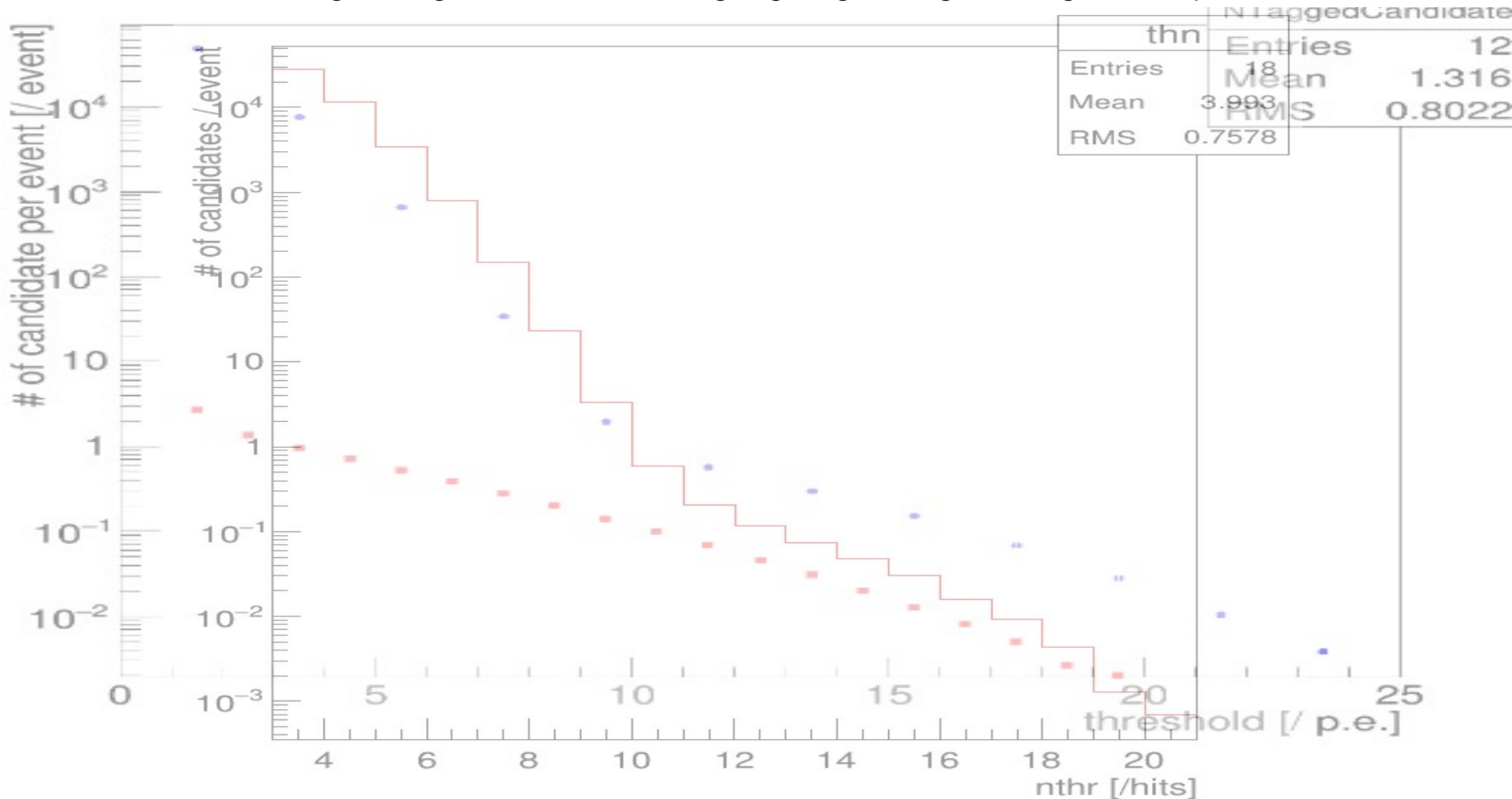
Pre-search: N10 method

- AFT window 500us is too wide to handle all together → introduced pre-search using N10 method
- N10 method: finding hit cluster in 10 ns window
 - Converted (hit time) to (hit time - TOF)
where $\text{TOF} = |(\text{n-capture vtx.}) - (\text{PMT position})| / c_{\text{water}}$
 - Searched time t such that
of hits in $[t, t + 10 \text{ ns}) > \text{threshold}$
- Right plots show candidates:
 - Blue: PMT hits (summed B&L and mPMT)
 - Red: candidate time t (nthr = 7)
 - Accumulated 100 events and normalized by maximum
 - N10 method works well
 - Width of blue is about 10 ns
 - note) plots of slides of 5 June have mistakes in TOF calculation



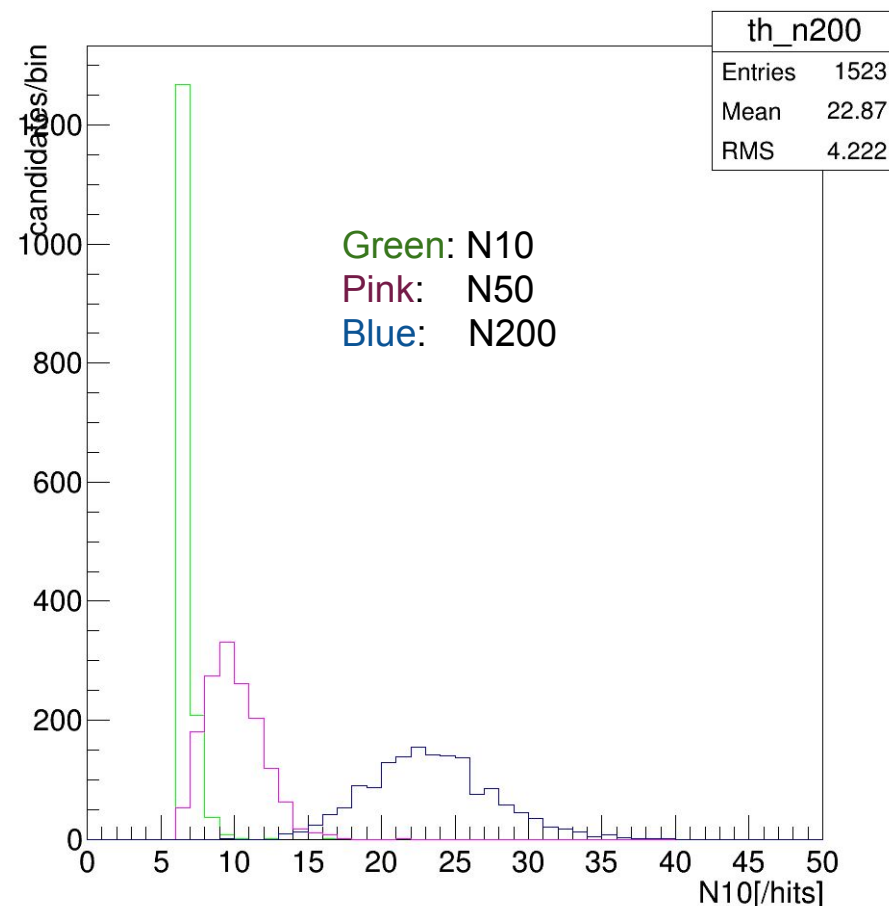
Scan by threshold in N10 method

- Overlaid on old plots: blue dots: old one, red line: today's one
 - Red dots: old plots but using MC w/o darkhit
 - There are some inconsistency
 - Low region: might be double counting, high region: might be bug with old plots ?



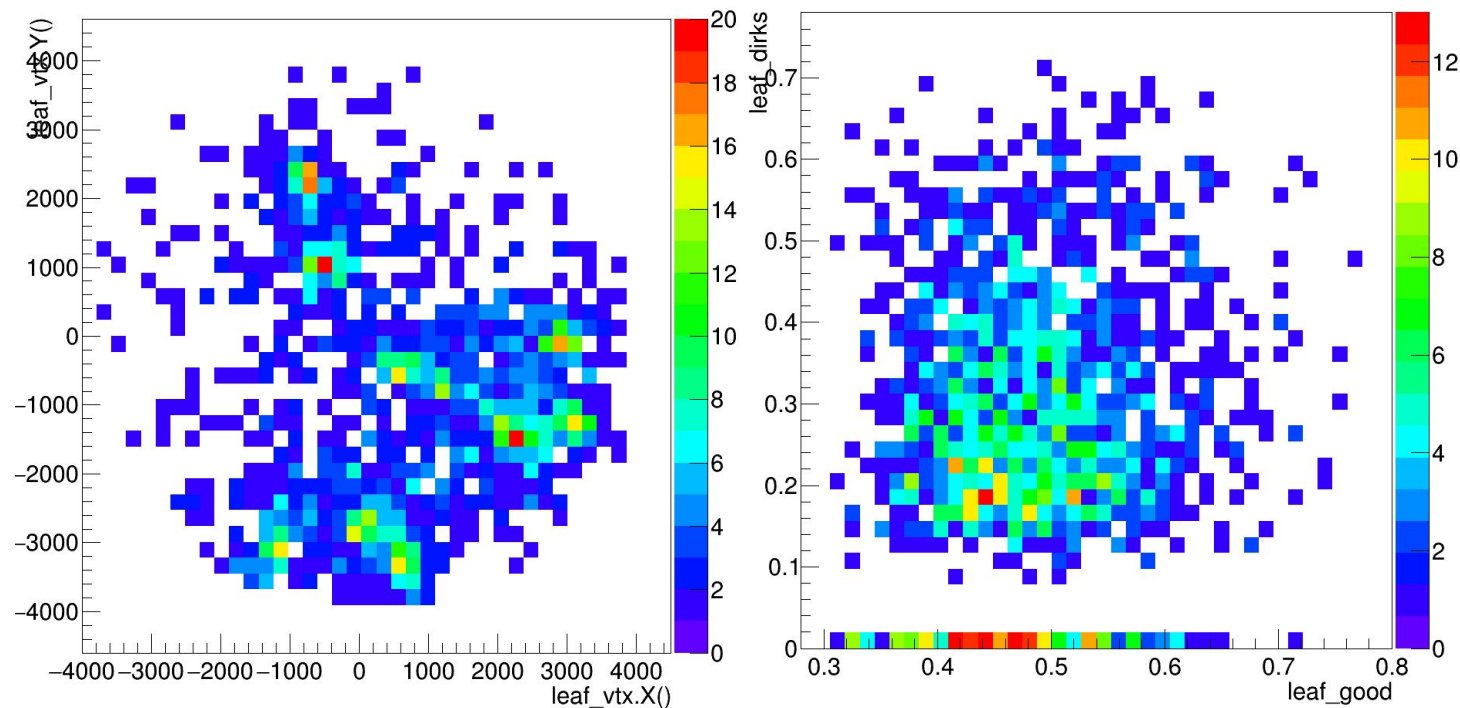
Variable reconstruction

- For each candidates t of N10 search, extracted hits such that (hit time) in $[t + n200_window.start, t + n200_window.stop)$
 - Where $n200_window = (-5, 195)$ ns for now.
 - $n50_window = (-5, 45)$, $n10_window = (0, 10)$
 - Strategy: to use only signal hits with scattering.
- Right plots: Nxx distribution
 - N10, N50, N200 using above window
 - Summed B&L and mPMT (I need to check individually)
 - Accumulated with 10 events
 - Here I applied $nthr = 7$. But there are many events at $N10 = 6$. This might be bug and I am investigating.
- I need to divide signal and mimic but not tried yet



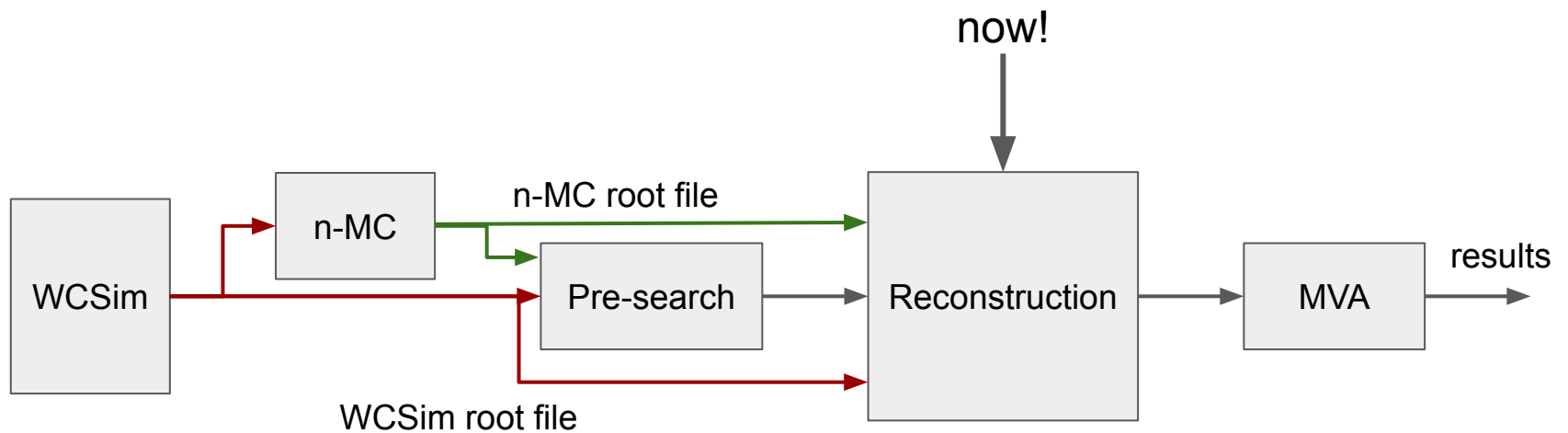
LEAF reconstruction

- Applied LEAF reconstruction (BQFitter) to hits contained in the n200_window
 - Segmentation fault occurred when I used multi-thread (example of git-repository did not work also). I used single thread.
 - Vertex looked reconstructed well. I am now checking output of the reconstruction.
 - Using 10 events or $O(1e3)$ candidates.
 - The most of all are mimic
- Anyway, the frameworks are getting ready



Summary

- Implementing n-tagging framework
- Checking its behaviour in parallel as shown
- Plan
 - Analyze variable with dividing 2.2 MeV signal and mimic of dark-hits
 - Q: does WCSim output have information of if dark-hit or not ? If not, I need to embed this.



Tools and file flow (plan)