# SVT Timing Study Status

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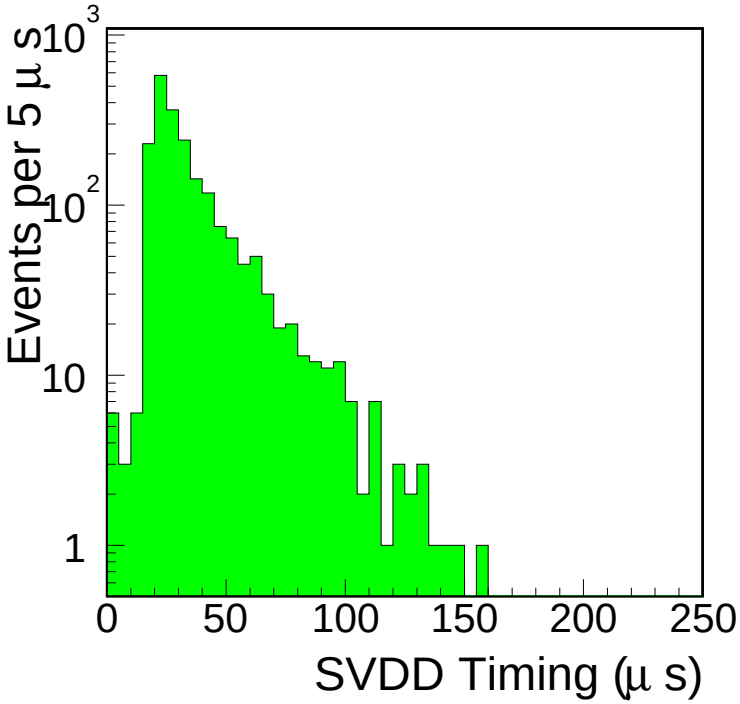
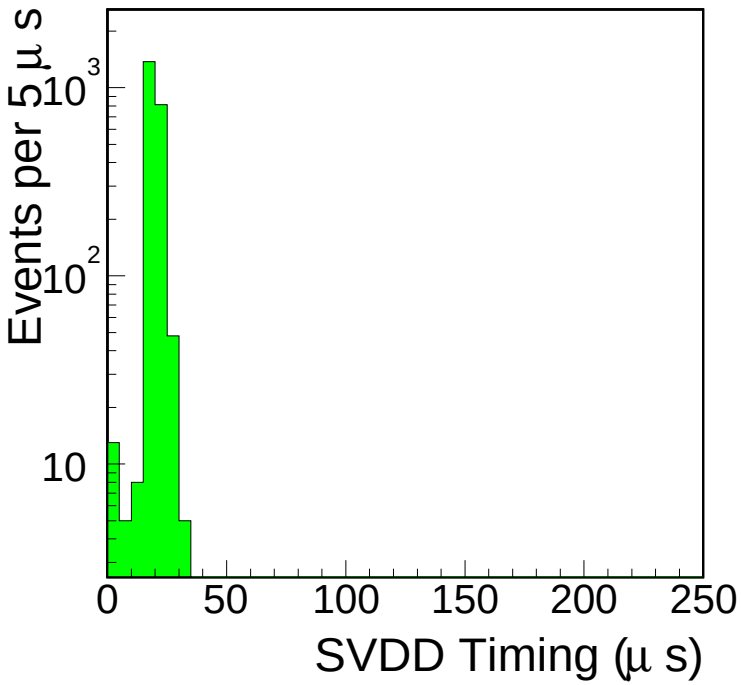
# Overview:

- simple linear model
- performance for different luminosities
- parametrizing the environment
- performance of the parametrization
- this week's plan

# Reminder: Clean timing measurement




- require L2 buffer 0
- require SVX back end state 0 (waiting for L1)
- significantly reduces number of "chopped" events

# Timing Models:

## Simple Linear Model:

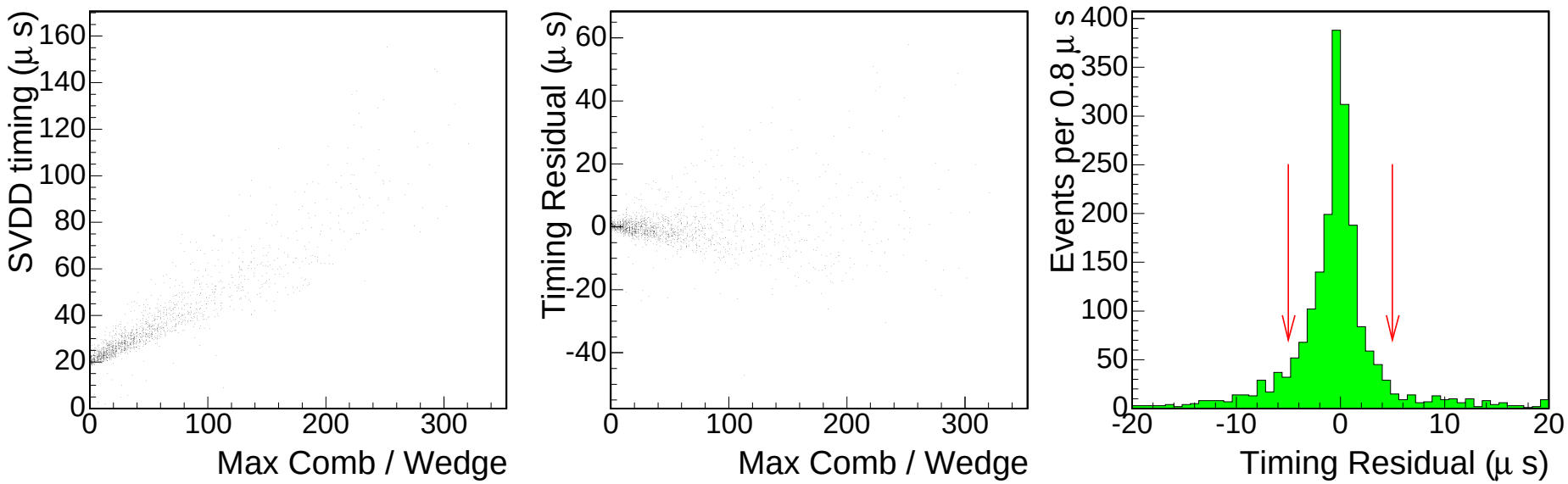
- assume hit loading time $\sim max(N_{hits}^{wedge})$
- assume track fitting time $\sim max(N_{comb}^{wedge})$
- these two effects drive SVT timing

## More Realistic Model:

- assume single board can be linearized
- account for data flow interference and interaction
- outlined in CDF 5021
- not enough handles in data to tune model parameters

time is an issue: need working model quickly

# Track Fitting Linearization:

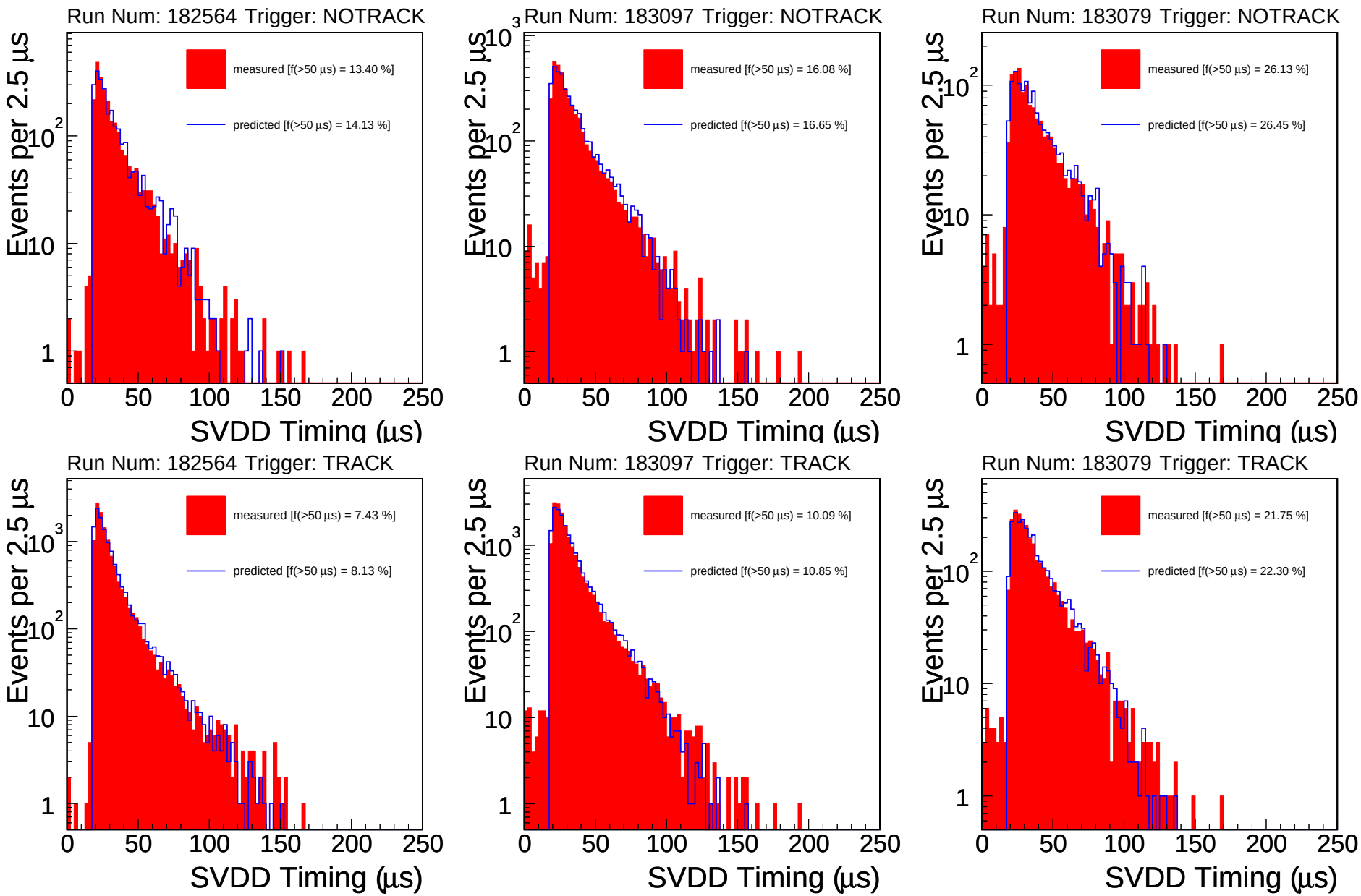



- low luminosity run
- in addition, scattered events
- residuals: 81% of events in $\pm 5\mu s$ window
- central Gaussian width around 2 $\mu s$

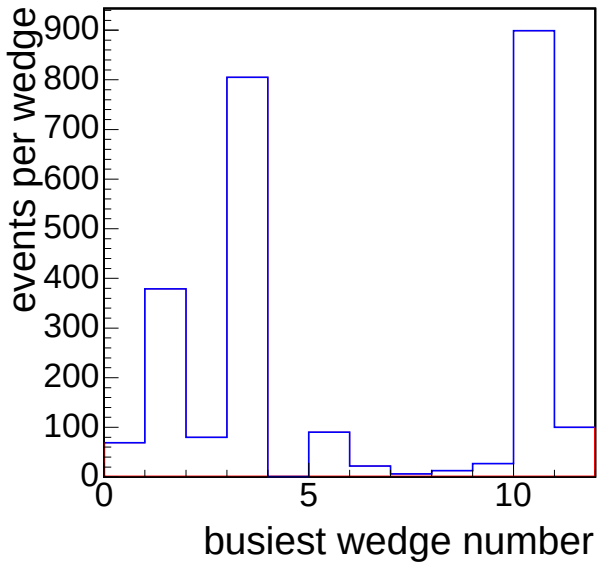
# Tests of Simple Model Performance:

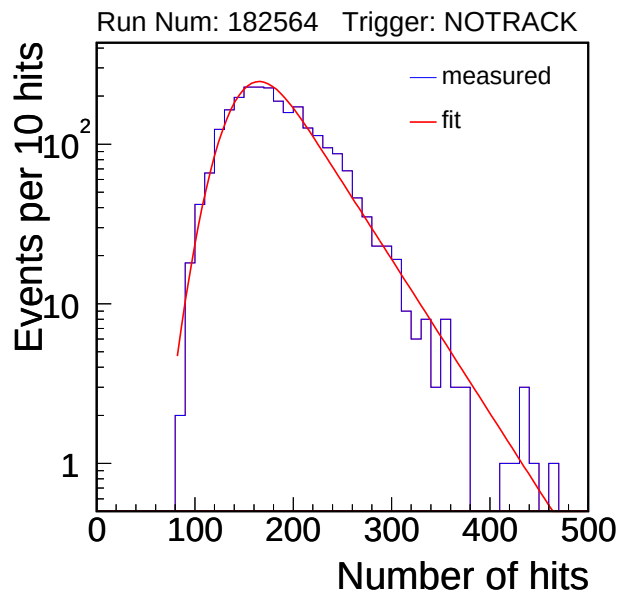
- compare measured SVDD timing to predicted
- base prediction on measured $N_{hits}$, $N_{comb}$
- three representative runs:
  - 182564 $(10 - 12 \cdot 10^{30})$
  - 183097 $(17 - 25 \cdot 10^{30})$
  - 183079 $(40 - 50 \cdot 10^{30})$
- two representative (unbiased) triggers:
  - `MONITOR_L2_INCLUSIVE_NOTRACK`
  - `MONITOR_L2_INCLUSIVE_TRACK`
- quantify: fraction with processing time $> 50\mu s$
- as following slide will show, reasonably good agreement

# Simple Timing Model Performance:



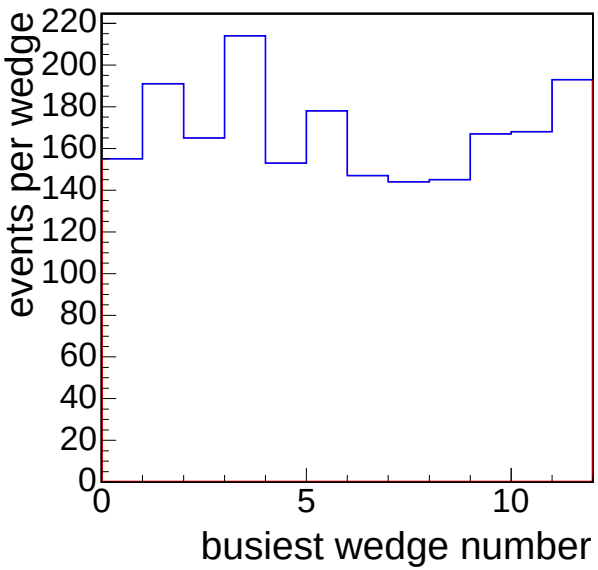
# Parametrizing the hit distribution:

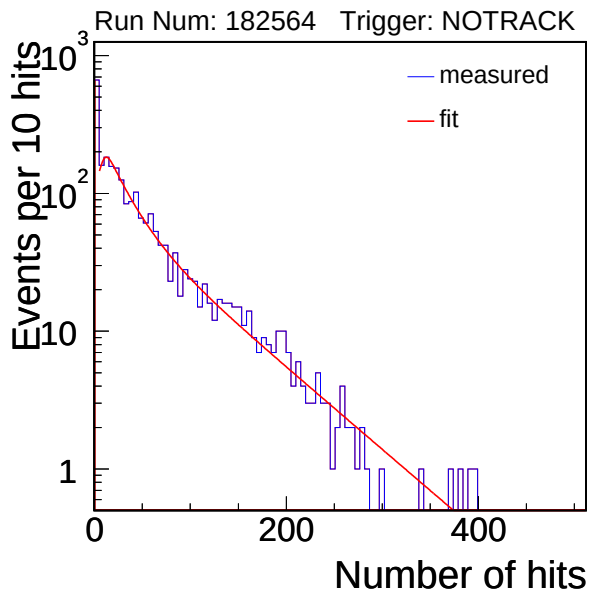


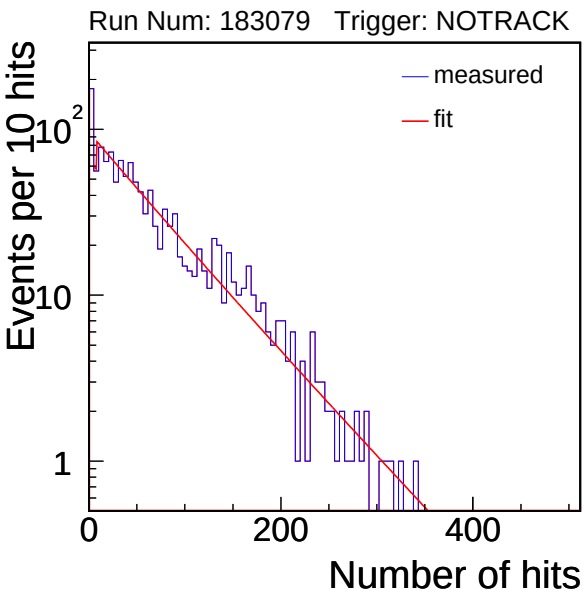




- take distribution of busiest wedge from data
- parametrize $N_{hits}$ with gaus $\otimes$ exponential
- seems to work well for all luminosities

# Parametrizing Combinations:

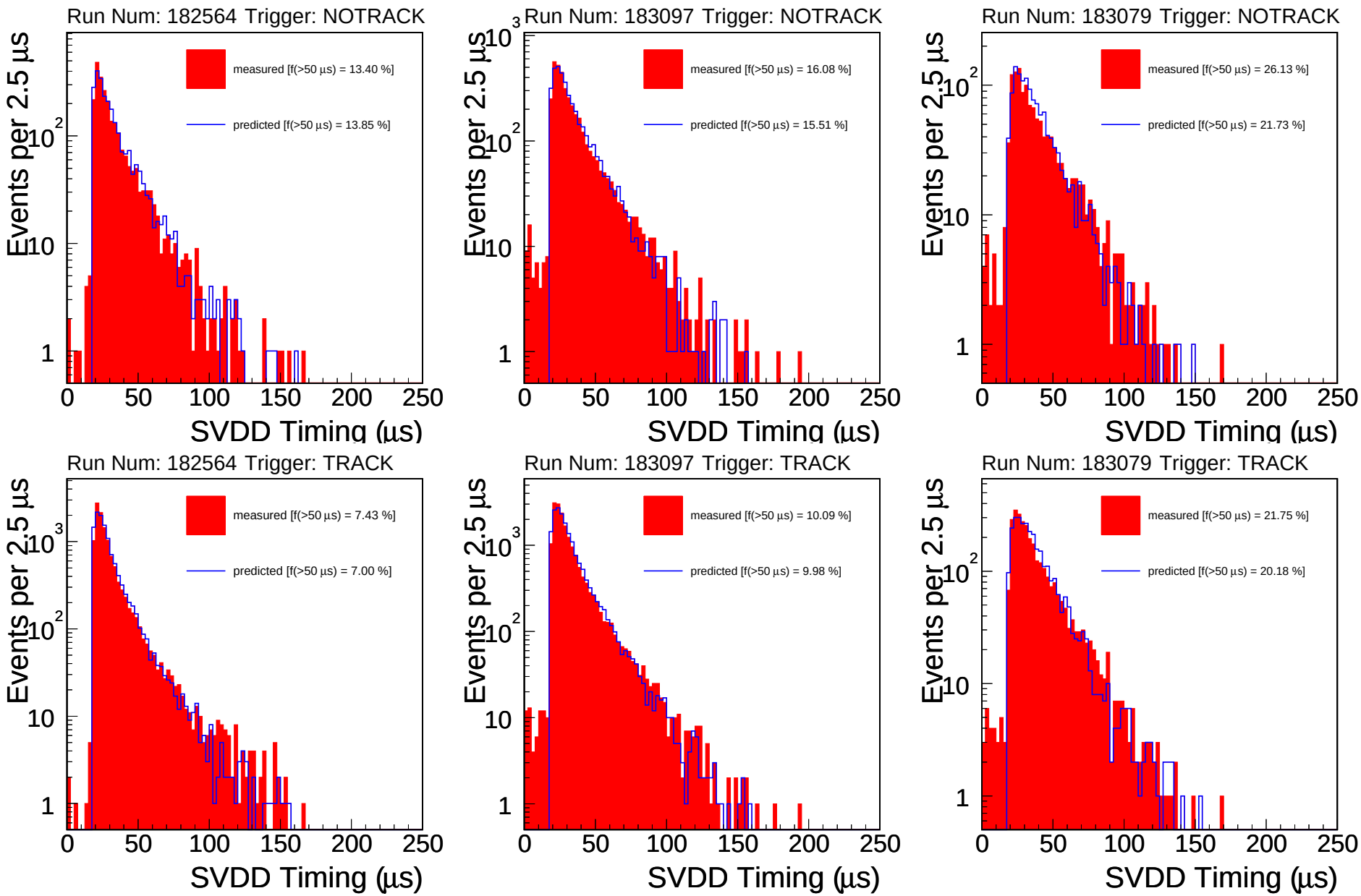



- take distribution of busiest wedge from data
- parametrize $N_{combs}$ with:
  zero-bin fraction,
  gaus $\otimes$ exponential (low-comb shoulder)
  $+$ exponential (high-comb tail)
- describes lower lumi well, working on high lumi

# Simple Timing + Parametric Env:



# Test results:

- good description of low luminosity ($< 30 \cdot 10^{30}$) events
- less successful in describing higher luminosities
- problem: robust model for $N_{combs}$, working on it
- eventually: dependance of model parameters on $\mathcal{L}$
- this will then provide a method to predict the environment for $5e32$.
- use linear timing model to predict timing based on derived environment
- expect good timing prediction based on good environment prediction

# SVT Timing Test Runs:

- setup so SVT timing should be understandable:
- eliminate wedge negotiation noise: run single wedges
- eliminate timing sculpting: run with single L1 buffer
- extra runs: two wedges, all wedges
- 14x50k events at low luminosity
- slowest, fastest wedge and 12 wedges at high luminosity
- triggers: two track, $Z \rightarrow b\bar{b}$ and no-track
- if possible, add pulsar $\rightarrow$ intermediate timing
- improve timing calibration, get more handles

# Todo list:

- interface to ModSim with simple model, parametric env.
- estimate how well these models work.
- study scaling of environment variables with $\mathcal{L}$
- establish timing model for pulsar SVT (3x, 6x clock speed)
- simulate 128k/512k patterns?

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- take special runs, improve calibrations
- attempt to tune realistic model on test run data

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- a lot of work, needs to converge in $<$ two weeks

# Conclusions:

- cleaned up svt timing distributions
- implemented simple linear timing model
- simple model measures:
  - 30-45 ns/hit processing time
  - 250-300/ns combination processing time
- can work in a pinch, residual tails potentially a problem
- rough environment model established
- problems at high luminosity, working on fixing
- quality of timing prediction limited by quality of environment ($N_{combs}$) prediction for high luminosity
- also working on testing models with ModSim, environment scaling, parametrizing improvements