LIGO

Update on Simulations for the S2 Bursts Analyses

Patrick Sutton, Igor Yakushin

LIGO-G040208-00-Z

LIGO

Outline

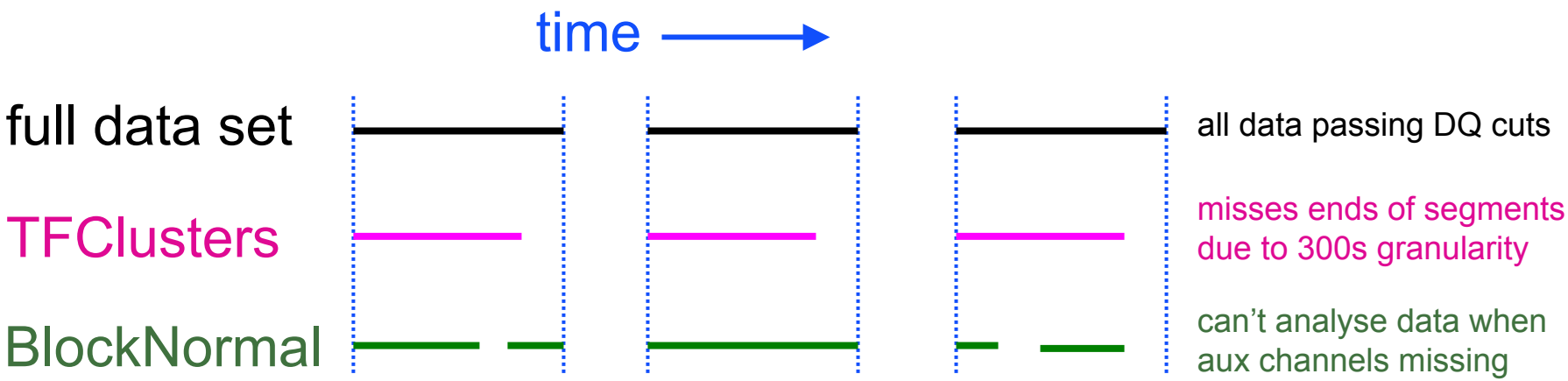
- Statement of Problem
  - » Measuring efficiency, observation time of S2 pipeline
- Proposal for Solution
- Implementation of Proposal
- Next Steps

LIGO

The Issue

- Goal: Estimate efficiency of full pipeline to real GWBs.
- Problem: ETGs analyse slightly different data sets. How do we combine their triggers and efficiencies?
  - » Upper Limit: $R(h) \sim N/(\varepsilon(h)\, T)$
  - » How do we measure efficiency $\varepsilon(h)$?
  - » How do we specify observation time T?
- Solution: Measure efficiency using same pipeline as real GWB would see.
  - » Real GWB could be found in any data which 1/some/all ETGs analyse
  - » To be detected a real GWB only has to be seen by one ETG
  - » Observation time := duration of all data analysed by any ETG.
  - » Efficiency := fraction of simulated signals surviving pipeline.

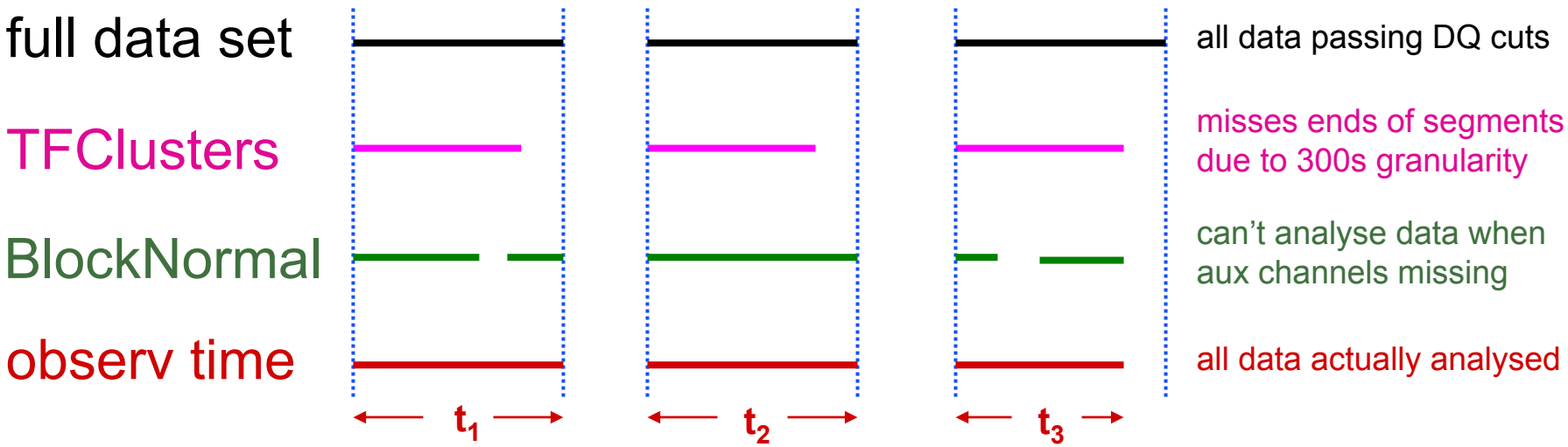
The Problem



- ETGs analyse slightly different data sets.
- Upper Limit: $R(h) \sim N/(\varepsilon(h)\, T)$
  - » How do we measure efficiency $\varepsilon(h)$?
  - » How do we specify observation time T?

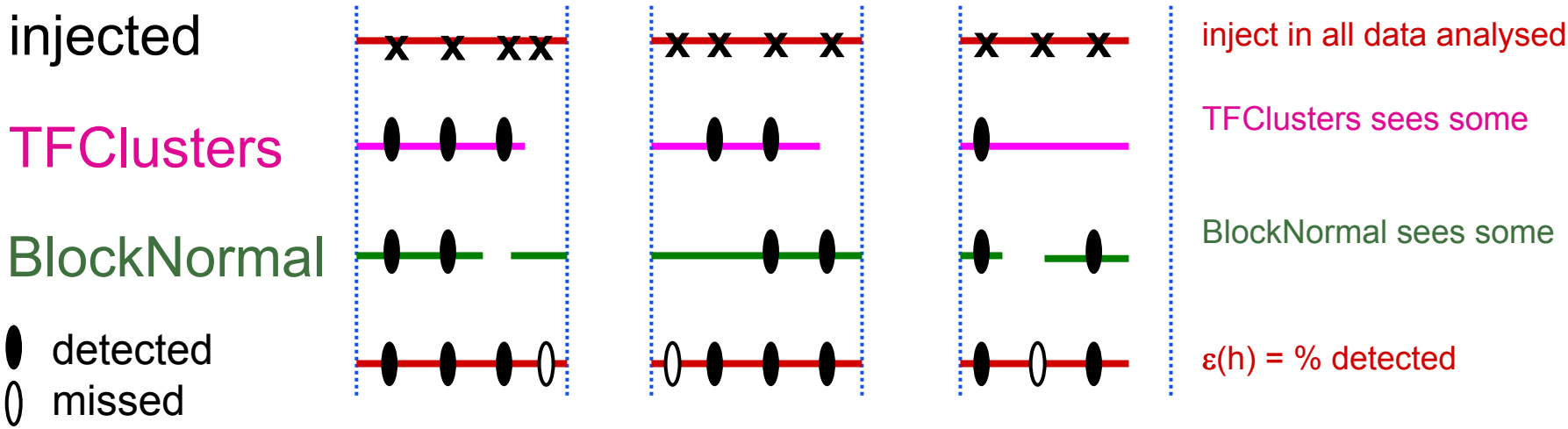
Observation Time

- T = duration of union of all data passed through any ETG:



$$T = t_1 + t_2 + t_3$$

Efficiency



- Inject signals into all analysed data.
  - » Coordinated injections through full set of analysed data automatically accounts for differences in data sets analysed by various ETGs.
  - » Doesn't matter why individual ETGs see/miss individual signals.

LIGO

Implementation: Options

- "On-the-fly" simulations (signals injected into raw data by ETG driver code)
  - » Fast – can inject many signals into same conditioned data
  - » Different ETGs have different capabilities – hard to coordinate.
  - » Have to validate many pieces of code.

- MDC frames
  - » Can do now (Yakushin)
  - » Guaranteed that all ETGs see same signal
  - » Worry about tremendous size of data (T ~ 10^6s $\Rightarrow$ 200GB of data)

LIGO

Choice: MDC frames

- Size problem is solved (Sylvestre, Zweizig)
  - » Create MDC frames containing only signal (no noise); make ETG/driver script add to raw data before analysing.
  - » 1 copy of S2: ~ 200GB (signal + noise) $\Rightarrow$ 1GB (signal only)
- Estimated length of data set required = few x S2:
  - » ~2500+ inj/waveform for efficiency curve
  - » ~20 waveforms
  - » 1 inj/90sec (well separated)
  - » 2500 x 20 x 90 ~ 5 x 10^6s
- Time to produce: ~ 40hrs for 10^6s in LDAS
  - » May want to produce sets in parallel

LIGO

Status

- Yakushin has produced sample injection frames and injection logs
  - » checking signals
  - » verified that compressed MDC frames are readable by WaveBurst
- Zweizig has tested compression (factor ~200)
- Ready to begin frame production very soon.

LIGO

Next Steps

- Each ETG user/group has to be able to add signal-only MDC data to raw data before analysing.
  - » **Please verify ASAP**

- Need to fix exact set of waveforms to be analysed.
  - » Begin with SG, Q ~ 9, f0 = {100, 153, 235, 361, 554, 850}Hz
  - » All sky, polarization.

  My proposal:
  - » G, τ = {0.1, 0.5, 1.0, 2.5} ms
  - » SG, Q ~ 9, f0 = {700, 1053, 1304, 1615, 2000}Hz (LIGO-TAMA)
  - » Lazarus BH mergers: M = {10, 20, …, 100}M_o (2 polarizations).

  Damped sinusoids? Other?