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# **JOINT HARDWARE INJECTIONS AND SYNCHRONIZATION STUDY IN THE STOCHASTIC BACKGROUND GROUP**

LIGO-G080356-00-Z

# Hardware injections

- Several hardware injections done during the VSR1 run
- In the stochastic group, we tried synchronized injections
  - Test for the synchronization between the detectors
  - Signal recovery test (synchronization not mandatory)
- Never attempted before in Virgo
  - Hardware issue: stochastic injections more “heavy” than others
  - Software issue: some basic facility for gps synchronization available, but never tested

# Injection infrastructure

- We tried to solve hardware and software issues at the same time
  - Injection code patched to allow gps synchronization
  - A simple “injection server” was implemented

“Injection server”.  
Data to be injected  
here:

- Stored on disk
- Generated “on fly”



Injection system



- Dedicated machine
- low memory
- low computational power

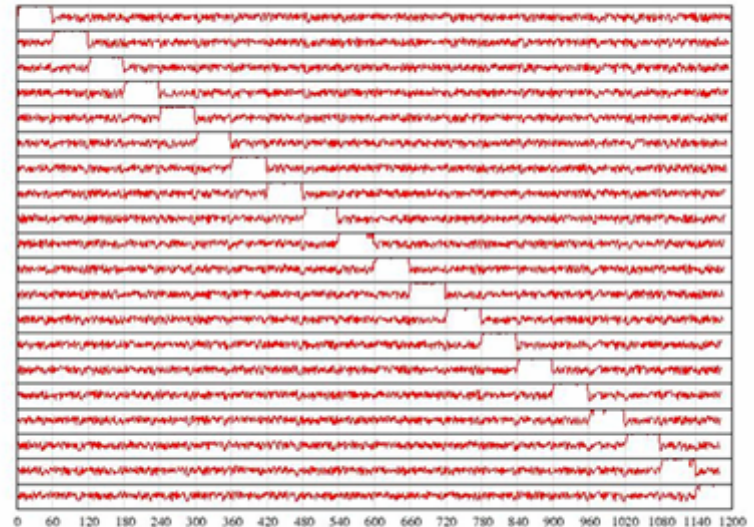
- No time for extensive tests on the detector
- Difficult to find common time windows between the detectors

# Results

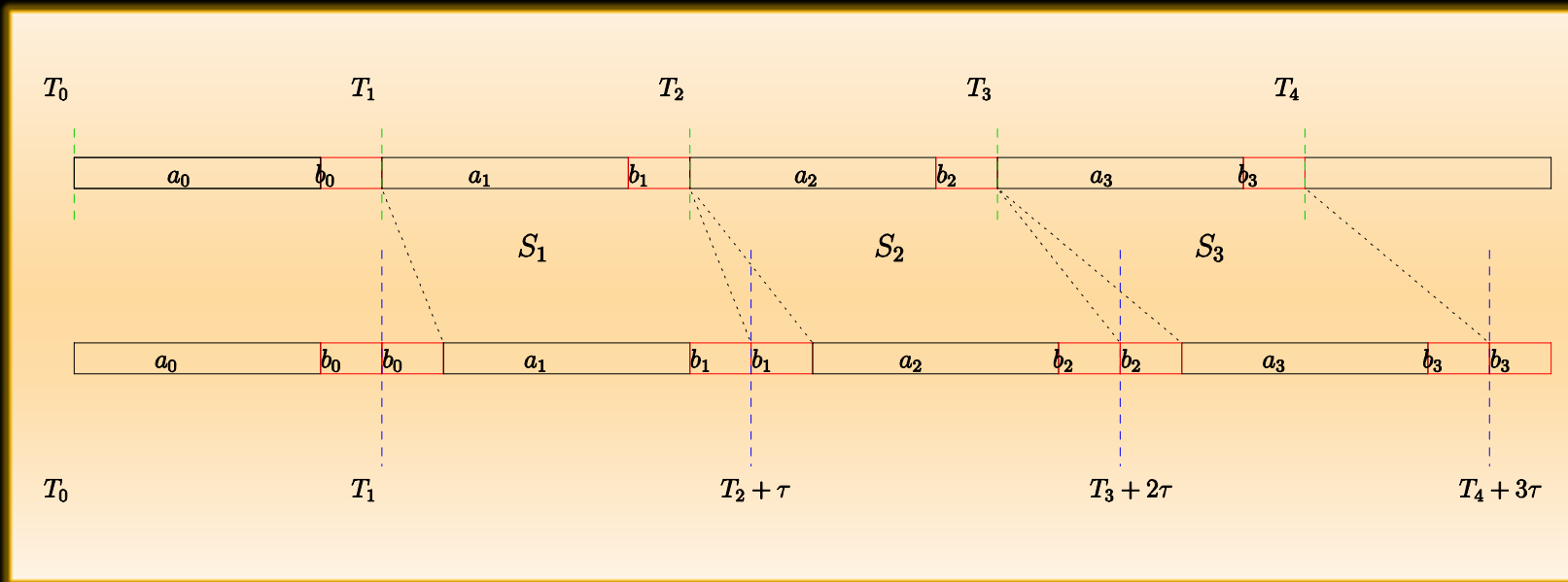
- A couple of synchronized injections finalized
  - Problem with the first one: SNR too low
  - Second trial: unexpected loss of coherence between (L1,H1) and Virgo
  - The reason: a problem with the injection

On row N: running coherence between the signals injected in H1 and V1, with N seconds of time shift

The problem is solved now, but we were not able to find another occasion for a synchronized injection.



# Injection reconstruction



- The injection system inserted a spurious 1-sec segment (replicating the last one) every 60 seconds
- We reconstruct the stream with some cut and paste
- Obviously this is not a faithful reconstruction:
  - Discontinuities in the data are amplified by the mirror response....
  - .... and propagated in time
- But not too bad:
  - 1 sec of data after each discontinuity is removed

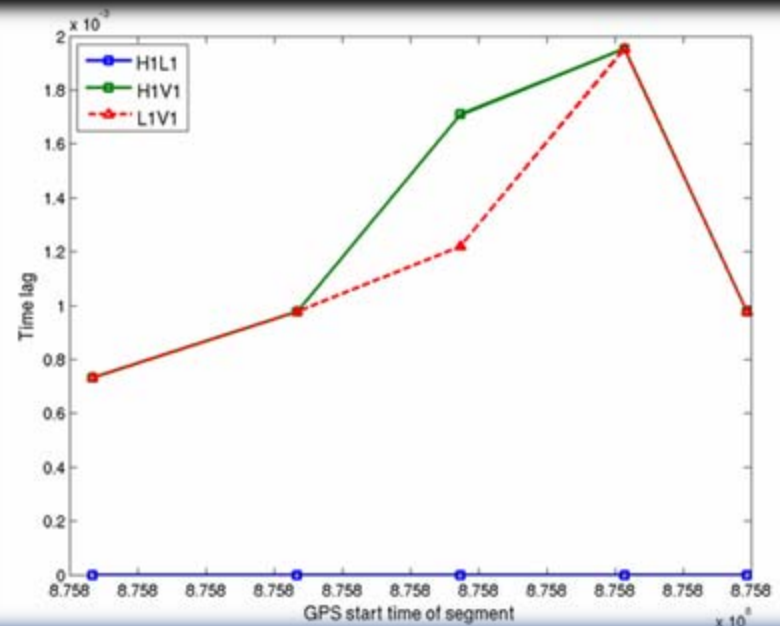
# Analysis of reconstructed data:

- Wrong factor in the SNR for V1-H1 & V1-L1 pairs
- An unexpected time delay (not constant!)
  - See E. Robinson talk tomorrow

Can this be an artifact of the reconstruction? Maybe.

- Discontinuities introduce additional noise in the system
- The frame replication change the time coherence structure

But: preliminary numerical simulations show that the effect is quite small. So, we do not have yet a convincing explanation for the observed results.



## Next steps

- Understand if there is another problem hidden in the injection system
  - We are recovering the data of another sb injection (Virgo only), which will give useful informations
  - Planned injections in the foreseen engineering run will not be possible anymore, due to the anticipated shutdown
- Evidence from other groups suggest that this is not a calibration issue (no apparent timing problems with unsynchronized injections)
- An effort to understand better the issue is mandatory in my opinion