

Hardware Injections in S4

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(for P. Shawhan, S. Marka, S. Bose, M. Landry, S.
Fairhurst, R. Prix ...)

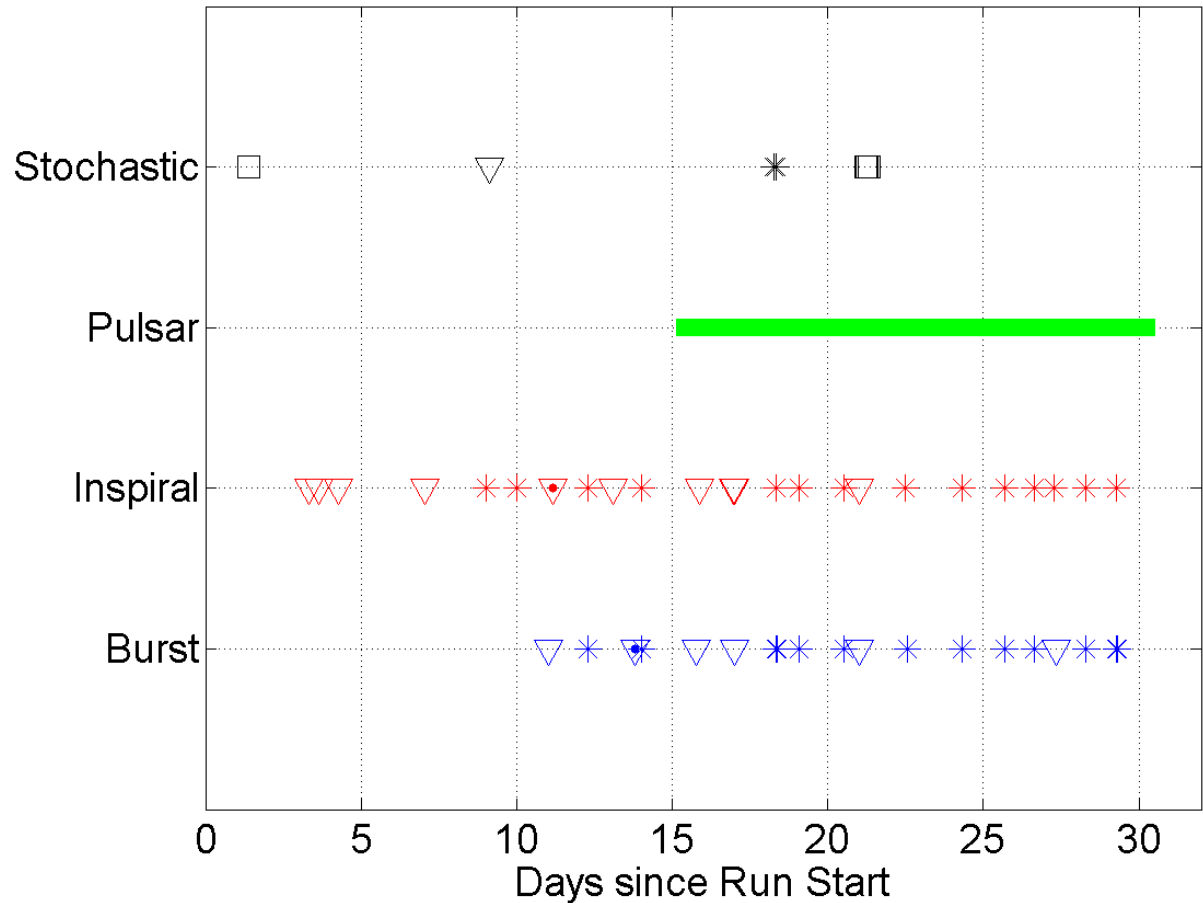
LSC Meeting, LLO
March 23, 2005
DetChar Session – S3/S4 Investigations

Novelties

- Daily inspiral and burst injections
 - » Each 5min/day, at various times, various sensitivities, various IFOs
 - » New software mostly automates the procedure
 - » Coordinate the operators at both sites to enter/exit injection state
- Modified code for “on-the-fly” stochastic injection
 - » Should resolve the synchronization problem from S3
- New pulsar code and configurations
 - » Actuation function read from a file

Overview of Injections

- Injections:
 - » Single (•)
 - » Double (∇)
 - » Triple (*)
 - » A1-L1 (□)
- Total triple-coincidence:
 - » About 5-6 hours
 - » 1-2% of total triple-coincident time



Bursts

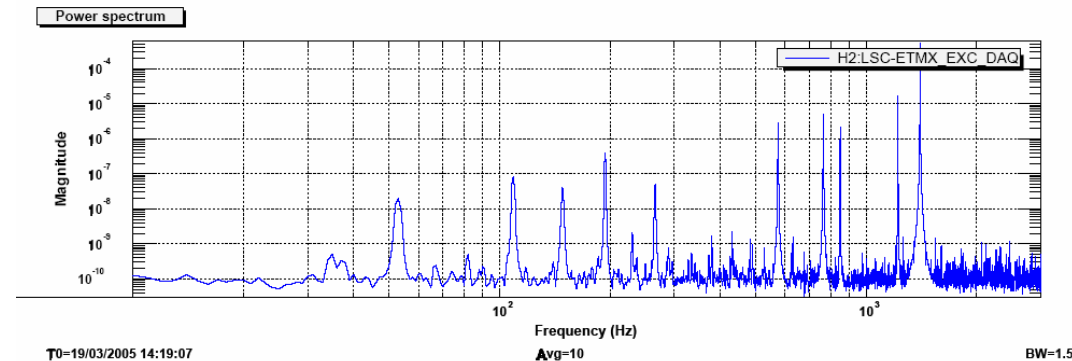
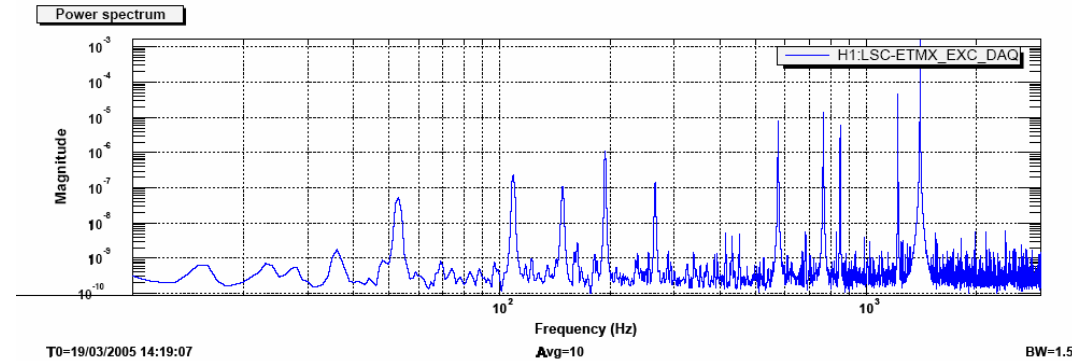
- Waveforms calculated by Peter Shawhan
- 3 configurations, 20 waveforms each
 - » Sine-gaussian waveforms at 235 Hz and 914 Hz
 - » One Gaussian waveform
 - » One Zwerger-Muller SN waveform
 - » Various amplitudes and delays between LLO and LHO
 - » One configuration per day
- Set of 16 loud Sine-gaussian waveforms once per week
- Injection Stats:
 - » Triple-coincident: 272 waveforms
 - » Double-coincident: 112 waveforms

Inspirals

- Waveforms calculated by Stephen Fairhurst
- 3 configurations, 3 waveforms each
 - » One configuration per day
 - » Includes 1.4+1.4, 3+3, and 10+10 M_{\odot} waveforms for several different distances
- 40 minutes of low-background running surrounds each injection (usually prior to injection)
- Injection Stats:
 - » Triple-coincident: 42 waveforms
 - » Double-coincident: 27 waveforms

Pulsar

- Parameters calculated by Mike Laundry
- makefakedata updated by Reinhard Prix, compiled by Peter Shawhan
- Same 10 pulsars as in S3, but with smaller amplitudes.
- Pulsars started on March 8, and remained running for the rest of the run, in the science mode.
- Last day of S4: added 2 binary pulsars



Stochastic

- New code and all waveforms provided by Sukanta Bose
- IFO injections:
 - » Pre-calculated 17 min waveform into H2-L1 pair, $\Omega=0.04$.
 - » Pre-calculated 17 min waveform into H1-H2-L1, $\Omega=0.01$.
 - » “On-the-fly” 75 min injection into H1-H2-L1, $\Omega=0.04$.
 - » Weaker injections planned for post-run period.
- ALLEGRO-LLO
 - » Three 17 minute pre-calculated injections in the “Minus” and “Plus” orientations of ALLEGRO, $\Omega=2500$.
 - » Planned another three 17 minute pre-calculated injections in the “Null” orientation of ALLEGRO for the post-run period.

Problems

- Glitches when starting/stopping the injection stream
 - » Caught by the burst monitors
 - » Injections started/stopped in injection mode only
- Pulsars running?
 - » Injection code sometimes does not recognize that pulsars are running
 - » Burst/inspiral injected “with” the pulsars
 - » Only two such cases in S4
- Confusion how to enter/exit the injection state
 - » First ~week only

Conclusion

- A number of successful injections have been performed
 - » Of all 4 types
 - » Many in triple-coincidence
- Feedback from the analysis groups looks great!
- For the future (i.e. S5):
 - » Hope to completely automate the process
 - Inject waveforms according to a pre-determined schedule
 - Allow operators to override the injections
 - Avoid the overhead of coordinating the two sites
 - » Hope to determine exactly what will be done long before the run starts!