LIGO

Astrophysical Signal Injection Studies During the E6 & E7 Runs

Peter Shawhan, Daniel Sigg, Sukanta Bose, Duncan Brown, Gaby Gonzalez, Szabi Marka, John Zweizig

(LIGO/Caltech, LIGO/LHO, WSU, UWM, LSU, LIGO/Caltech, LIGO/Caltech)

LSC Meeting

March 22, 2002

Signal Injection Mechanics

Uses the LIGO Global Diagnostics System's "arbitrary waveform generator"

- **awg** process runs on a front-end processor
- Can add an excitation waveform at various points in the servo system

"awgstream" client utility sends waveforms to awg

- Runs on any workstation in the control room
- Reads waveform from an ASCII file of arbitrary length
- Streams data to **awg** in 1-second blocks, with buffering
- Actual injection is synchronized to GPS clock

There is also a C library interface

- Could be used by a program which calculates a waveform on-the-fly

Have to weight waveform by f^2 to account for pendulum

Signal Injections During E6 / E7

Have been injecting into servo output signal sent to ETMX

E6: **Inspirals into L1**

1.4 + 1.4 $M_{\odot}$

E7: **Inspirals into L1+H1 simultaneously**

Several mass combinations from 1.4 + 1.4 to 7.4 + 2.7 $M_{\odot}$

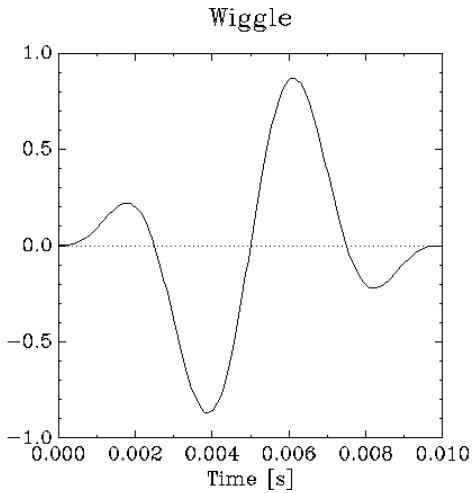
Correlated noise into L1+H1 simultaneously

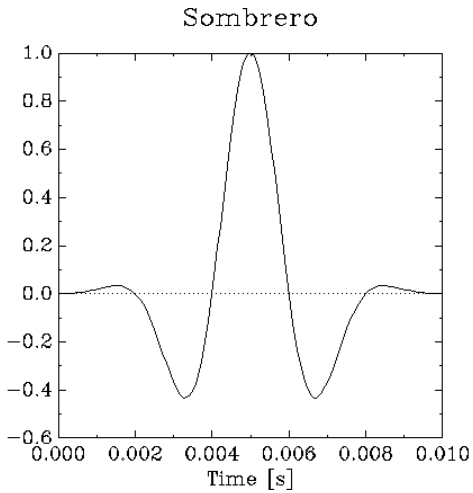
512 seconds long

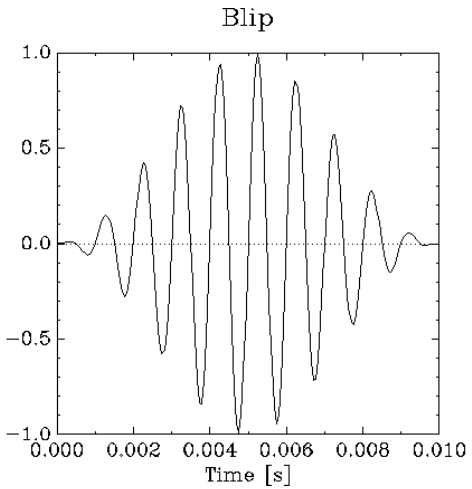
Bursts into L1+H1, L1+H2 simultaneously

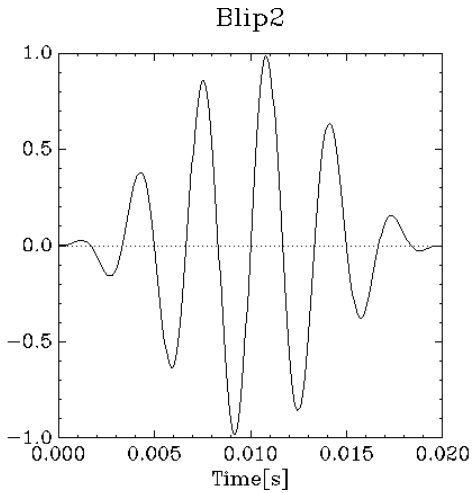
Four different “toy” waveforms

Simulated Burst Waveforms

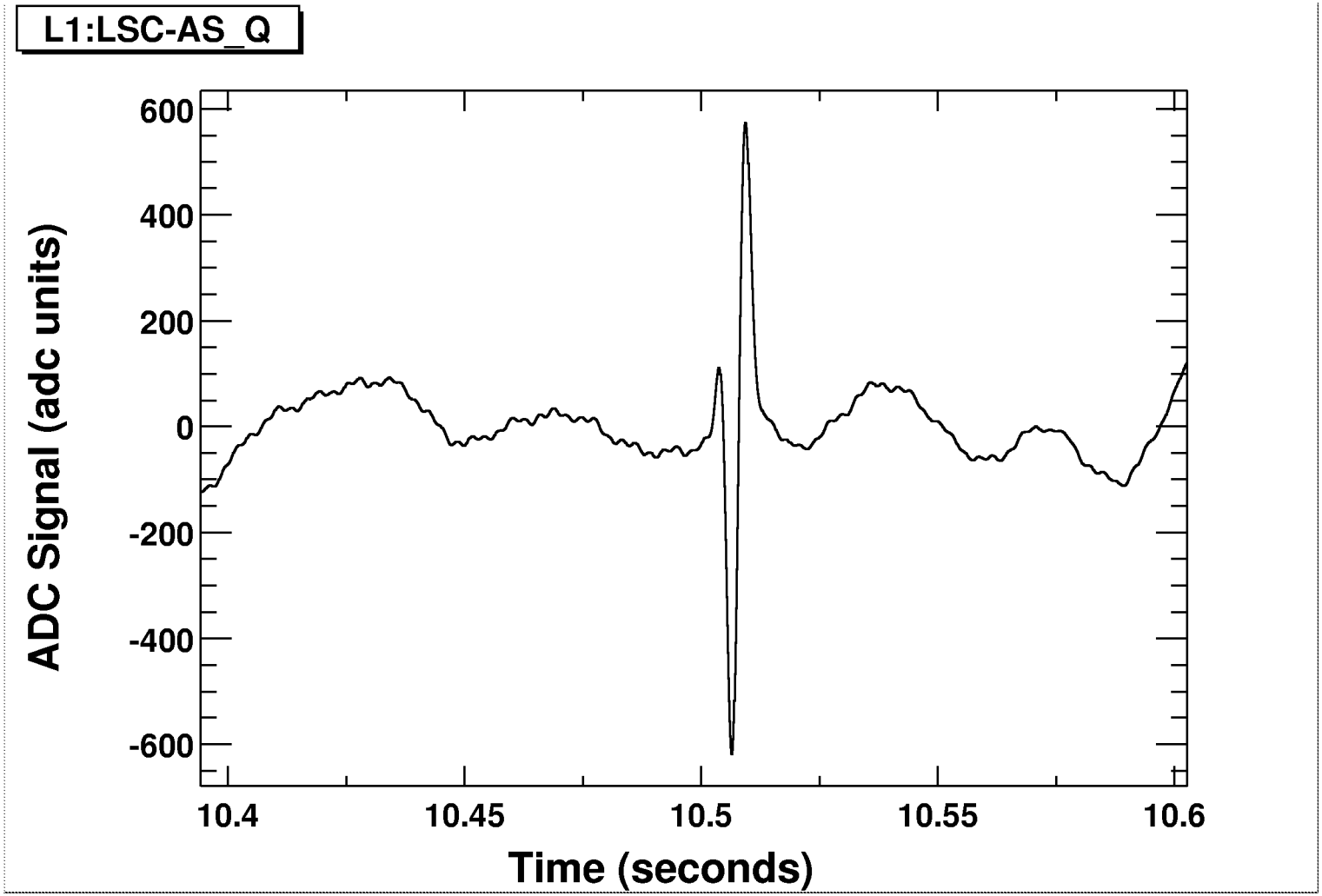




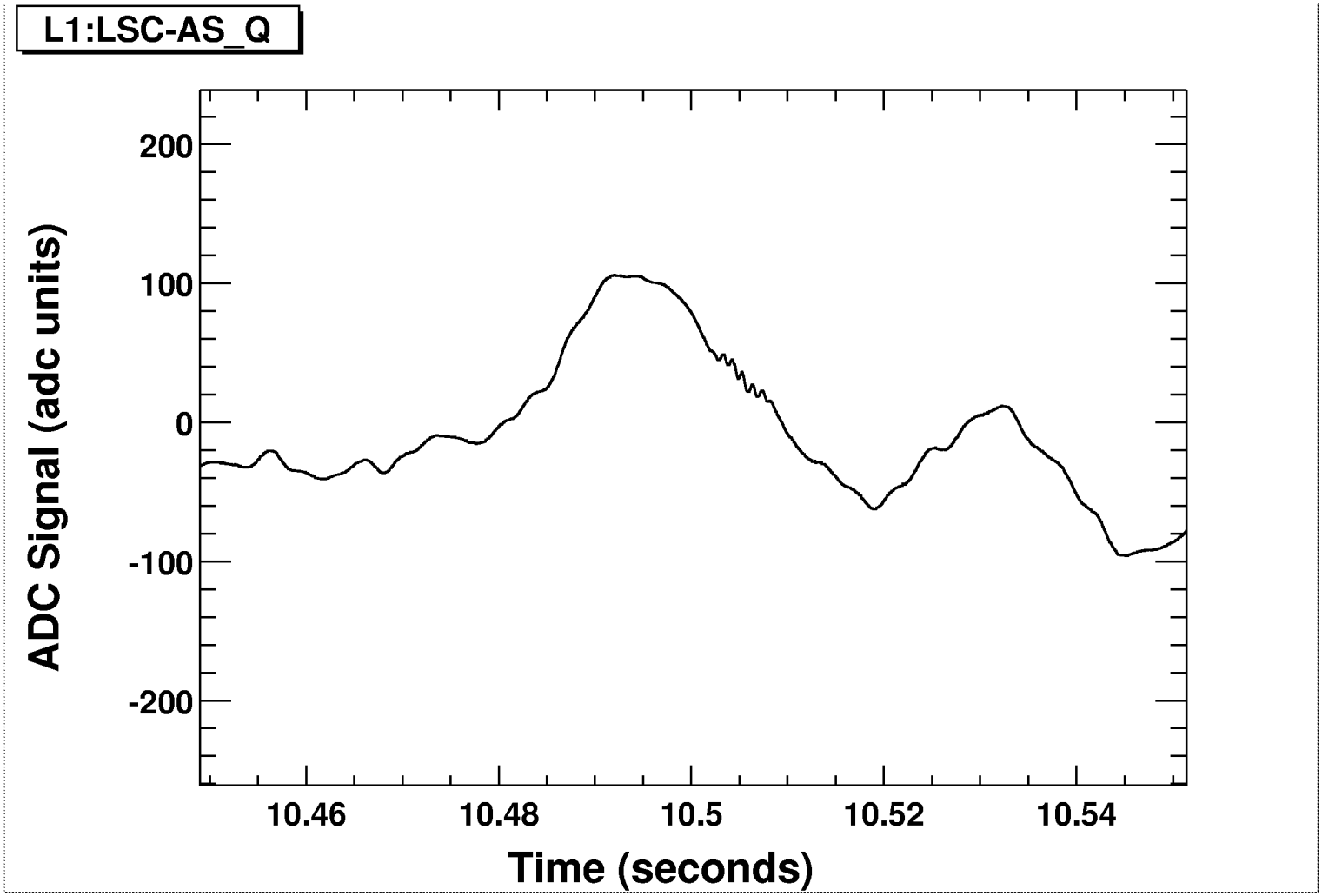




“Wiggle” Waveform in Data



“Blip” Waveform in Data



Analysis of Data Containing Injected Signals

Inspiral

- Duncan Brown has processed E7 data from H1 using the **`findchirp`** search code in LDAS
- Rough study so far (wrong response function; selected template params)
- Succeeds in finding chirps at roughly the right times

Burst

- John Zweizig compared L1 injection times against DMT “Glitch” triggers on AS_Q; DMT found “sombrero” and “wiggle” waveforms, but not “blip”
- No offline analysis so far

Stochastic

- No analysis so far

LIGO

Summary

Signal injection software worked well

Analysis of E7 data is ongoing

`awgstream` utility is available for general use

C library interface could be used to inject simulated signals from periodic sources, sequences of bursts, etc.

There should be a proper "how-to" guide, but there isn't yet