



LIGO-G040133-00-E

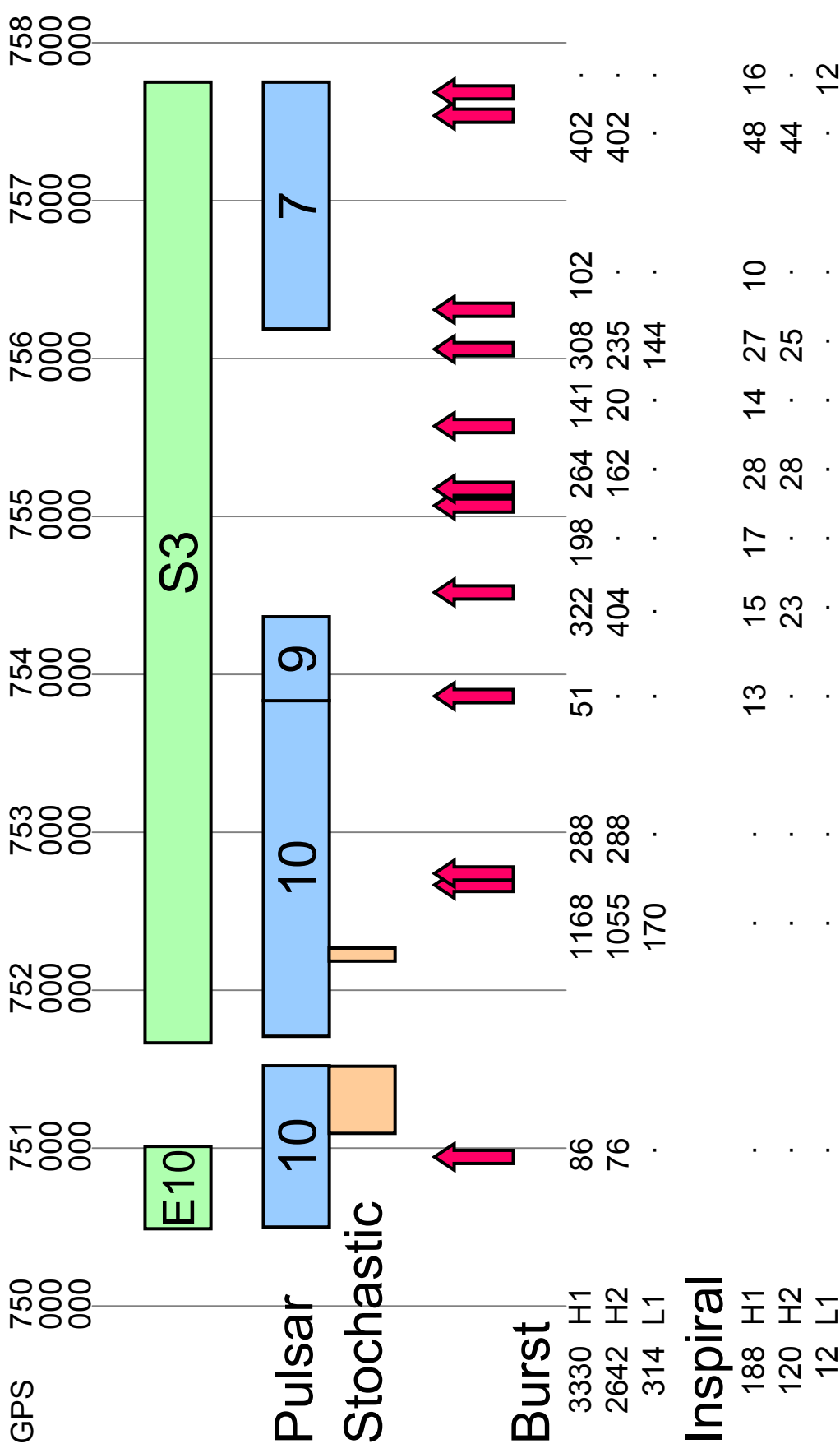
# Summary of E10 / S3 Hardware Signal Injections

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Michael Landry, Alan Weinstein**

*Additional software written by Daniel Sigg and Isabel Leonor*

**LSC Meeting  
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# The Big Picture



# General Details

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**Pulsar and stochastic injections are in science-mode data**

Burst and inspiral injections are not

**All signals were injected into ETMX\_EXC**

Calibration lines continued on DARM\_CTRL\_EXC during all injections

**Injections synchronized between sites using GPS timing**

# Pulsar Injection Details

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## **Simulated pulsar waveforms calculated on-the-fly**

Software provided by Bruce Allen

Up to 10 simultaneous simulated pulsars

Wide range of sky positions, frequencies, spin-down rates, and amplitudes

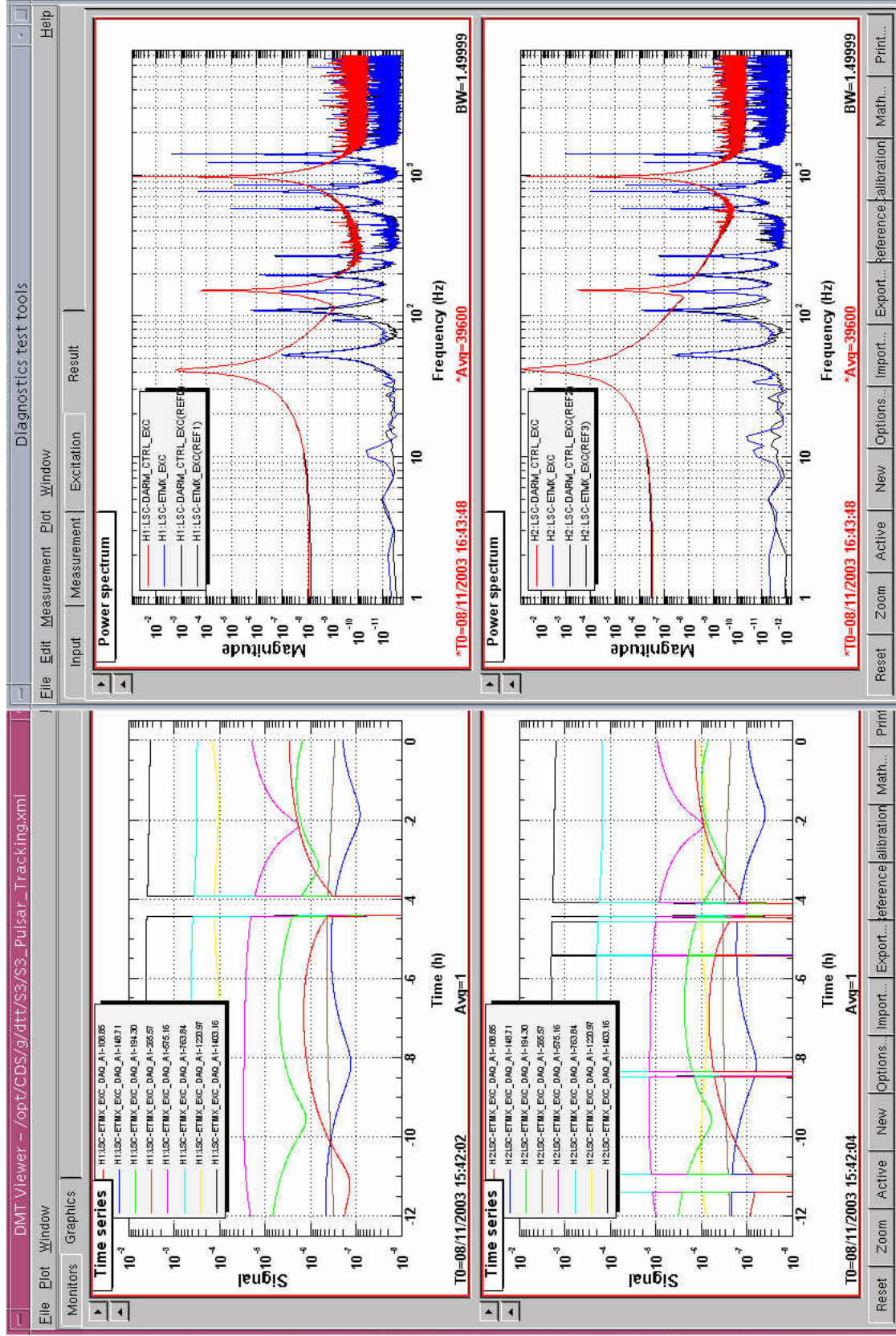
Injection parameters accounted for actuation transfer functions

Late in run, one pulsar injected in coordination with GEO

## **Largest-amplitude pulsars discontinued partway through run**

## **All pulsar injections turned off for middle part of run**

# Pulsar Injection Monitoring



## Correlated noise calculated on-the-fly

Software provided by Sukanta Bose and Bruce Allen

Injected over a period of several hours during S3 run

Normalized to correspond to  $\Omega_{\text{GW}} = 1$

Science data: 1.9 hours for H1, 4.6 hours for H2, 3.7 hours for L1

# Burst Injection Details

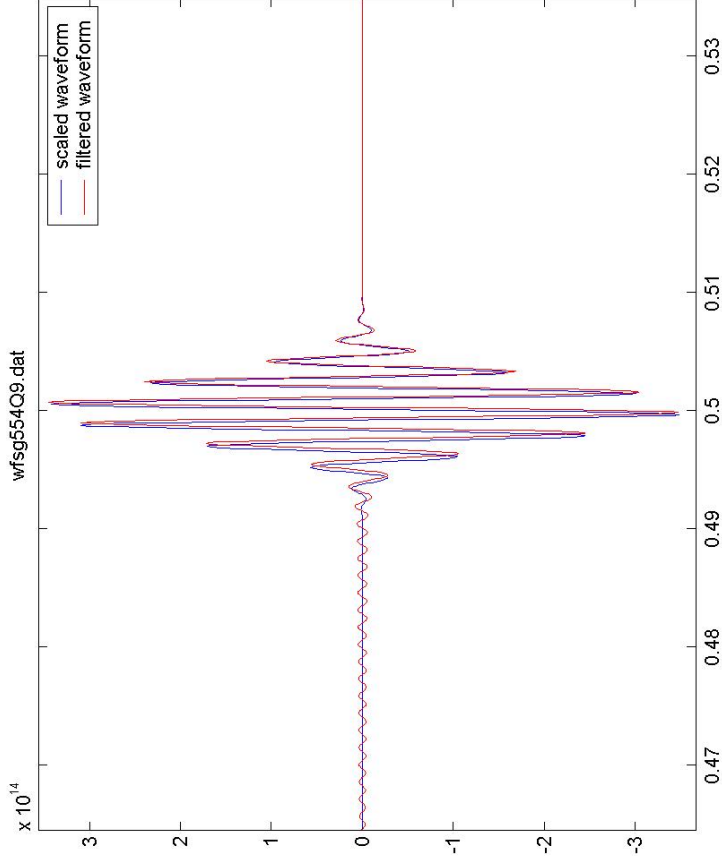
## Various pre-computed waveforms

Waveform files provided by Alan Weinstein

Sine-Gaussian with various frequencies and Qs,  
Zwinger-Müller and Dimmelmeier-Font-Müller,  
and a few Gaussians

Injected with various amplitudes

Did not account for actuation  
transfer functions (makes little  
difference for Sine-Gaussians)



## Used a few sets of waveform files

S2 waveform files used at first

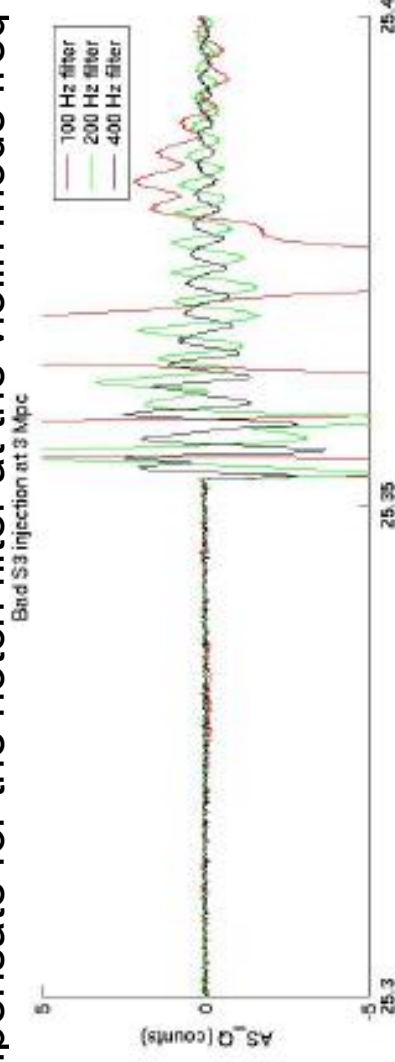
New files for S3 provided by Steve Fairhurst

Masses:  $1.4+1.4$ ,  $1.0+1.0$ ,  $10+10$ ,  $10+1 M_{\odot}$

## Tricky to account for actuation transfer function

Unable to exactly compensate for the notch filter at the violin mode freq

Switched to using  
“notchless” transfer  
function to avoid  
big transient



## Tried a few ways to avoid a big kick at coalescence time

Rolled off waveform amplitude at end



# Summary

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**Pulsar and stochastic injections were highly successful**

**“Astrophysical” as well as simple burst waveforms**

**Improved understanding of inspiral waveform issues**

**Few burst / inspiral injections into L1**

**Further details (lists, etc.) on Hardware Injection web page:**

<http://blue.ligo-wa.caltech.edu/scirun/S3/HardwareInjection/>

**We need to decide what do to for S4 well before it begins**