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Data Analysis Overview

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LIGO-MIT

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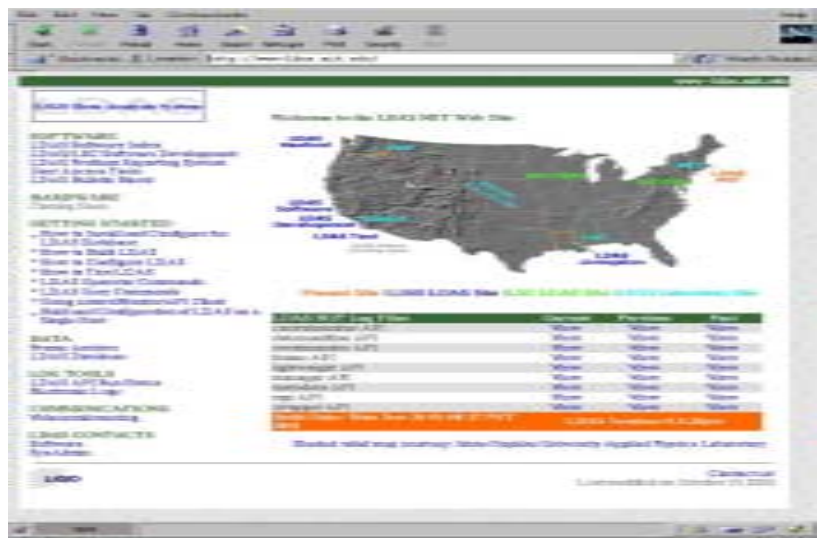
Data Analysis Participation

- All LIGO-MIT group members participate across all four LSC Data Analysis Working Groups
- P. Fritschel/M. Zucker co-chair Stochastic/Continuous Wave Groups
- Participation in the Inspiral group under the leadership of P. Brady and G. Gonzalez:
  - » Mittleman, Mavalvala, Harry
- Participation in the Stochastic group under the leadership of P. Fritschel and J. Romano:
  - » Weiss, Regimbau, Katsavounidis
- Participation in the Bursts group under the leadership of S. Finn and P. Saulson:
  - » Zucker, Sylvestre, Shoemaker, Ottoway, Katsavounidis, Cadonati, Bayer, Ballmer, Adhikari
  - » Operation of the Bursts group's main analysis computing infrastructure
  - » Direct contribution in algorithms, vetoes and pipeline integration of the E7 engineering run

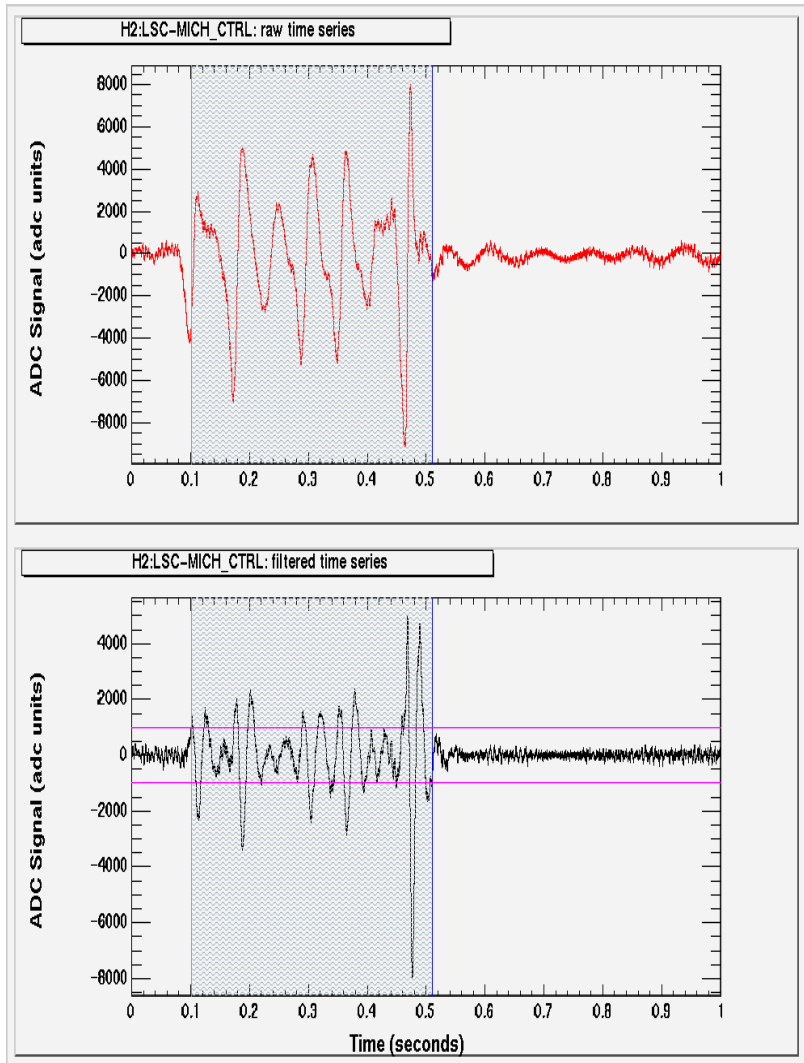
LDAS Cluster at MIT

- Laboratory and LSC facility
- Operational as of summer 2001
  - » Anderson, Blackburn, Lazzarini
  - » Bayer, Thomas, Katsavounidis, Shoemaker
- Additional DMT machines
- Data Challenges:
  - » September 2001, Bursts/Stochastic
  - » May 2002, Bursts E7 dress rehearsal
- Start up hardships- being worked on (CIT,CSR,MIT):
  - » facilities
  - » network



Bursts Upper Limit Effort

- Goal: search for transients of unmodeled (or not well modeled) gravitational radiation
- Search filters
  - » Slope (Arnaud et al, Daw) – slope of data in time domain
  - » Excess power (Anderson et al) – power of the data above noise in time-frequency band
  - » Time-Frequency clusters (Sylvestre) – thresholded spectrograms combined with clustering analysis
  - » Externally triggered analysis: GRB's, neutrinos via on/off IFO cross correlation (Finn et al)



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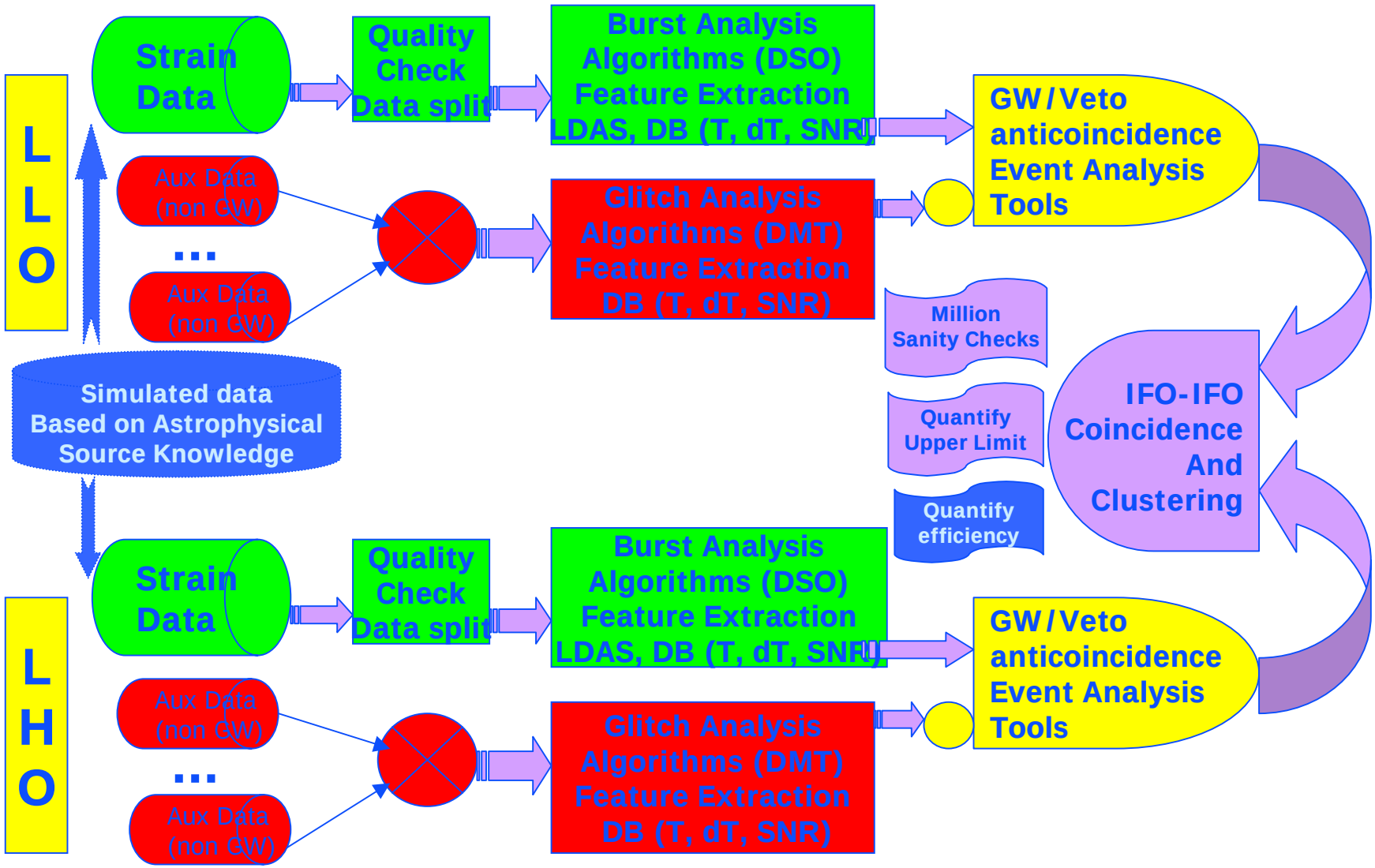
E7 Bursts Search Pipeline



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E7 Pipeline Implementation

- E7 = Dec 28, 2001 – Jan 14, 2002 of which ~400 hours reflected LLO-4k/LHO-2k coincident data taking.
- A complete pipeline analysis of E7 data was carried out by Julien Sylvestre for his PhD work – defended June 24.
- A complementary approach was adopted and carried out in a synergetic way by the Bursts group:
  - » select ~3 hours of 'playground' data over which pipeline optimization ('tuning') is going to be performed (filter thresholds, veto parameters)
  - » prepare statistical tools and methods under a unified and commonly accepted platform
  - » apply and confront multiple veto-defining methods and channels: purely time-domain, template-matching (IUL) on at least 4+4 auxiliary channels
  - » study each of the bursts filters independently

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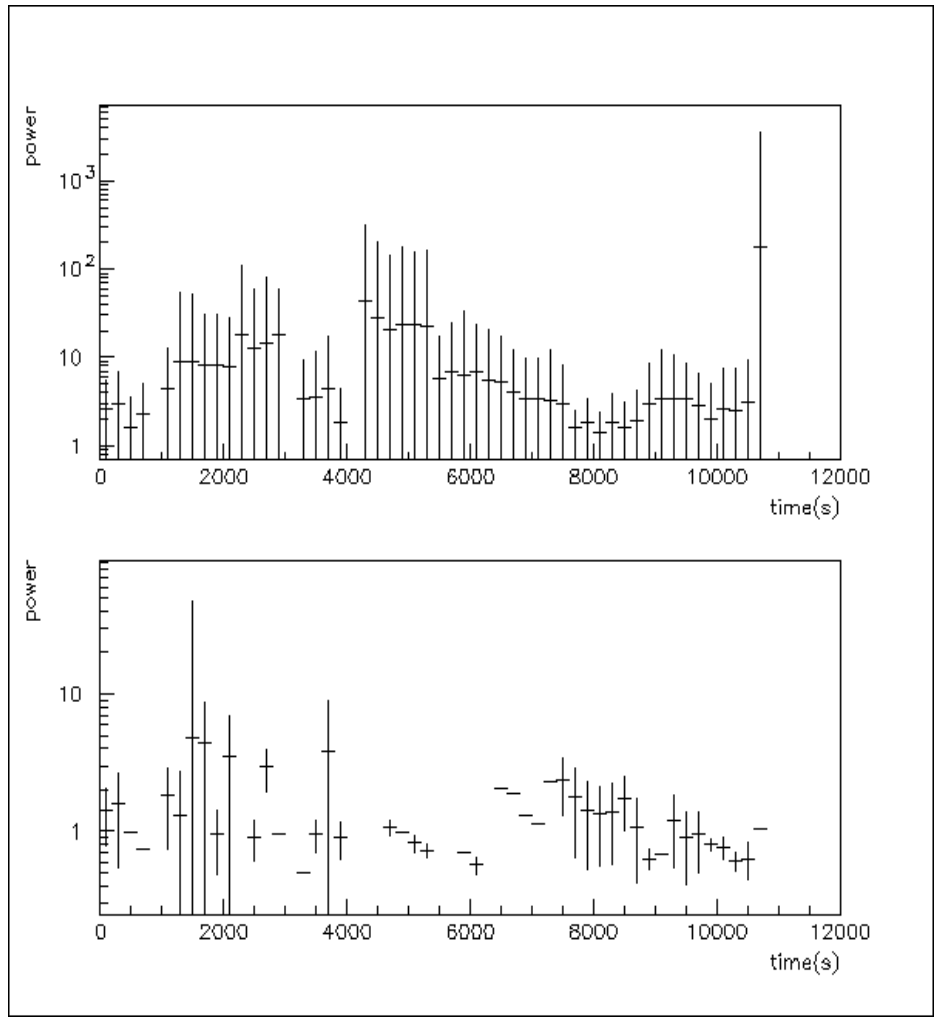
E7 Pipeline Implementation

- » perform analysis of single IFO and multi-IFO (coincidence) events
- » quantify Upper Limit by estimating the background via time-shifting and using confidence belt statistics
- » establish sensitivity to modeled sources via software injection (Monte Carlo by Alan Weinstein)

- Redundant and complementary ways to look at the E7 burst data: luxury or necessity?

What have we learnt?

- Instrument was bursty during E7
- Are events coming from a random source?
- How varying are the amplitudes of the instrumental glitches?



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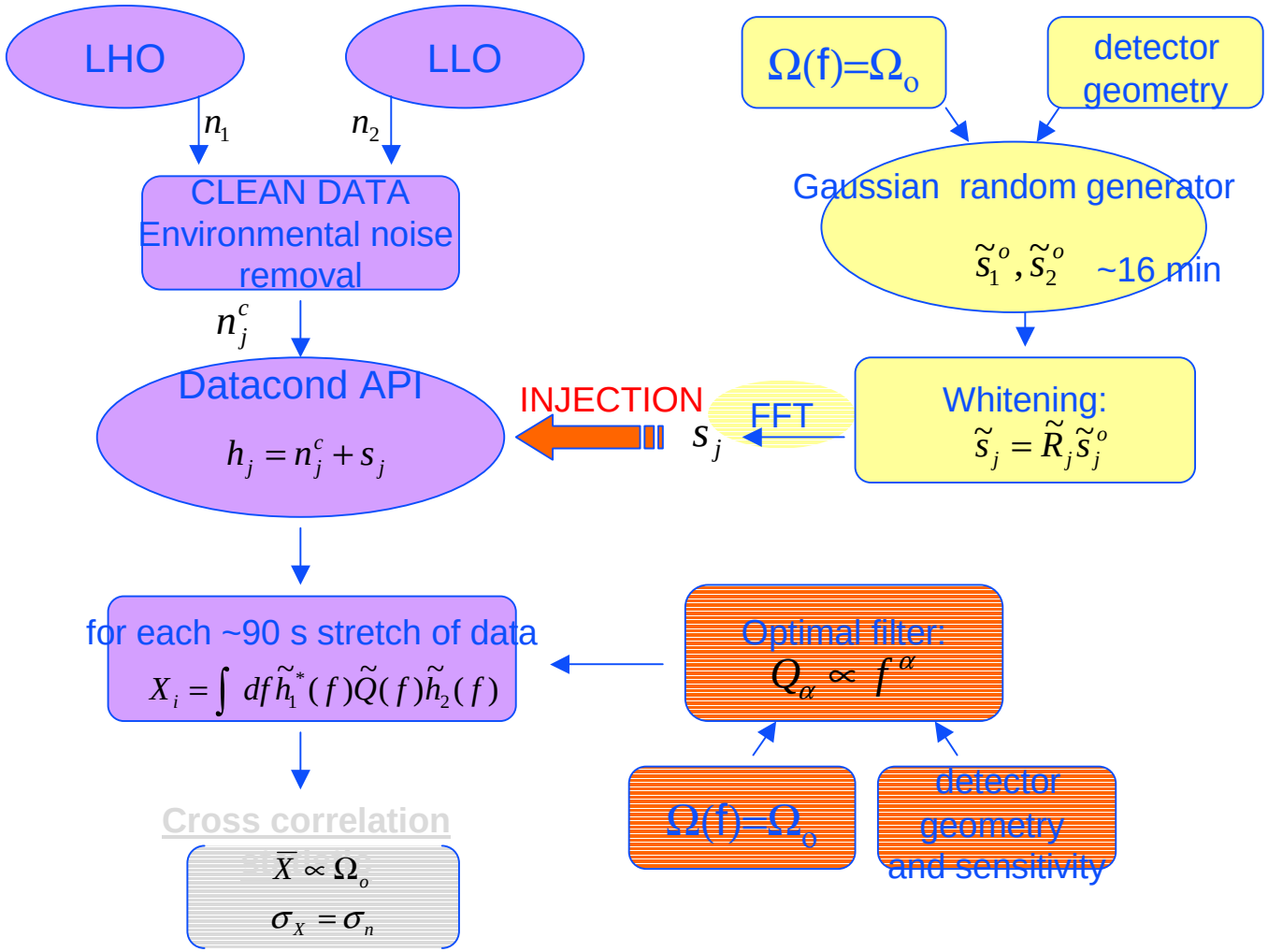
Where are we standing now?

- Infrastructure to perform any Bursts pipeline analysis is in place and in multiple versions
  - » finalize the tuning of vetoes
- Define and integrate in pipeline post-(time) coincidence analysis strategies
- Complete study of efficiency of search (DSO's+vetoes) to benchmark sources
- Proceed with the full set of E7 data
- Express upper limit in astrophysical terms

E7 Stochastic Search Pipeline



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Looking at S1 and beyond

- Ready to start looking at burst triggers and vetoes as they are coming in
- A good number of new people brought online and ready to pursue instrument and search studies
- S1 will give the opportunity to exercise the full path of most analyses via hardware-injected data (Alan Weinstein, Daniel Sigg, Szabi Marka)
- Develop new methods for extracting bursts and their features via time-frequency decomposition beyond Fourier, e.g. wavelet bases (S. Ballmer's thesis work)
- Feasibility studies to bring up the search for bursts close to real-time