

# Update on the Detector Characterization Working Group

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University of Michigan & LIGO Hanford Observatory

LIGO Scientific Collaboration Meeting

Stanford University

July 19, 1999

# Overview

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Goal - Characterize the Interferometers

- Active online diagnostics – Mainly LIGO responsibility (but on-site LSC members welcome to contribute!)
- Passive offline monitoring – Good for off-site LSC members  
⇒ Primary focus of working group (for now)

Two broad monitoring tasks:

- Performance characterization (stationary noise)
- Transient analysis – Dedicated subgroup (chair: F. Raab)

Two additional subgroups dedicated to tools:

- Data set reduction (chair: J. Brau)
- Data set simulation (chair: S. Finn)

# LSC Detector Characterization Working Group

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**This is the home page of the Detector Characterization Working Group  
of the LIGO Scientific Collaboration (LSC)**

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Working Group Bulletin Board

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Goals of the Working Group

Working Group Members

Performance Characterization

## **Subgroups:**

- Transient Analysis
- Reduced Data Sets
- Data Set Simulation

Meetings

What is this Working Group's role in LIGO?

Mock Data Challenge

## **Other LSC Data Analysis Working Groups:**

- Astrophysical Source Identification and Signatures (ASIS)
- Detection Confidence and Statistical Analysis

## **Other Relevant Links:**

- LIGO Laboratory
- LIGO Scientific Collaboration
- LIGO Hanford Observatory (Washington)
- LIGO Livingston Observatory (Louisiana)

# LSC Detector Characterization Working Group

## Members and Observers

Working Group Chair: Keith Riles

LIGO Laboratory Liaison: Daniel Sigg

Subgroup leaders:

Transient Analysis - Fred Raab  
Reduced Data Sets - Jim Brau  
Data Set Simulation - Sam Finn

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# Task Organization & White Paper

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- At Gainesville and afterward, many volunteers came forward to take on detector characterization tasks
- Drafting of Data Analysis White Paper helped focus thinking on task organization and prioritizing
- Led to creation of (giant) table of tasks, priorities, institutions & people

White Paper draft contains highly condensed summary:

Task Category	Priority	Institution
Online Diagnostics/Measurements	1,2,3	Caltech, MIT
Offline Monitoring Infrastructure	1,2	Caltech, MIT
Environment Monitor (hardware)	1,2	Caltech, LaTech, LSU, MIT, Uoreg, PSU
Line Identification	1	AEI, LSU, Umich, PSU, UWM
Instrument Correlations	1	AEI, Caltech, MIT, UWM
Environment Correlations	1,2,3,R	LaTech, LSU, Umich, Uoreg, PSU, Syr, UWM
IFO State Identification	1,2,3	Caltech, Umich, MIT, PSU
IFO/IFO Correlation	3	
Transient ID / Analysis (instr)	1,2,3,R	UFL, Umich, PSU, UWM
Transient ID / Analysis (envir)	2,3,	Caltech, LSU, MIT, Uoreg
Time/Frequency Analysis	1,2	Caltech, MIT
Customized Data Sets	1,2	Uoreg
Phenomenological Modeling	1,2	Caltech, MIT, PSU
End-To-End Modeling	1,2	Caltech, UFL, MIT, Pisa, PSU

Priorities:

- 1** = Needed at start of 2-km commissioning (10/99)
- 2** = Needed during 2-km commissioning (5/00)
- 3** = Needed by six months before science run (6/01)
- R** = Research area for advanced LIGO

Details at

<http://www-mhp.physics.lsa.umich.edu/~keithr/lscdc/tasktables.html>

Detector Characterization Tasks	Transfer	Calibration	Optical, RF &	Data Monitor	Trigger	Diagnostics
	Functions		Geom Params	Tool	Infrastructure	Control
Task Classification	Diag (LAB)	Diag (LAB)	Diag (LAB)	Diag (LAB)	Diag (LAB)	Diag (LAB)
(Priority)	1	1	1	1	1	1
Effort: Basic (FTE Months)	36	12	6	?	?	?
Effort: Display/Enhanced	24	?	?	?	?	?
Scientist	Institution					
Adhikari	MIT					
Allen, B.	UWM					
Anderson, W.	UWM					
Barton	CIT					
Bhawal	CIT					
Brau	UOregon					
Cella	Pisa					
Chassande-Mottin	AEI					
Coldwell	UFL					
Coles	LLO					
Daw	MIT	X	X	?		
Dhurandhar	AEI					
Evans	CIT					
Finn	PSU	X	X			
Frey	UOregon					
Fritschel	MIT			?		
Giame	LSU					
Gonzalez	PSU					
Greenwood	LaTech					
Gustafson, D.	UMich					
Hughes, S.	CIT					
Johnson, W.	LSU					
Kells	Lab					
Klimenko	UFL					
Lazzarini	CIT					
Majid	CIT					
Maros	CIT					
Mavalvala	CIT					
McNeil	LSU					
Mohanty	PSU					
Mukherjee	PSU					
Ottewill	UWM					
Penn	Syr					
Petrovich, Denis	CIT					
Raab	LHO					
Rakhmanov	CIT					
Riles	Umich					
Rizzi	LLO					
Savage	LHO					
Schofield	UOregon					
Scott, S.	ANU					
Sigg	LHO	X	X	?		X
Sintes	AEI					
Strom	UOregon					
Svoboda, B.	LSU					
Whiting, B.	UFL					
Yamamoto	CIT					
Zucker	MIT					
Zweizig	CIT				X	X

EMPTY! Full!



Detector Characterization Tasks		Whitening	Analog/digital	ADC/DAQ	Diag Interp.	Violin, mirror,	Seismic
Task Classification		filter	Saturation	Quality Ctrl	& Enhanc.	line modes	Noise
(Priority)		Diag (LAB)	Diag (LAB)	Diag (LAB)	Diag	Perf Char	Perf Char
Effort: Basic (FTE Months)		1	1	1	3	1	1
Effort: Display/Enhanced		1	?	?	?	1	1
Effort: Display/Enhanced		1	?	?	?	1	1
Scientist	Institution						
Adhikari	MIT						
Allen, B.	UWM					X	X
Anderson, W.	UWM						
Barton	CIT						
Bhawal	CIT						
Brau	UOregon						
Cella	Pisa						
Chassande-Mottin	AEI					X	
Coldwell	UFL						
Coles	LLO						
Daw	MIT						
Dhurandhar	AEI					X	
Evans	CIT						
Finn	PSU					X	
Frey	UOregon						
Fritschel	MIT	?					
Giame	LSU						
Gonzalez	PSU						X
Greenwood	LaTech						X
Gustafson, D.	UMich					X	
Hughes, S.	CIT						
Johnson, W.	LSU					X	
Kells	Lab						
Klimenko	UFL						
Lazzarini	CIT						
Majid	CIT						
Marios	CIT						
Mavalvata	CIT						
McNeil	LSU						
Mohanty	PSU						
Mukherjee	PSU					X	
Ottewill	UWM					X	
Penn	Syr						X
Petrovich, Denis	CIT						
Raab	LHO						
Rakhmanov	CIT						
Riles	Umich						
Rizzi	LLO						
Savage	LHO						
Schofield	UOregon						
Scott, S.	ANU						
Sigg	LHO						
Sintes	AEI					X	
Strom	UOregon						
Svoboda, B.	LSU					X	
Whiting, B.	UFL						
Yamamoto	CIT						
Zucker	MIT						
Zweizig	CIT		X	X			





EMPTY!



Detector Characterization Tasks		Bandlimited	Time/freq	Inter-channel	Time-domain	2Km-4km WA
		RMS	plots	correlations	System ID	Correlation
Task Classification		Perf Char	Perf Char	Perf Char	Perf Char	Perf Char
(Priority)		2	2	1	3	3
Effort: Basic (FTE Months)		1	3	1	3	2
Effort: Display/Enhanced		1	2	1	1	1
Scientist	Institution					
Adhikari	MIT		X			
Allen, B.	UWM			X		
Anderson, W.	UWM					
Barton	CIT					
Bhawal	CIT					
Brau	UOregon					
Cella	Pisa					
Chassande-Mottin	AEI			X		
Coldwell	UFL					
Coles	LLO					
Daw	MIT					
Dhurandhar	AEI			X		
Evans	CIT					
Finn	PSU				X	
Frey	UOregon					
Fritschel	MIT					
Giame	LSU					
Gonzalez	PSU					
Greenwood	LaTech					
Gustafson, D.	UMich					
Hughes, S.	CIT					
Johnson, W.	LSU					
Kells	Lab					
Klimenko	UFL					
Lazzarini	CIT	X				
Majid	CIT					
Maros	CIT					
Marvalvaia	CIT					
McNeil	LSU					
Mohanty	PSU					
Mukherjee	PSU					
Ottewill	UWM			X		
Penn	Syr					
Petrovich, Denis	CIT	X				
Raab	LHO					
Rakhmanov	CIT					
Riles	Umich					
Rizzi	LLO					
Savage	LHO					
Schofield	UOregon					
Scott, S.	ANU					
Sigg	LHO					
Sintes	AEI			X		
Strom	UOregon					
Svoboda, B.	LSU					
Whiting, B.	UFL					
Yamamoto	CIT					
Zucker	MIT					
Zwetzig	CIT					

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EMPTY



Detector Characterization Tasks	Inter-site	Impulse	Ring-down	Servo	Out-of-band	Quakes
	Correlated noise	Stimulus		instabilities	resonances	
Task Classification	Perf Char	Tran Anal	Tran Anal	Tran Anal	Tran Anal	Tran Anal
(Priority)	3	2	2	1	2	3
Effort: Basic (FTE Months)	2	2	1	1	1	1
Effort: Display/Enhanced	1	1	1	1	1	1
Scientist	Institution					
Adhikari	MIT					
Allen, B.	UWM		X			
Anderson, W.	UWM					
Barton	CIT					
Bhawal	CIT					
Brau	UOregon					
Cella	Pisa					
Chassande-Mottin	AEI					
Coldwell	UFL		X			
Coles	LLO					
Daw	MIT					
Dhurandhar	AEI					
Evans	CIT					
Finn	PSU		X			
Frey	UOregon					
Fritschel	MIT					
Giame	LSU					
Gonzalez	PSU					
Greenwood	LaTech					
Gustafson, D.	UMich			X		
Hughes, S.	CIT					
Johnson, W.	LSU					
Kells	Lab					
Klimenko	UFL					
Lazzarini	CIT					
Majid	CIT					
Manos	CIT					
Mavavata	CIT					
McNeil	LSU					
Mohanty	PSU					
Mukherjee	PSU		X			
Ottewill	UWM		X			
Penn	Syr					
Petrovich, Denis	CIT					
Raab	LHO					
Rakhmanov	CIT					
Riles	Umich			X		
Rizzi	LLO					
Savage	LHO					
Schofield	UOregon					
Scott, S.	ANU					
Sigg	LHO					
Sintes	AEI					
Strom	UOregon					
Svoboda, B.	LSU					
Whiting, B.	UFL					
Yamamoto	CIT					
Zucker	MIT					
Zweizig	CIT					

EMPTY

EMPTY

Detector Characterization Tasks		Flickering	Wind Gusts,	Magnetic	Dust in beam	Event	Wavelets
		optical model	lightning, etc	Response		Catalog	
Task Classification		Tran Anal	Tran Anal	Tran Anal	Tran Anal	Tran Anal	Tran Anal
(Priority)		2	3	2	3	1	R
Effort: Basic (FTE Months)		2	1	2	1	2	3
Effort: Display/Enhanced		1	1	1	1	2	1
Scientist	Institution						
Adhikari	MIT						
Allen, B.	UWM						
Anderson, W.	UWM						
Barton	CIT						
Bhawal	CIT						
Brau	UOregon						
Cella	Pisa						
Chassande-Mottin	AEI						
Coldwell	UFL						
Coles	LLO						
Daw	MIT						
Dhurandhar	AEI						
Evans	CIT						
Finn	PSU						
Frey	UOregon						
Fritschel	MIT						
Giame	LSU						
Gonzalez	PSU						
Greenwood	LaTech						
Gustafson, D.	UMich						
Hughes, S.	CIT						
Johnson, W.	LSU						
Kells	Lab						
Klimenko	UFL						
Lazzarini	CIT						
Majid	CIT					X	
Maros	CIT						
Mavavala	CIT						
McNeil	LSU						
Mohanty	PSU						
Mukherjee	PSU						
Ottewill	UWM						
Penn	Syr						
Petrovich, Denis	CIT						
Raab	LHO						
Rakhmanov	CIT						
Riles	Umich						
Rizzi	LLO						
Savage	LHO						
Schofield	UOregon			X			
Scott, S.	ANU						
Sigg	LHO						
Sintes	AEI						
Strom	UOregon						
Svoboda, B.	LSU						
Whiting, B.	UFL						
Yamamoto .	CIT						
Zucker	MIT						
Zwezig	CIT						

EMPTY



Detector Characterization Tasks		Automated	Customized	Reduced	Reduction	Compression
		Transient ID	Data Distribution	Data Templates	Algorithms	Algorithms
Task Classification		Tran Anal	Data Reduct	Data Reduct	Data Reduct	Data Reduct
(Priority)		3	1	1	2	2
Effort: Basic (FTE Months)		4	?	?	?	?
Effort: Display/Enhanced		1	?	?	?	?
Scientist	Institution					
Adhikari	MIT					
Allen, B.	UWM					
Anderson, W.	UWM					
Barton	CIT					
Bhawal	CIT					
Brau	UOregon		X	X	X	X
Cella	Pisa					
Chassande-Mottin	AEI					
Coldwell	UFL					
Coles	LLO					
Daw	MIT					
Dhurandhar	AEI					
Evans	CIT					
Finn	PSU					
Frey	UOregon		?	?	?	?
Fritschel	MIT					
Giame	LSU					
Gonzalez	PSU					
Greenwood	LaTech					
Gustafson, D.	UMich					
Hughes, S.	CIT					
Johnson, W.	LSU					
Kells	Lab					
Klimenko	UFL					
Lazzarini	CIT					
Majed	CIT					
Mares	CIT					
Navatvata	CIT					
McNeil	LSU					
Mohanty	PSU					
Mukherjee	PSU					
Ottewill	UWM					
Penn	Syr					
Petrovich, Denis	CIT					
Raab	LHO					
Rakhmanov	CIT					
Riles	Umich					
Rizzi	LLO					
Savage	LHO					
Schofield	UOregon		X	X	X	X
Scott, S.	ANU					
Sigg	LHO					
Sintes	AEI					
Strom	UOregon		X	X	X	X
Svoboda, B.	LSU					
Whiting, B.	UFL					
Yamamoto	CIT					
Zucker	MIT					
Zweizig	CIT					

EMPTY



Detector Characterization Tasks		Data set noise	Data set signal	End-to-End (E2E)	E2E Time dom	E2E
		Simulation	Simulation	Infrastructure	Modal Model	SEI / SUS
Task Classification		Data Sim	Data Sim	Data Sim	Data Sim	Data Sim
(Priority)		2	2	1	1	2
Effort: Basic (FTE Months)		2	1	3	3	3
Effort: Display/Enhanced		2	3	6	6	6
Scientist	Institution					
Adhikari	MIT					
Allen, B.	UWM					
Anderson, W.	UWM					
Barton	CIT					X
Bhawal	CIT				X	
Brau	UOregon					
Cella	Pisa					X
Chassande-Mottin	AEI					
Coldwell	UFL					
Coles	LLO					
Daw	MIT	X				
Dhurandhar	AEI					
Evans	CIT			X	X	
Finn	PSU	X				
Frey	UOregon					
Fritschel	MIT					
Giame	LSU					
Gonzalez	PSU					
Greenwood	LaTech					
Gustafson, D.	UMich					
Hughes, S.	CIT					
Johnson, W.	LSU					
Kells	Lab					
Klimenko	UFL					
Lazzarini	CIT					
Majid	CIT					
Maros	CIT					
Mavalvala	CIT					
McNed	LSU					
Mohanty	PSU					X
Mukherjee	PSU					
Ottewill	UWM					
Penn	Syr					
Petrovich, Denis	CIT					
Raab	LHO					
Rakhmanov	CIT			X		X
Riles	Umich					
Rizzi	LLO					
Savage	LHO					
Schofield	UOregon					
Scott, S.	ANU					
Sigg	LHO					
Sintes	AEI					
Strom	UOregon					
Svoboda, B.	LSU					
Whiting, B.	UFL					
Yamamoto	CIT			X		X
Zucker	MIT					
Zweizig	CIT					

Detector Characterization Tasks		E2E Input	E2E Pre-Stab	E2E	E2E
		Optics	Laser	ISC	GUI
Task Classification		Data Sim	Data Sim		
(Priority)		1	1	1	1
Effort: Basic (FTE Months)		3	3	3	3
Effort: Display/Enhanced		6	6	6	12
Scientist	Institution				
Adhikari	MIT				
Allen, B.	UWM				
Anderson, W.	UWM				
Barton	CIT				
Bhawal	CIT		X		
Brau	UOregon				
Cella	Pisa				
Chassande-Mottin	AEI				
Coldwell	UFL				
Coles	LLO				
Daw	MIT				
Dhurandhar	AEI				
Evans	CIT			X	
Finn	PSU				
Frey	UOregon				
Fritschel	MIT				
Giame	LSU				
Gonzalez	PSU				
Greenwood	LaTech				
Gustafson, D.	UMich				
Hughes, S.	CIT				
Johnson, W.	LSU				
Kells	Lab				
Klimenko	UFL	X			
Lazzarini	CIT				
Majid	CIT				
Maros	CIT				X
Mavalvala	CIT				
McNeil	LSU				
Mohanty	PSU				
Mukherjee	PSU				
Ottewill	UWM				
Penn	Syr				
Petrovich, Denis	CIT				
Raab	LHO				
Rakhmanov	CIT	X			
Riles	Umich				
Rizzi	LLO				
Savage	LHO		X		
Schofield	UOregon				
Scott, S.	ANU				
Sigg	LHO				
Sintes	AEI				
Strom	UOregon				
Svoboda, B.	LSU				
Whiting, B.	UFL				
Yamamoto	CIT		X	X	
Zucker	MIT				
Zweizig	CIT				

# Offline Software Infrastructure

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## Algorithms:

- Core of numerical algorithm library being developed by W. Majid, B. Allen, S. Finn
- Library will be used in onsite / offsite offline analysis (to borrow liberally from diagnostics group and literature)
- Algorithm Specification and Style Guide near release
- Detector characterizers strongly encouraged to conform early to specification
- Mandatory conformance as algorithm library matures



# Offline Software Infrastructure

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## Data Monitor Tool (DMT):

- J. Zweizig developing DMT infrastructure for passive offline monitoring on dedicated Sun workstations:
  - Record periodic characterization info in meta-database
  - Generate triggers (& control room alarms)
  - Provide first level of data reduction (probably)
- Support to be provided for
  - Background monitoring
  - Foreground monitoring + graphics display (root-based)
- Software can be run on “any” unix system with Gnu egcs c++/c compiler installed  
(demonstrated on Sun, Linux, HP so far)
- Algorithms can be written in procedural c
- First version (no graphics support) released in April
- Root-supporting version to be released very soon  
(downloadable from Web)

# Detector Characterization W.G. Sessions Agenda

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## Monday Afternoon Session [5:00-6:00]

- 10' K. Riles / D. Sigg Introduction
- 15' J. Zweizig Data Monitor Tool (DMT) update
- ~~15' W. Majid Numerical algorithm library update~~
- 30' All Discussion on DMT ~~and algorithms~~

## Tuesday Afternoon Session [1:00-3:00]

- 10' K. Riles Performance characterization update
- 10' F. Raab Transient analysis subgroup update
- 10' D. Strom Data set reduction subgroup update
- 15' S. Finn Data set simulation subgroup update  
(5' on Thermal Noise of Violin Modes)
  
- 15' All Discussion
  
- 15' H. Yamamoto End-to-End Model update
  
- 20' ~~15'~~ R. Schofield Ambient and Diagnostic Magnetic Fields Measur  
Inside of a BSC Vacuum Chamber at Hanford
  
- 10' D. Sigg On-site seismic correlations  
E. Daw
  
- 15' All Discussion

# Detector Characterization W.G. Sessions Agenda

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## Wednesday Morning Session [9:00-11:00]

- |     |                          |  |
|-----|--------------------------|--|
| 15' | G. Gonzalez &<br>S. Finn | Statistical properties of the detectors' noise power spectrum                            |
| 15' | S. Mohanty               | A non-parametric method for detecting non-stationarity                                   |
| 10' | S. Mukherjee             | Simultaneous dynamical tracking and removal of multiple violin modes                     |
| 15' | B. Whiting               | Progress in Noise Characterization   |
| 15' | All                      | Discussion of favored data tape technology (see Stuart Anderson web page for background) |
| 30' | All                      | Discussion of working group contribution to LSC White Paper on Analysis                  |
| 10' | <b>S. KLIMENKO</b>       | <b>INPUT OPTICS SIMULATION STATUS</b>  |
| 10' | <b>N. SIMICEVIC</b>      | <b>SEISMIC MEASUREMENT PROGRAM AT LLO</b>  |

*Note 1, Linda Turner, 08/17/99 07:37:19 PM*  
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