



Spectral Line Working Group Report

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Spectral Line Working Group

- Now a “working group” under the Detector Characterization Committee
- Required to contribute to annual white paper, make regular reports.
- This provides a good opportunity to define our mission, set goals, decide priorities
- We (may) need better communication, organization within our group
 - » For instance, who are the members of the working group?



Spectral Line Analysis Tools

- Control Room Investigations
 - » Fourier, Spectral Coherence Tools (Schofield)
 - » DMT Monitors - LineMon, NEW SixtyHertzMon (Riles)
- Offline Studies
 - » Daily Spectral Line-Finding Summary (KT)
 - Can also do special runs on any other channels
 - » SFT-based Spectrograms (Dupuis)
- Results from Search Groups
 - » Narrow Lines seen in Pulsar Group analyses (Mendel, Dergachev)
 - » Broader Coherences seen in Stochastic Group analyses
 - PEM - DARM_ERR coherences (Mandic, Fotopoulos)



Daily Line-Finding Pipeline in S5

- Makes daily summaries of DARM_ERR spectral lines

S5 Daily LineFinding

https://gravity.psu.edu/~psurg/detchar/LineFinding/Daily_S5/S5_Linefind_Summary.html

[Latest Report](#)
S5 Lists (July 24, 2006)
[H1 Lines](#) [H2 Lines](#) [L1 Lines](#)

November 2005

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

December 2005

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

January 2006

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

S5 LineFinding 2006-08-14

Day starts 16:00 UTC covers GPS 839606414 - 839692814

Channel	# Total Lines	# NEW Lines
H1:LSC-DARM_ERR	81	9
H2:LSC-DARM_ERR	100	8
L1:LSC-DARM_ERR	91	9

REFERENCE LINES UPDATE

S5 reference line lists updated 07-24-2006

H1 Spectral Lines - RECENT CHANGES

- New unknown line at 67.5 Hz
- New unknown line at 80.2 Hz
- Unknown 87.5 Hz line reduced/disappeared!
- 540Hz Power-line harmonic re-appears

Existing H1 Features for Study

- Sidebands visible (again) on 120, 180, 240, 300Hz power-line harmonics
- 329 Hz line clusters [ilog entry](#)
- 546, 566 Hz line clusters [Coherence Study \(Schofield\)](#)
- 646 Hz line cluster [Coherence Study \(Schofield\)](#)

LIGO-G060392-00-Z

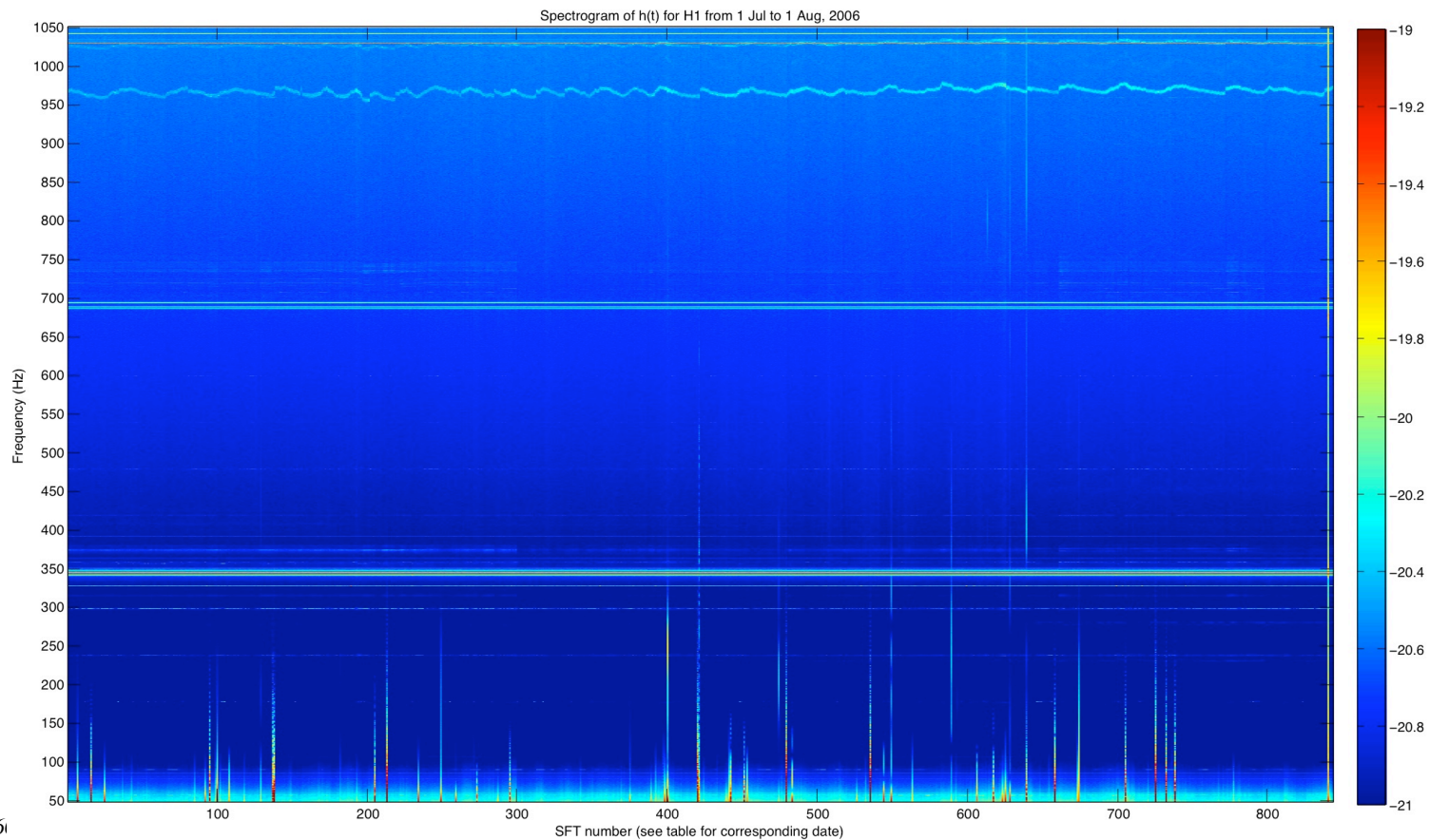
August 16, 2006

August 2006 LSC Meeting - DetChar



S5 Coherence Spectrograms

- Rejean Dupuis compiles spectrograms from SFTs



LIGO-G06i

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Spectral Line Successes in S5

- H1 - Extended 60 Hz comb
 - » Traced to poor RF distribution cabling - Fixed Feb 9, 2006
- L1 - 12 Hz comb
 - » Identified as “bounce-mode”
 - » Solved with new Beam-Splitter de-whitening board - Jan 2, 2006
- L1 - 38-48 Hz Combs - Identified
 - » S. Waldman found strong coherence with optical levers
- *But progress has slowed down in recent months*

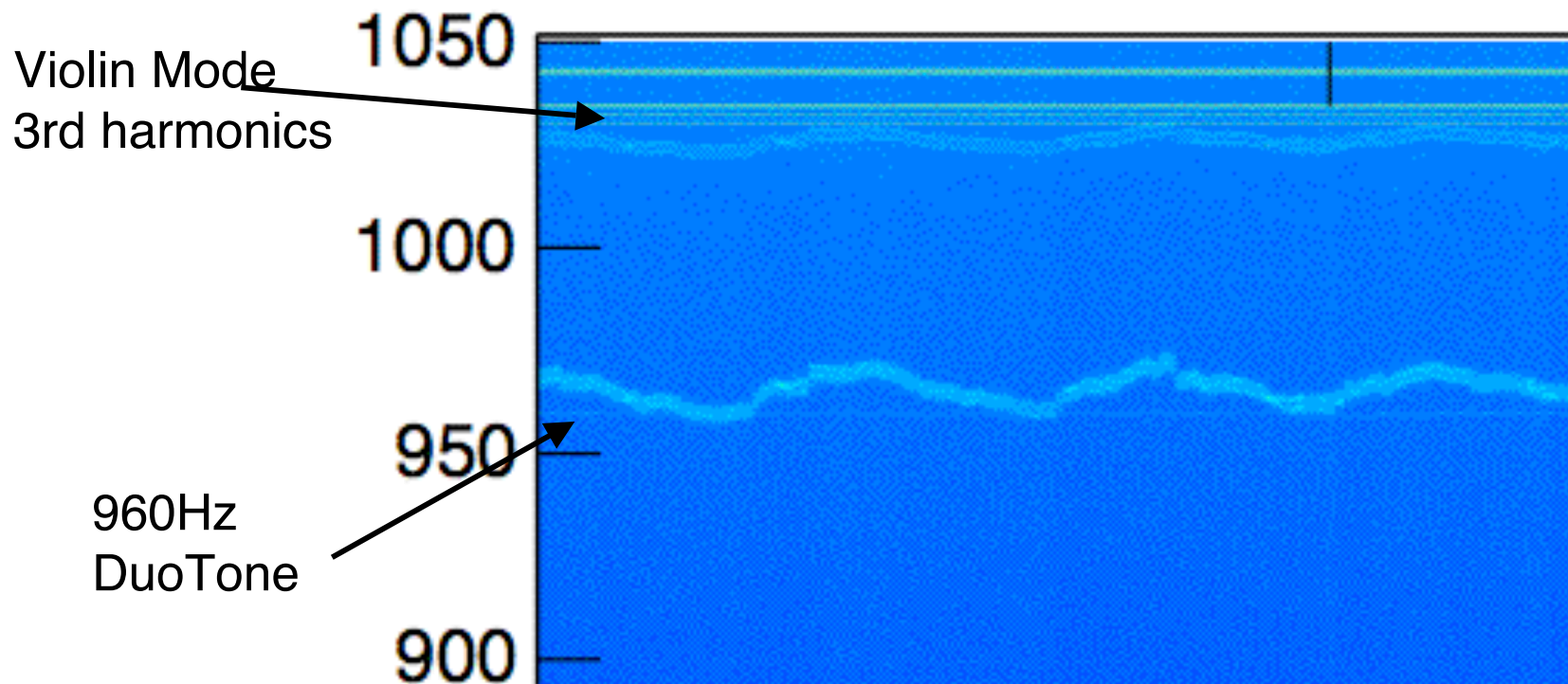


The 60 Hz mystery

- The 60 Hz harmonics structure in DARM_ERR does not match that in PEM channels
 - » Causes attempts to regress lines to fail
- Schofield has investigated magnetic field coherences with PEM injections
 - » Different coherences at ETMY,ETMX,ITMY,ITMX
- Weiss, Waldman have found LLO harmonics come from magnetic coupling that is not being sensed
 - » From overhead transmission lines

Wandering 960 Hz Line in H1

- Seen in July 06 Spectrograms (also in Line-Finder)
- Co-moving line about 60Hz higher



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“Eternal” Spectral Line Mysteries

- 329 Hz Lines (all IFOs)
 - » Strong enough that 2nd, 3rd harmonics seen
 - » Speculation that they are Beam Splitter (BS) Violin Modes
- 335 Hz Lines (H1, etc.)
 - » Rung up very strongly when beam power raised prior to science mode
 - » Speculation that they are Recycling Mirror (RM) violin modes
- 646-648 Hz Lines (all IFOs)
 - » 2nd, 3rd Harmonics often seen
 - » Coherences in other interferometer channels
- 546,566 Hz Lines (H1 only)
 - » Again, 2nd, 3rd harmonics often seen
 - » Coherent with some WFS channels
- 2.60, 2.64 Hz combs (H2 only)
 - » Extend from 40-100 Hz
 - » Seen in ETMX, ETMY shadow sensors

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Possible Priorities

- Mission, charge, plans for annual white paper
 - » Will need input from other groups
- Pulsar Group needs solid association of spectral artifacts with instrumental causes to remove them
 - » Most PEM coherence studies are too low resolution for this
 - » Needs working group follow-up + commissioning time
 - > S5 Line Report for next LSC meeting ?
- Stochastic Group - help identify PEM coherences
 - » Schofield's PEM injection studies useful
- Offline monitors
 - » Automate spectrogram, channel coherence studies ?



Possible New Efforts

- Identifying causes of long-persistent lines
 - » Would require substantial commissioning time
 - » If they aren't a control or analysis issue, should we bother?
- Assisting with GEO detector characterization
 - » Run line-finder on GEO $h(t)$ channel?
- Central repository for Spectral Line info
 - » A Spectral Line Wiki?
- Understanding multitude of lines below 100 Hz
 - » Do these indicate couplings we are unaware of that contribute to the noise floor?
- Other suggestions from the floor...