Stochastic HW Injections in S4

Sukanta Bose

Washington State University, Pullman

For the **Stochastic Working Group** / *Inject. Team / Calib. Team*
**LSC Meeting, LIGO Livingston
DetChar/ASIS Wednesday Morning Session
LIGO-G050162-00-Z**
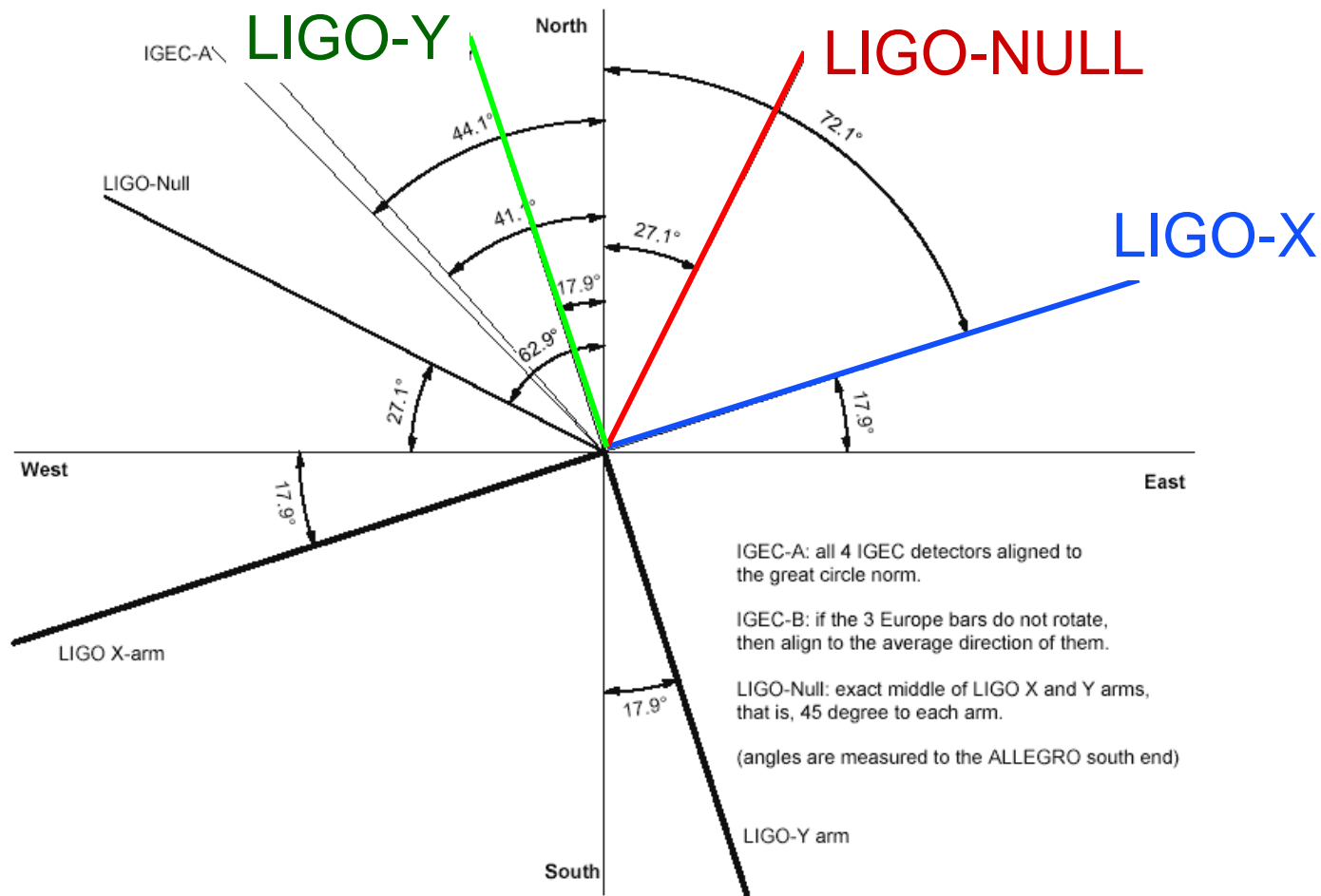
The S4 HW injection Plan

Injection / waveform type

Allegro-LLO

- **A1 Y-orientation**
    1. **Y-waveform**
    2. **X-waveform**
    3. **Null-waveform**

- **A1 X-orientation**
    - **…**
- **A1 Null-orientation**
    - **…**

IFO-IFO

- **Codes**
    1. **Matlab**
    2. **LAL-short**
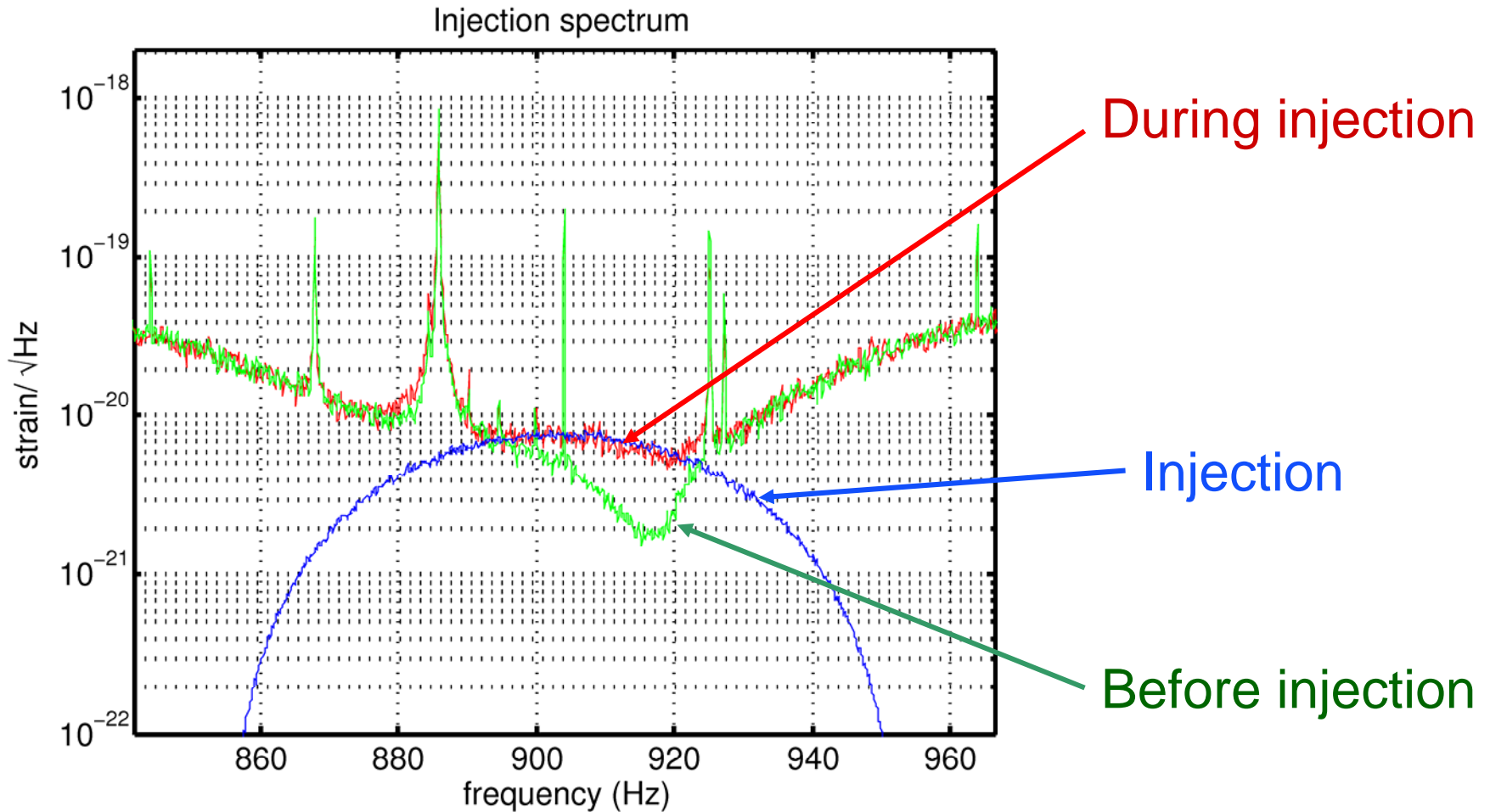   3. **LAL-long**

- **Strengths**
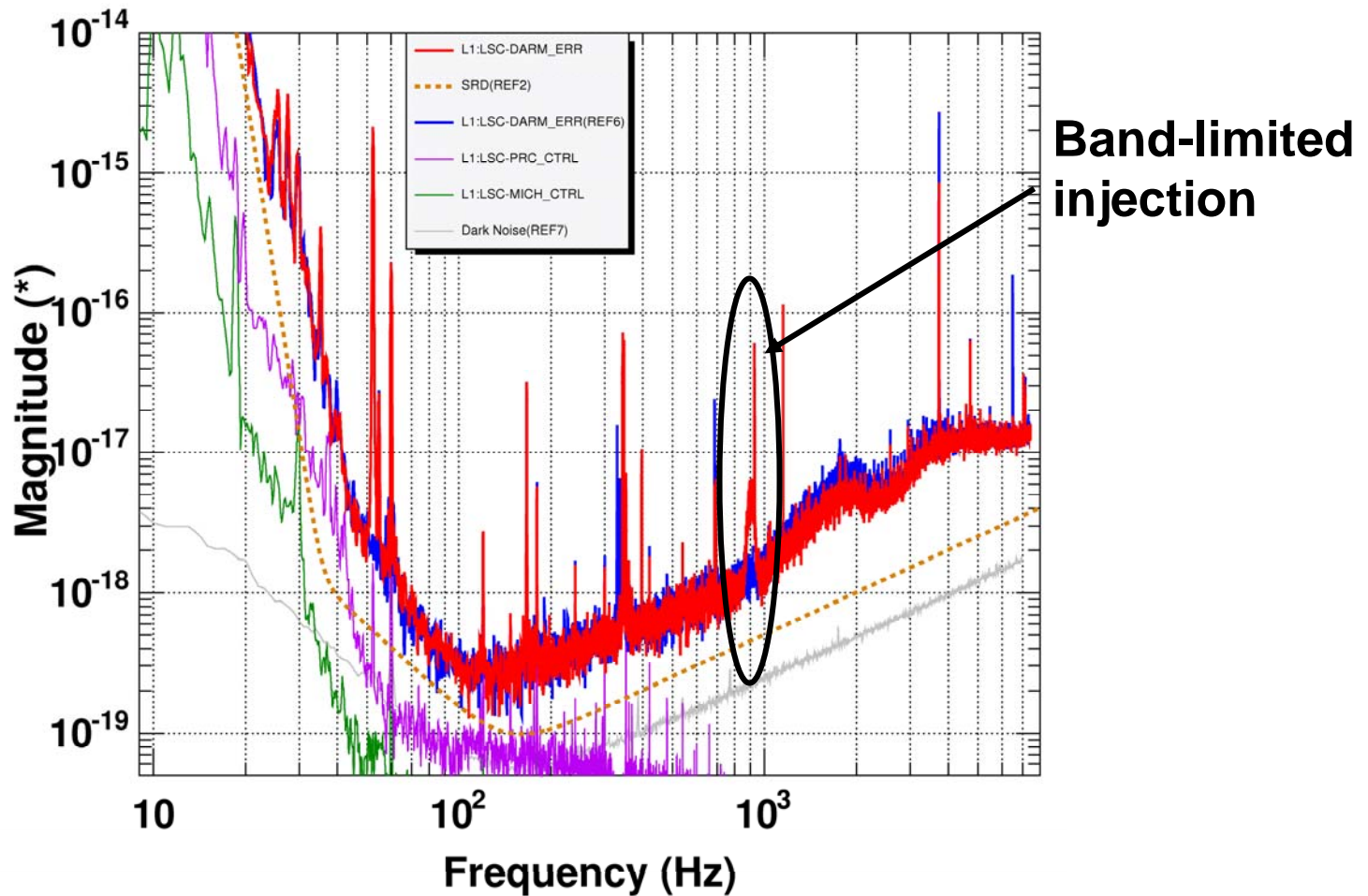
- **Injection duration**

Allegro Orientations in S4

LIGO-Y

LIGO-NULL

LIGO-X

IGEC-A

North

LIGO-Null

44.1°

41.°

27.1°

17.9°

62.9°

27.1°

17.9°

West

East

17.9°

LIGO X-arm

IGEC-A: all 4 IGEC detectors aligned to the great circle norm.

IGEC-B: if the 3 Europe bars do not rotate, then align to the average direction of them.

LIGO-Null: exact middle of LIGO X and Y arms, that is, 45 degree to each arm.

(angles are measured to the ALLEGRO south end)

17.9°

LIGO-Y arm

South

S4 Hardware injections *in A1-L1*: Planned / Done

Allegro Orientation	Waveform-type	Omega0 injected	Comments
L1-Y	Wave-Y	1302	Done (1024s)
,,	Wave-X	1302	Done (1024s)
,,	Wave-Null	1302	Done (1024s)
L1-X	Wave-Y	2500/x	Done (1024s)
,,	Wave-X	2500/x	Done (1024s)
,,	Wave-Null	2500/x	Done (1024s)
L1-Null	Wave-Y,-X,-Null	2500/x	Planned (1024s)

A1-L1 Hardware injections

Injection spectrum

During injection

Injection

Before injection

strain/√Hz

frequency (Hz)

A1-L1 Hardware injections

A1-L1 Hardware injections

Coherence between injected signal and calibrated output

Injection

Expected avg. For incoherent

25ms time-shift
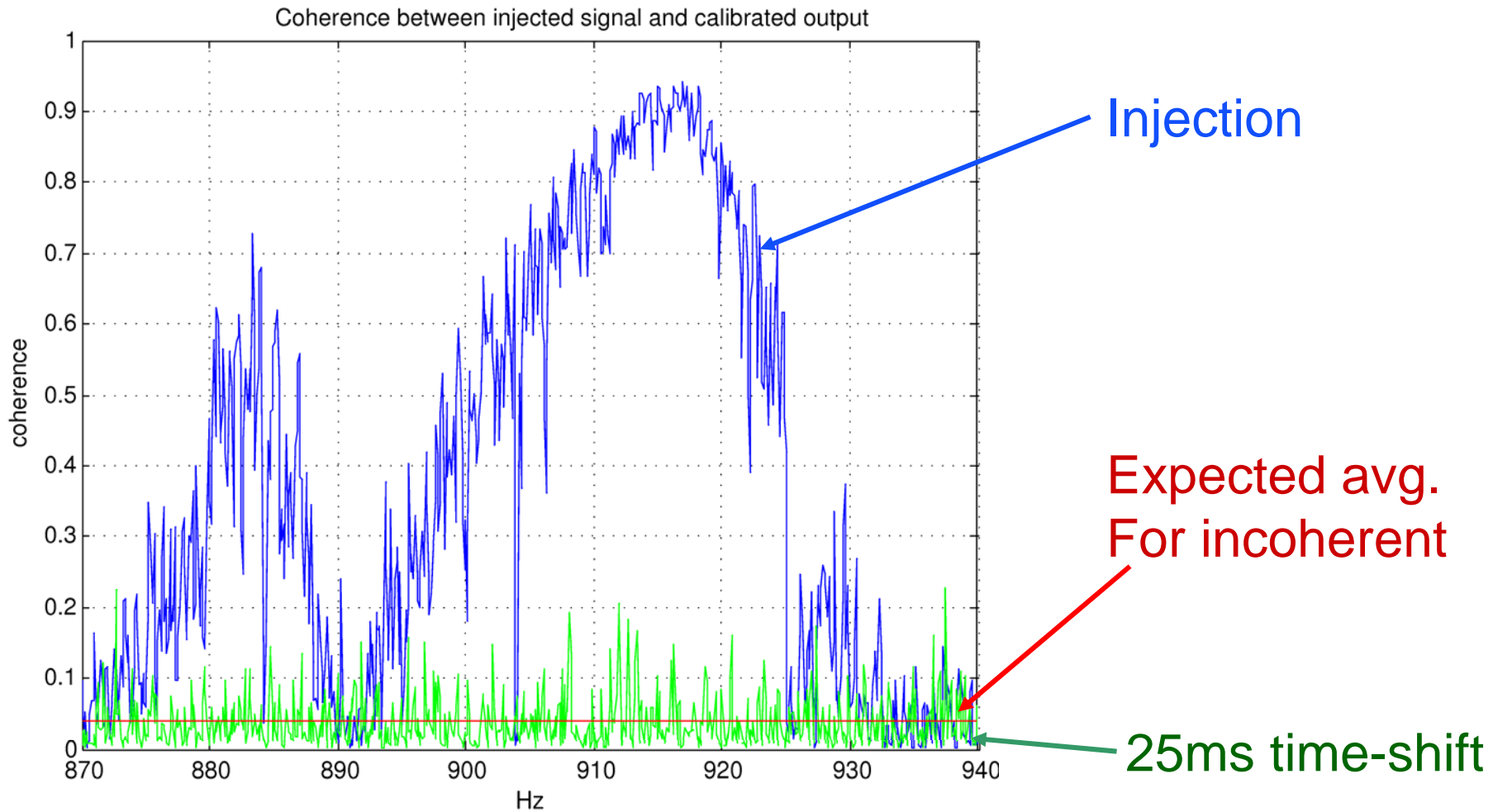
S4 Hardware injections *in A1-L1*: Results

| Allegro Orientation	Waveform-type	Omega0 injected	Pt.Est., Error
L1-Y	Y (Hann)	1302	1098, 25
,,	X (Hann)	1302	1122, 24
,,	Null (Hann)	1302	1864, 773
L1-X	Y (Tukey)	2500/x	Being studied
,,	X (Tukey)	2500/x	,,
,,	Null (Tukey)	2500/x	,,
L1-Null	Tukey-Y,-X,-Null	2500/x	Planned (1024s)

S4 Hardware injections *in A1-L1*: Null waveform CC-statistic
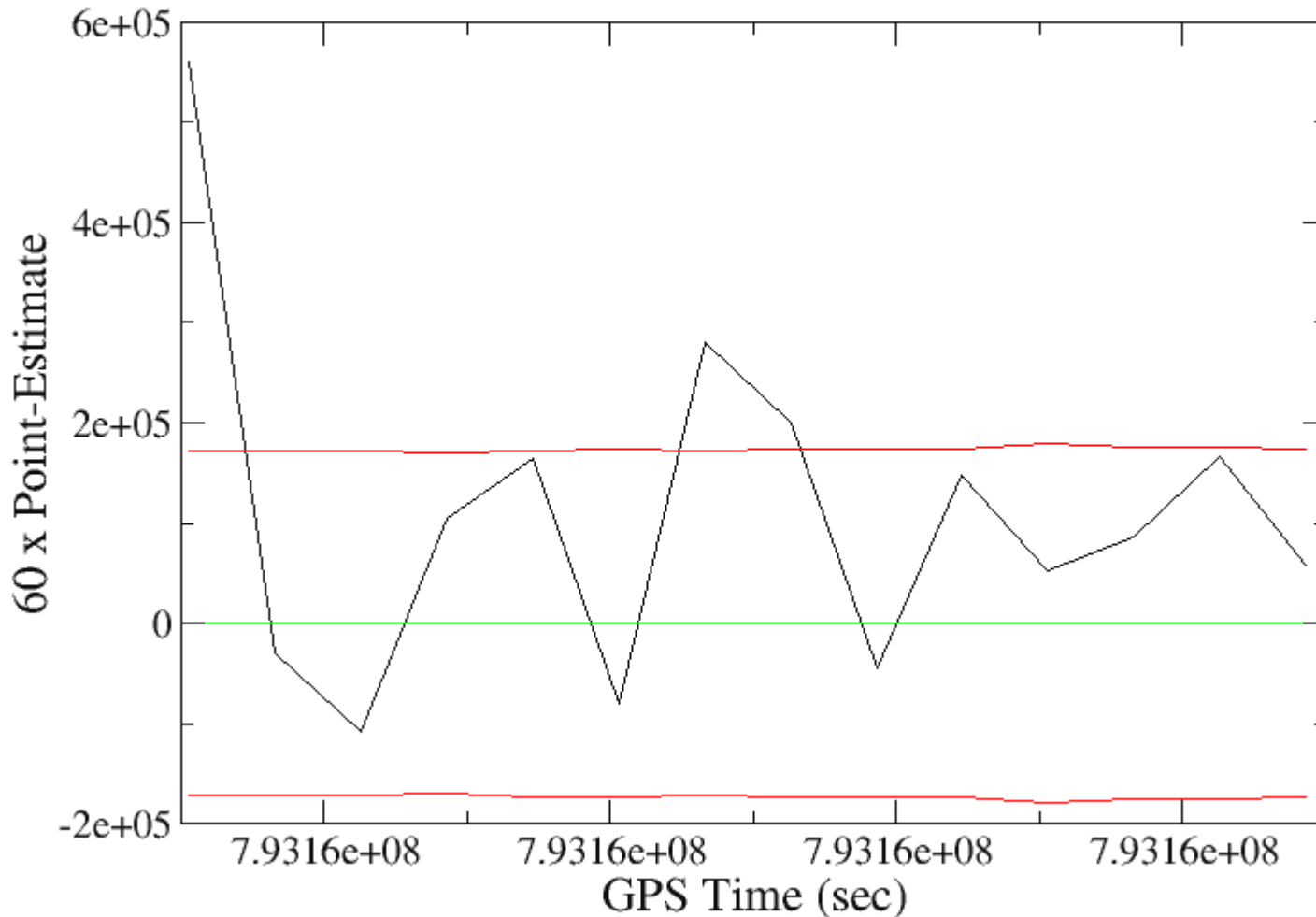
Omega0 = 1302
Pt.Est.   = 1864
Err. Bar =   773

S4 Hardware injections *in A1-L1*: Waveform-X CCstatistic
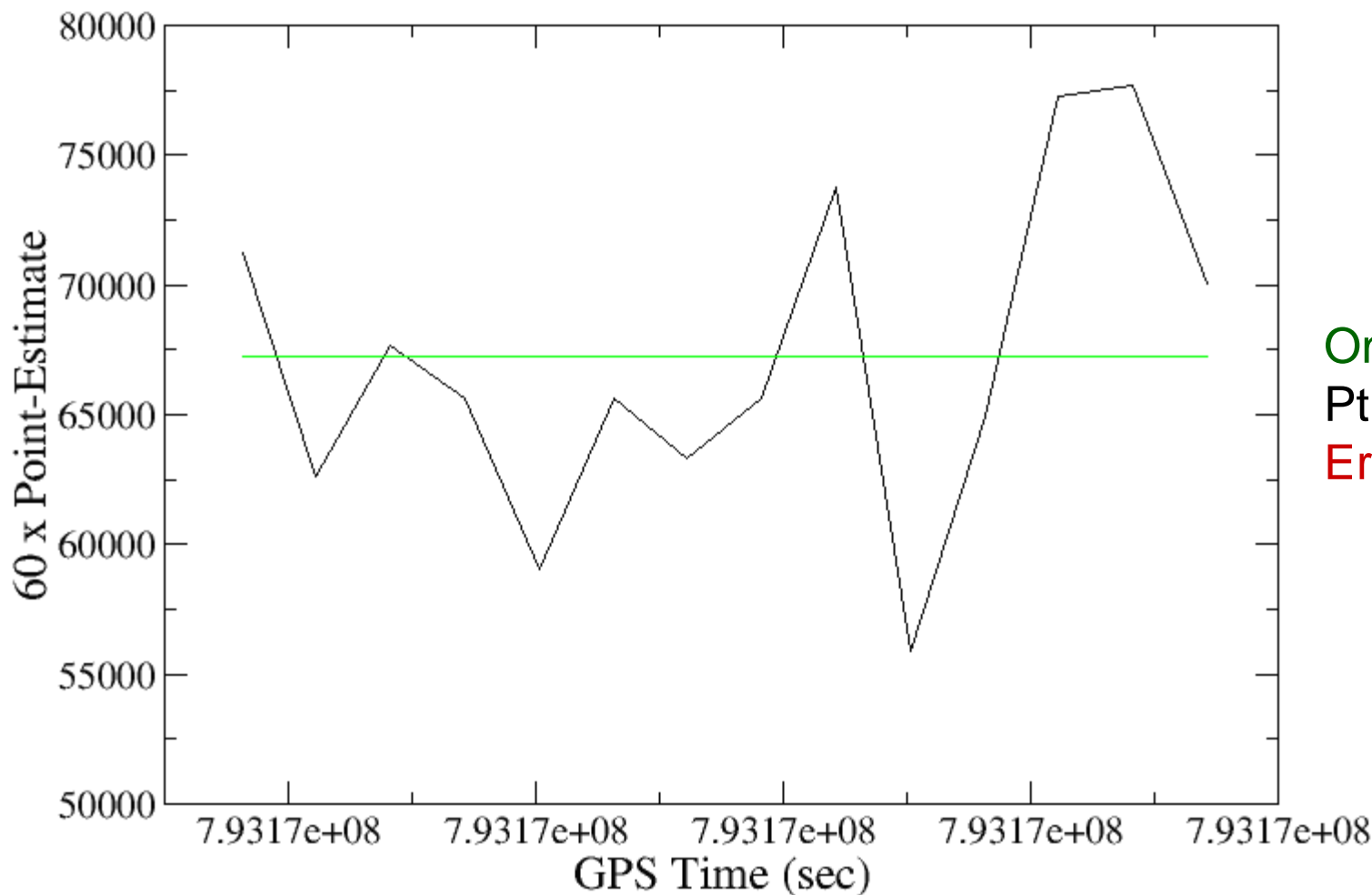
Omega0 = 1302
Pt.Est. = 1122
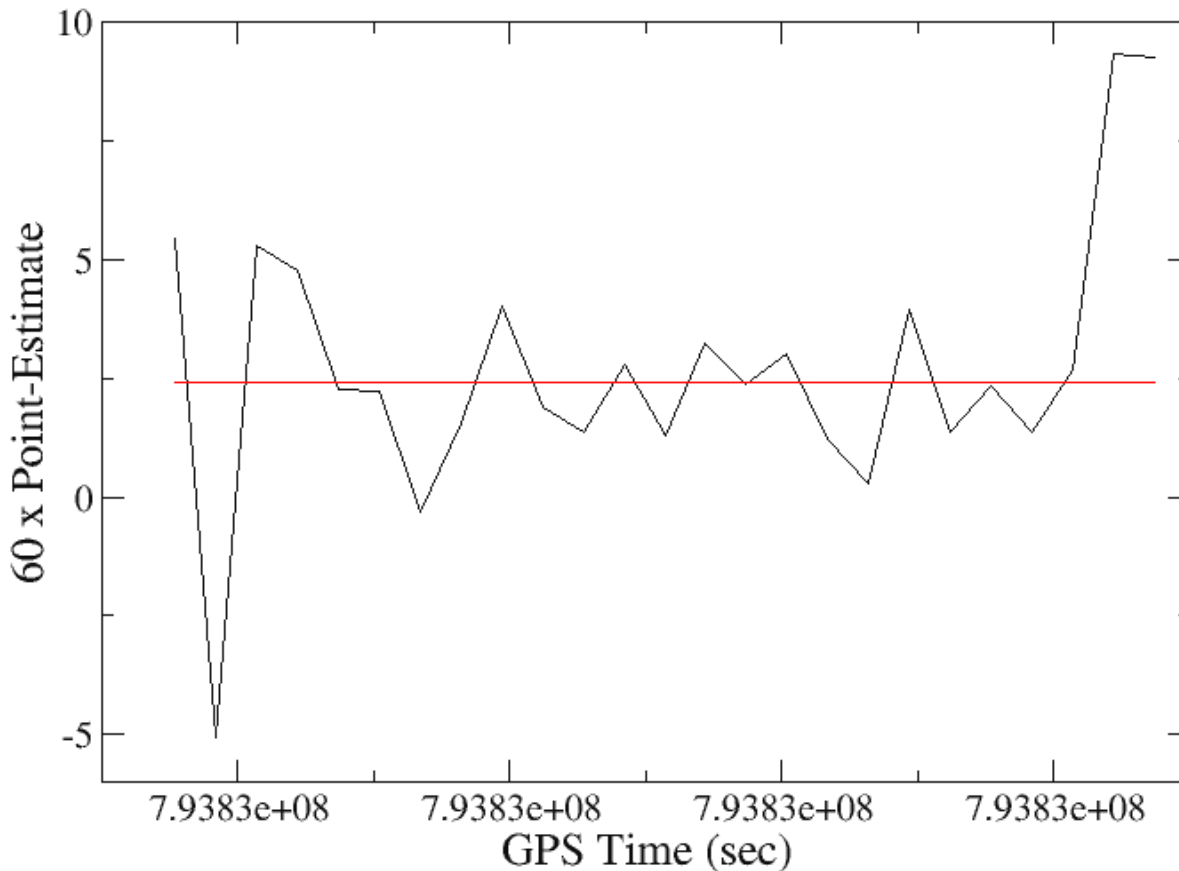Err. Bar = 24

S4 Hardware injections *in IFOs*: Planned / Done

Injection Type	Simulation-code	Omega0Ref	Comments
Short, 3 ifos	Matlab-preComp	0.04	Done (1024s)
,,	,,	0.01	,,
,,	LAL-preComp	0.04	Planned (1024s)
Long, 3 ifos	LAL-on-the-fly	0.04	Done (1hr15min)
Long, H1-L1	LAL-on-the-fly	0.005	Planned (4hr)
3xShort, one-ifo	LAL-on-the-fly	0.04	Planned (1200s)

S4 Hardware injections *in IFOs*: Results

Injection Type	Simulation-code	Omega0Ref	Result |Pt.Est.|, Error
Short, 3 ifos	Matlab-preComp	0.04	0.036, 0.0047
,,	,,	0.01	Being studied
,,	LAL-preComp	0.04	
Long, 3 ifos	LAL-on-the-fly	0.04	Being studied
Long, H1-L1	LAL-on-the-fly	0.005	
Short, Single ifo	LAL-on-the-fly	0.04	

S4 Hardware injections *in IFOs*: CC-statistic values

H2-L1 Pre-computed Matlab Waveform

Omega0 = 4.0e-02
Pt.Est.   = 3.6e-02
Err. Bar = 4.7e-03

Acknowledgments

- Bruce Allen
- Warren Anderson
- Peter Fritschel
- Gaby Gonzalez
- Warren Johnson
- Mike Landry
- Albert Lazzarini
- Vuk Mandic
- Martin McHugh
- Jeff Noel
- Brian O'Reilly
- Kaice Reilly
- Joe Romano
- Peter Shawhan
- Xavier Siemens
- John Whelan
- …and many others