

Proposal to NSF from Loyola University New Orleans

RUI: Search for a stochastic background
of gravitational radiation with LIGO and
the ALLEGRO resonant detector

Martin McHugh



- 5500 students
- primarily liberal arts undergraduate institution
- University includes
 - College of Arts and Sciences
 - College of Business
 - College of Music
 - Law School

Department of Physics

- Enrollment of about 30 undergraduates in physics and pre-engineering (3-2 program with Tulane University)
- Strong motivation for student involvement in research

Physics Faculty

- Creston (Mickey) King (chair)
- Carl Brans
- Martin McHugh
- Daryl Steinhart (visiting faculty)

currently conducting a faculty search, will begin another search next Fall

My Background

- PhD in precision measurements with Jim Faller at JILA
- Postdoc with the LSU bar group
- Joined Loyola faculty in 2000
- Joined LSC in 2001
- Participation in LSC stochastic background upper limits working group

Stochastic background of gravitational radiation

- Extremely interesting potential source
- Observational limits are very weak
- Unique opportunity with the proximity of LLO-ALLEGRO
- Detection through cross correlation with optimal filter

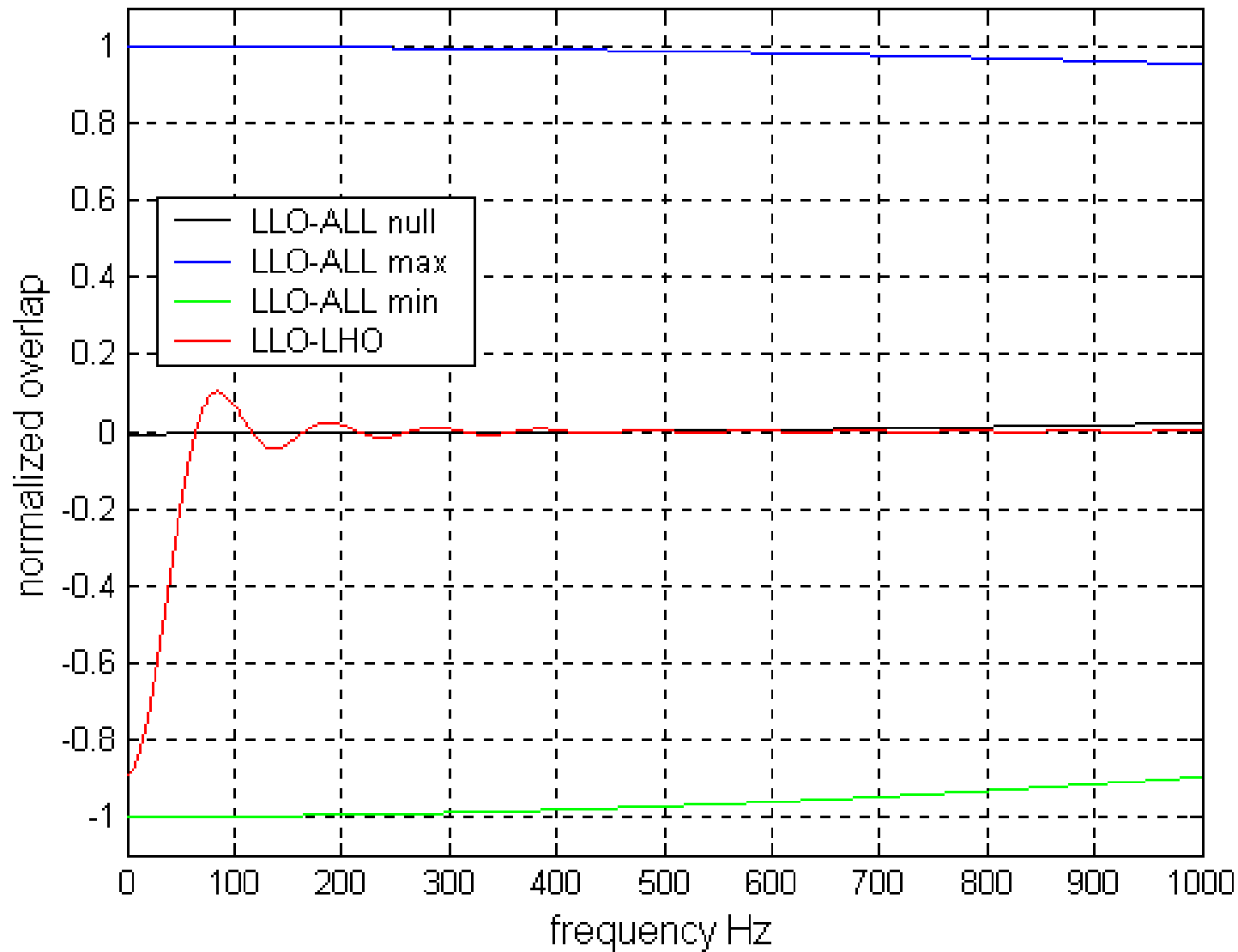
$$\lambda \frac{\gamma(f)\Omega(f)}{f^3 P_1(f)P_2(f)}$$

LLO - ALLEGRO correlation

- Good overlap (40 km separation) – sensitive to different frequency range than LLO-LHO
- Modulate the signal – rotate to align/misalign antenna patterns *
- Independent technology – less likely to have ‘built-in’ correlations

*Modulating the experimental signature of a stochastic gravitational wave background, **Lee Samuel Finn and Albert Lazzarini** Phys. Rev. D **64**, 082002 (2001) xxx.lanl.gov/abs/gr-qc/0104040

Overlap functions for LLO-LHO and LLO-ALLEGRO for various orientations



Research activities

- Collaboration with (mainly) UTB and LSU groups on LLO-ALLEGRO stochastic background experiment
- Bar-ifo stochastic code tested in Mock Data Challenge and subsequent quasi-MDC at UTB

CVS archive <http://fermat.utb.edu/cgi-bin/cvsweb.cgi/qmdc-200111/>

- Rotation of ALLEGRO implemented
- Plan for extra data channels, frame data etc.

Future Activities

- Participate in upcoming E7 engineering run (will be a very rough first try) and subsequent analysis (won't be near real time)
- Participate in science and engineering runs as sensitivity improves
- Goal of upper limit $\Omega_{\text{gw}} < 0.1$ near 900Hz

Lots to do!

- Testing and implementation of cross correlation code for GW channel and PEM channels (heterodyning etc.)
- Understand data -- characterize PEM and GW correlations
- Purchase and install Streckheisen STS-2 seismometer
- Implement signal injection

➤ **Many good undergraduate research projects**

Experiment should be done, need liason and manpower to make it happen

Extremely valuable to be within driving distance of both sites