
University of Minnesota Twin Cities Application to Join the LSC

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Proposal Summary

- I will join the Physics Department at UMN Twin Cities in the Fall 2007, after 3 years at LIGO-CIT.
- I propose to form a new LSC group:
 - » ~1 postdoc
 - » ~2 graduate students (and ~2 undergraduates)
- Research program:
 - » Stochastic searches
 - » Detector diagnostics and characterization
 - » Beyond AdvLIGO technology: gravity gradient noise
 - Underground interferometry
- Continue present roles:
 - » Co-chair of the Stochastic Working Group
 - » Member of the Data Analysis Council
 - » Co-chair of the Hardware Injections Subgroup
 - » Member of the Calibration Review Committee

UMN Twin Cities

- Leading campus of the UMN system.

Students	Undergraduate	Graduate
Total	28,957	13,564
Institute of Technology	4063	2292

- Academics:
 - » 3356 Faculty
 - » 370 Fields of Study
 - » Degrees (2005):
 - Bachelor: 6088; Masters: 2798; PhD: 678
 - » Research Support: > \$561,000,000
 - » Library housed in 14 buildings
 - 6.2 million print volumes
 - nearly 37,000 serial subscriptions

LIGO-G070508-00-D



UMN School of Physics and Astronomy



- Faculty and Students
 - » Faculty: 36 (Physics) + 9 (Astronomy)
 - » Undergraduate: 90 (Physics) + 30 (Astronomy)
 - » Graduate: 134 (Physics) + 23 (Astronomy)
- Research
 - » Experimental Astrophysics/Cosmology:
 - CMB, Dark Matter, Formation and Evolution of structure (stars, planetary systems, galaxy clusters etc)
 - » Cosmology theory:
 - Inflation, BBN, particle Dark Matter, neutrino astrophysics
 - » Strong HEP experiment and theory groups (CMS, MINOS...)
 - » Condensed matter, nuclear physics, biophysics
- Operating Soudan Underground Laboratory (Soudan, MN).
- Good machine shop, LHe recovery plant etc.

Stochastic Searches

- Continue the role of the Group Co-chair.
- Continue involvement in different analyses:
 - » Isotropic search using H1-H2 pair
 - Interesting collaboration with Nelson Christensen at Carleton College, whose group calculates IFO-PEM coherences.
 - » Directional searches
 - Group currently developing spherical harmonic decomposition technique.
 - Study performance of different algorithms (isotropic, radiometer, spherical harmonics) for different sources (astrophysical, cosmological).
 - » Implications of the search results for various models
 - Include astrophysical models (collaboration with Tania Regimbau) and cosmological models (previous collaborations with Xavi Siemens and Alessandra Buonanno)
- The stochastic pipeline upgrade will produce time-frequency map of the LHO-LLO cross-correlation.
 - » Parse this data to look for transients on the time-scale of minutes/hours.
- Possibly develop a computer cluster to be shared with the HEP group.
 - » Possible support from the UMN Supercomputing Institute.

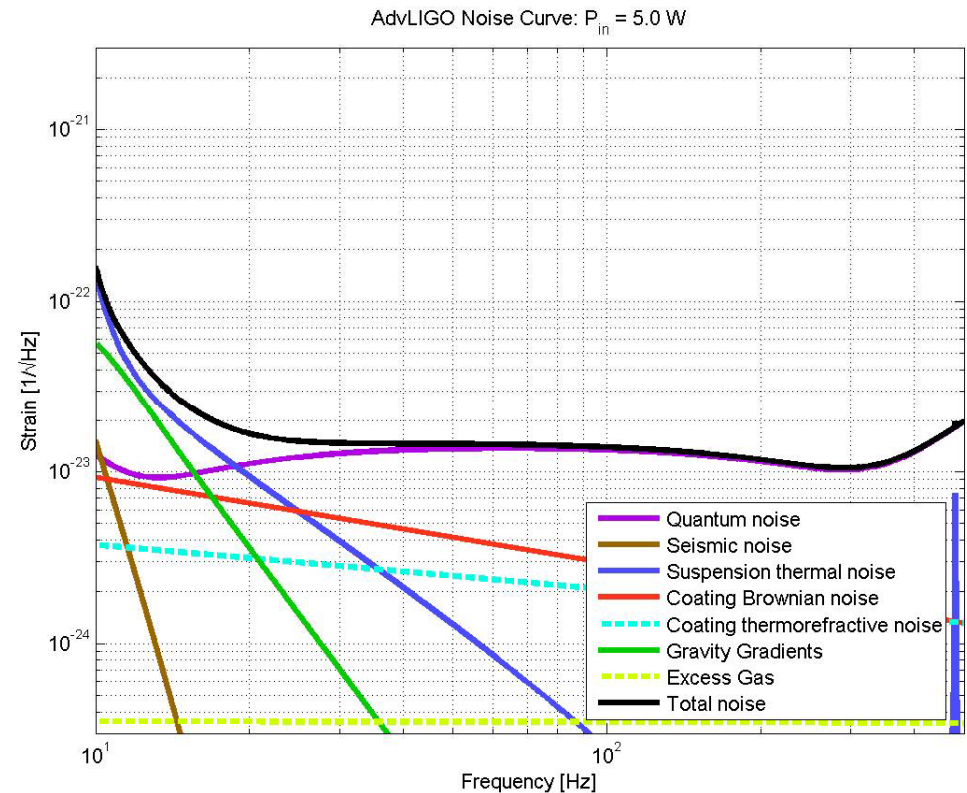
Diagnostics and Characterization

- Development of diagnostic tools that would help commissioning efforts.
 - » Build on existing tools, such as DTT.
 - » Matlab based:
 - Good graphics capabilities.
 - A number of useful toolboxes (optimization, simulink etc).
 - Relatively easy to code: Allow others to develop their tools.
 - » Study coupling mechanisms of different noise sources:
 - e.g. multiple coupling mechanisms, linear vs bilinear, upconversion
 - Complementary to the NoiseBudget
 - » Good way for UMN students to get involved in the activities at the sites.
- Hardware Injections
 - » Continue as a co-chair of the Hardware Injections Subgroup
 - » Expand the selection of waveforms for future runs
 - » Introduce a more automated “blind” injection mechanism
- Long-term coherence calculations
 - » LHO-LLO and H1-H2

Gravity Gradient Noise

- Gravity gradient noise may become important for AdvLIGO (and beyond).
 - » At low frequencies and with low laser power.
- Try to develop a technique to suppress it.
- One possibility: install an array of accelerometers throughout the site and feed back to the mirrors.
 - » Or, possibly do an offline subtraction.
- Will require simulations at first.
 - » G. Cella already performed some such studies, indicating 10-100x suppression is possible.
- Depending on simulation results, possibly develop some techniques in the lab on UMN campus.
- Collaborate with Giancarlo Cella, Szabi Marka, and others.

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Long Term: Underground Interferometry

- Underground interferometer may be sensitive to GW at 1Hz or below.
 - » Seismic (and gravity gradient) noise is suppressed.
- Will require new solutions for thermal noise etc.
- UMN operates the Soudan Underground Lab, where some of the initial tests could be made.
- Also, relatively close to the Homestake mine, SD, which was recently chosen as the DUSEL site (Deep Underground Science and Engineering Laboratory).



Conclusions

- I enjoyed being a part of the LSC over the past three years.
- I look forward to future collaborations with LIGO and LSC members as I move onto a faculty position at UMN Twin Cities.
- I hope to build a well-rounded group at UMN, with significant involvement in activities at the LIGO sites, in data analysis efforts, and in R&D efforts for beyond AdvLIGO.
- UMN Twin Cities and its Physics Department provide a very vibrant and scientifically stimulating environment!
- Twin Cities: great location for a collaboration meeting!