Education within LIGO

Nergis Mavalvala

NSF review
Hanford, WA
October 23, 2006

LIGO-G060530-00-U

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Some higher education stats

- 106 graduate students accounted for in LSC MOUs
- 46 “registered” Ph.D. student projects underway
- ~10 Ph.D.s completed last AY
- Several Masters students
- Undergraduates
  - 35+ participate in LIGO REU summer program
    - 20 to 25 at Caltech
    - 5+ at each Observatory
  - 10 at MIT
  - Numerous others across LSC groups
- 61 Post-docs
- With all this educational activity we need…

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The LIGO Academic Advisory Council (LAAC)

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LAAC Charge

- The LIGO Academic Advisory Council is charged with advising the LIGO Executive Director and Directorate on issues related to education of all students and post-docs who are participating in LIGO and to provide oversight of the quality of the education they receive through their participation in LIGO

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Who are the LAAC-eys?

- Committee
  - Kip Thorne, Caltech (Chair)
  - Nergis Mavalvala, MIT
  - Nelson Christenson, Carleton College
- Ex-officio members
  - Jay Marx, Caltech
  - Albert Lazzarini, Caltech
  - Peter Saulson, Syracuse
- Student/post-doc liaisons
  - Evan Goetz, U. Michigan
  - Sam Waldman, Caltech

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What should the LAAC do?

- Serve as an advocate to the LIGO Directorate for the educational aspects across all of LIGO for
  - Undergraduates
  - Graduate students
  - Post-docs
- Provide mechanisms for gathering and evaluating LIGO educational program
- Recommend improvements to the LIGO Directorate
- Meet at least quarterly with the LIGO Directorate to
- Work with LIGO collaborating institutions to ensure that all students and post-docs associated with LIGO get
  - Broad education in LIGO-related science
  - Quality mentoring

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What did the LAAC do?

- First annual “town meeting” at the August LSC meeting
  - Jay provided refreshments
  - Over 40 post-docs and graduate students attended
  - Some issues that were aired
    - Would like more opportunity to spend extended time at the Observatories
    - Would like more visibility outside LSC
    - Would like greater access to non-LSC conferences
    - Job anxiety
    - Not enough access to tutorial-level pedagogy re. GW detection
    - Strong desire to have this student/post-doc social/discussion group at every LSC meeting

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LAAC action so far

- Web site (http://www.ligo.caltech.edu/laac)
- Educational resources
  - Thorne's famous Ph207 lectures
  - Weinstein's REU lecture series for undergraduates
  - Buonanno's SLAC summer school lecture series
  - Links to CaJGWR seminar materials
  - Links to LIGO document center
  - Links to workshops and summer schools
    (e.g. Penn State and UT, Brownsville)
  - Listing of text books and review articles useful for learning GW science
    (including online links to some unpublished gems)
  - Living Reviews

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More LAAC action

- LIGO fellowship for outstanding students stationed at an Observatory
  - Competitive → fame and fortune (annual competition)
  - Supplemental stipend ($5000)
  - Travel funds
- Database of all Ph.D. projects

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Current Ph.D.s *

- Betzwieser, Joseph (Mavalvala, MIT and Mendell, LHO)
  - A search for isolated nearby pulsars
- Blackburn, Lindy (Katsavounidis, MIT)
  - Search for gravitational wave burst from binary black hole mergers and supernovae
- Bloomer, Edward (Woan, U. Glasgow)
  - Bayesian Markov chain Monte Carlo (MCMC) methods for parameter estimation in ground- and space-based GW detection
- Bodiya, Timothy (Mavalvala, MIT) *
  - Extreme radiation pressure dominated interferometers
- Chalkley, Eleanor (Rowan, U. Glasgow)
  - Material properties of suspension, mirror substrate and coating materials
- Clark, James (Woan, U. Glasgow)
  - Evidence-based Bayesian methods applied to burst detection in ground-based GW detection

* Registered in database

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Current Ph.D.s *

- Corbitt, Thomas (Mavalvala, MIT) *
  - Quantum noise in GW detectors; generation of sub-quantum states using radiation pressure coupling
- Cumming, Alan (Hough, U. Glasgow)
  - Material properties of suspension, mirror substrate and coating materials for GW detectors, including studies of fused silica suspension elements
- Dergachev, Vladimir (Riles, U. Michigan)
  - All-sky search for periodic GWs in LIGO data (PowerFlux Search for Pulsars)
- Dalrymple, Josh (Saulson, Syracuse)
  - Influence of impulsive environmental disturbances; methods for using PEM channels as vetoes appropriate for the burst search
- Duke, Ian (Mavalvala, MIT) *
  - Lock acquisition studies for AdLIGO including quad suspension dynamics
- Fang, Hua (Thorne, Caltech)
  - Foundations for LIGO data analysis for EMRI's (extreme-mass-ratio inspirals)

* Registered in database

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Current Ph.D.s *

- Fazi, Diego (Brown, Caltech)
  - Search for spinning NS-BH binaries in S5 data (implementation of the Physical Template Family)
- Giampanis, Stefanos (Melissinos, U. Rochester)
  - Search for a high frequency (37.5 kHz) stochastic background of gravitational waves
- Goda, Keisuke (Mavalvala, MIT)
  - Development of techniques for squeezing-enhanced GW interferometers
- Goetz, Evan (Riles, U. Michigan) *
  - Unspecified (yet) search for pulsars in LIGO Data; calibration and commissioning contributions
- Goggin, Lisa (Weinstein, Caltech) *
  - Search for BH ringdowns in S4 and S5 data
- Hanna, Chad (Gonzalez, Louisiana State Univ.)
  - Reduction of false alarm rates in GW searches (preliminary) with signal-based vetoes; application to NS and BH searches

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Current Ph.D.s *

- Harstad, Emelie (Brau/Frey, U. Oregon)
  - Instrumental investigation of noise sources; astrophysical search for signals from supernovae (tentative)
- Hirose, Eiichi (Saulson, Syracuse Univ.)
  - Time domain calibration, study of short-timescale variations in calibration, relevance to interpretations of burst search results
- Kalmus, Peter (Marka, Columbia Univ.) *
  - Higher accuracy calibration method(s); search for astrophysically triggered signals (nearby GRBs and soft SGRs)
- Kasprzyk, Dominik (Vecchio, U. Birmingham)
  - Search for accreting msec x-ray pulsars and other LMXBs using frequency domain coherent analysis approach
- Kawazoe, Fumiko (Kawamura, NAOJ) *
  - Experiment on the 4m tuned resonant sideband extraction prototype
- Keppel, Drew (Weinstein, Caltech)
  - Search for BNS inspiral signals in S5 data; inspiral parameter estimation; measuring GW speed, polarization, and presence of PN corrections in high-SNR inspiral detections (tentative)

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Current Ph.D.s *

- Kokeyama, Keiko (Kawamura, NAOJ)
  - Experiment on advanced interferometer configuration
- Lovelace, Geoffrey (Thorne, Caltech)
  - Scaling laws for thermal noise with changes of light-beam shape; foundations for LIGO data analysis for EMRI's; tidal coupling in EMRI's; (numerical simulations of binary black holes)
- Mandel, Ilya (Thorne, Caltech)
  - Foundations for LIGO data analysis for EMRI's; (Periodic Standing Wave Approximation for binary BH)
- Markowitz, Jared (Katsavounidis, MIT)
  - Directional searches for GW point source transients by application of coherent and incoherent methods; GW sky map for transient sources
- Martin, Iain (Rowan, U. Glasgow)
  - Material properties of suspension, mirror substrate and coating materials, including studies of temperature-dependence of coating mechanical loss
- Miller, John (Strain, U. Glasgow)
  - Experimental tests of cavities with flat-top mode shapes for application in advanced GW detectors (at Caltech)

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Current Ph.D.s *

- Mitra, Sanjit (Dhurander, IUCAA)
  - Algorithms for efficient analysis of GWs and CMB (effective deconvolution for obtaining sky maps)
- Murray, Peter (Rowan, U. Glasgow)
  - Mechanical loss of mirror substrate materials and coatings, including studies of the loss factors for Si with differing crystalline axes, doping and dimensions
- Nishizawa, Atsushi (Kawamura, NAOJ)
  - Theory of advanced interferometer configurations
- Patel, Pinkesh (Weinstein, Caltech)
  - Search for pulsars; parameter estimation; measurement of GW speed and polarization in high-SNR CW signals
- Pletsch, Holger (Allen, U. Wisconsin, Milwaukee)
  - Search for continuous GWs from rotating NS (isolated pulsars) with Einstein@Home
- Reed, Tracie (Zotov, Louisiana Tech Univ.)
  - Automated trigger analysis for the Inspiral group (Grambling State Univ. student)

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Current Ph.D.s *

- Robinson, Emma (Vecchio, U. Birmingham)
  - A Bayesian approach to searches for isotropic GW stochastic backgrounds (tentative)
- Rollins, Jameson (Marka, Columbia Univ.) *
  - Advanced detector studies; search for GWs from nearby optical supernovae with well detected light curves (minimizes timing uncertainity)
- Ruet, Laurent (Mittleman/Ottaway, MIT)
  - Active control and filtering duality for AdLIGO interferometer suspensions
- Sakata, Shihori (Kawamura, NAOJ) *
  - Experimental observation and reduction of radiation pressure noise
- Savov, Pavlin (Thorne, Caltech)
  - Optical torque instability for Mexican-Hat mirrors; duality relations for nearly concentric and nearly flat optical cavities; influence of low-finesse modes on parametric instability in AdLIGO
- Shapiro, Brett (Mavalvala, MIT and Trumper, MIT Mech. Eng.) *
  - Control laws in the AdLIGO quadruple suspension and isolation platform

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Current Ph.D.s *

- Smith, Nicolas (Mavalvala, MIT) *
  - Optical torque instabilities in radiation pressure dominated interferometers; enhanced LIGO readout beam line
- Taylor, J. Robert (Strain, U. Glasgow)
  - Thermal noise measurement interferometer; 3-mirror coupled cavity experiments
- Torres, Charlie (Anderson, U. Wisconsin, Milwaukee
  - Search for longer-lived unmodeled bursts using Tracksearch (U. Texas, Brownsville student)
- Veitch, John (Woan, U. Glasgow)
  - Bayesian MCMC methods for parameter estimation in ground- and space-based GW detection, concentrating on periodic sources
- Ward, Robert (Weinstein, Caltech)
  - Lock acquisition and readout for advanced interferometer configurations
- Wipf, Christopher (Mavalvala, MIT)
  - Theoretical and experimental study of quantum effects radiation pressure dominated interferometers
- Zhang, Junyi (Riles, U. Michigan)
  - Astrophysical search and instrumental work TBD

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Partial list of Ph.D. dissertations completed AY2005*

- Stefan Ballmer (Katsavounidis/Fritschel, MIT)
- Tiffany Summerscales (Finn, Penn. State Univ.)
- Masahiro Ito (Brau/Frey, U. Oregon)
- Rakhola, Rauha (Brau/Frey, U. Oregon)
- Yi Pan (Thorne, Caltech)
- Stacy Wise (Mueller, Univ. Florida)
- Amber Stuver
- Glenn deVine
- Saikat Mujumber
- LAAC is working on compiling a complete list

* known

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LIGO Thesis Prize

- Awarded every two years
- Very strong pool of theses for first competition
  - 6 nominations
- And the winner was…

R. Adhikari (Weiss/Fritschel, MIT)

- Sensitivity and Noise Analysis of 4 km Laser Interferometric Gravitational Wave Antennae

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Other Lab educational activities

- Weekly journal club at Caltech
  - Discuss a paper of interest over lunch
  - Emphasis on linking experimentalists and data analysts through free form discussion
  - The “old and wise” intentionally excluded to allow for open displays of ignorance
- “Friday lunch talks” at MIT
  - Talks given by grads, post-docs and other speakers they invite
  - Lunch partially funded by prize money that the grad students win (almost every year) for the “best poster” at MIT physics department’s annual poster session

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Great strides, but…
some areas of ongoing efforts

- Ph.D. database only ~50% populated
- Pedagogical tools being enhanced
- 8 women among 48 registered Ph.D. candidates
- Intend to collect data on underrepresented groups
- Measuring our success → follow-up
  - How do our students and post-docs fare post LIGO? Where do they end up?

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The End