Education within LIGO

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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…
The LIGO Academic Advisory Council (LAAC)
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.
Who are the LAAC-eyes?

- **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
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
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
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
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
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
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
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

* Registered in database
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)

* Registered in database
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)

* Registered in database
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)

* Registered in database
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 uncertainty)

- 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

* Registered in database
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

* Registered in database
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
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
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
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?
The End