What comes next for LIGO? Planning for the post-detection era in gravitational-wave detectors and astrophysics

Motivation

The detection of LIGO's first gravitational wave will be a transformational event, opening new avenues for astrophysical exploration, opportunities to build more powerful detectors directed at known source populations and data analysis enhancements informed by direct detection. Participants in this workshop will discuss how the first few detections might influence which paths offer the best opportunities, and how the community can be prepared with appropriate plans, including international networks and outreach of gravitational wave science to the broad scientific community. We invite gravitational wave scientists, astronomers, and astrophysicists to participate in these discussions.

Workshop Structure

The program is organized into 5 sessions, each addressing a particular set of questions.

Each of the first four sessions is organized around either a coffee break or a lunch break, with talks before the break to set the stage and to introduce the important questions, and discussion periods after the break. The breaks are intended as time to discuss the topic among themselves. Individuals or small groups wanting to raise particular ideas or questions during the discussion period are encouraged to contact the session chair or the speakers during the break, to allow them to organize the discussion by grouping similar ideas/topics together. The session chairs and speakers will moderate the discussion portion of each session.

The fifth session is organized as a panel discussion, but active participation by all present is welcome.

Lunchtime on Friday is a time for all of the panelists and participants to review what has been discussed, in order to recommend actions during the final session after lunch.

Thursday, May 7

8:30-9:00 **Introduction and Purpose of the Workshop** (Gabriela González)

Session 1: Multi-messenger Astronomy (Session chair: Peter Shawhan)

The LSC and Virgo will share gravitational wave triggers (initially with partners who have signed MOUs, and later publicly) to allow searches for electromagnetic counterparts which would greatly increase the astrophysical knowledge about the sources of gravitational waves. Could the first few GW detections reveal or highlight certain challenges and/or opportunities for this program? (Examples: mismatch between required coverage (either FOV or depth) and available resources; a need for much shorter latency for GW alerts; …)

9:00-10:00 **Landscape and possibilities for multi-messenger astronomy**
Speakers: Neil Gehrels, Jonah Kanner, Mansi Kasliwal (remote)

10:00-10:30 Break

10:30-11:30 **Discussion and comments**, moderated by panel

Session 2: Data Analysis (Session chair: Laura Cadonati)

The current plans for LIGO/Virgo data analysis leading to discovery in the next few years are summarized in https://dcc.ligo.org/LIGO-T1400054/public , with the anticipated observing schedule in http://arxiv.org/abs/1304.0670 . How might these plans need to change after the first few sources are detected? What would trigger the need for new analyses or new deeper studies?

11:30-12:30 **What is not in the current data analysis plan, and what might be needed**
Speakers: Vicky Kalogera, Alessandra Corsi, Matt Pitkin

12:30-14:00 Lunch

14:00-15:00 **Discussion and comments**, moderated by panel

Session 3: aLIGO Improvements (Session chair: Matthew Evans)

The experimental community has detailed possible upgrades to Advanced LIGO in https://dcc.ligo.org/LIGO-T1400316/public . The first GW detections are expected to happen in observing runs before Advanced LIGO detectors reach their designed sensitivity. How might the first detections influence the direction and pace of the upgrade program?

15:00-16:00 **Prospects for improving aLIGO sensitivity in various frequency ranges**
Speakers: Rana Adhikari, Stefan Ballmer, Lisa Barsotti

16:00-16:30 Break

16:30-17:30 **Discussion and comments**, moderated by panel

Small groups are encouraged to continue discussions separately over dinner

Friday, May 8

Session 4: International Network (Session chair: Stan Whitcomb)

The first few detections with LIGO and Virgo detectors will likely be poorly localized, making the search for electromagnetic counterparts difficult, and lack of full polarization information may leave ambiguities in interpretation. Speeding the growth and robustness of the international network will become a priority in the next decade. Are there ways that LIGO and the LSC can help speed the completion of the international network? Do we need to encourage funding agencies to talk to each other?

9:00-10:00 **Plans for other GW detectors and potential areas of collaboration**
Speakers: Giovanni Losurdo (Virgo), Takaaki Kajita (KAGRA), Tarun Souradeep (LIGO-India)

10:00-10:30 Break

10:30-11:30 **Discussion and comments**, moderated by panel

Session 5: Gravitational Wave Science in the Broader Context of US Science

(Session chair: Beverly Berger)

The detection of gravitational waves with LIGO detectors will cap a large effort by scientists and funding agencies in building large scale, high precision instruments for a new form of astrophysical observations. Yet, in contrast to other "big science" fields, there is no interagency or NRC advisory group (or subgroup) whose charge is to provide advice on gravitational wave science. In the upcoming era of transition to observation, such advice at the national, interagency level could prove crucial to the future of this science. What are possibly advisory groups to be contacted or created in the post-detection era?

11:30-12:30 **Panel Discussion on current US GW funding sources and advising bodies**
Panel Members: Beverly Berger, Jackie Hewitt, Jay Marx, Michael Turner (remote), Rai Weiss (TBC)

12:30-14:00 Lunch

What Comes Next?

14:00-15:15 **Panel reports on recommended actions** (10+5 min each)

15:15-15:30 **Conclusions, action plan (white paper)**

15:30 End of workshop