Scientific Report

Gravitational Wave Astrophysics for Early Career Scientists

3-7 May 2021, Lorentz Center @online

Scientific

Short description of the aims for the virtual meeting

Gravitational-wave (GW) science is pursued by a heterogenous group of people working on several different theoretical predictions, observational projects, and detection techniques all around the world. The virtual Gravitational-Wave Astrophysics for Early Career Scientists (GWÆCS) workshop set out to connect and promote a productive and healthy GW community. To this end, the workshop was designed as having a 50% / 50% split between science and community sessions, and equally a similar balance was imposed between invited talks and open discussions. Among almost 250 applicants, 80 were selected to participate in the live workshop while all others were provided with access to follow the talks and discussions offline. Attendees were selected also keeping in mind diversity in all aspects of life and academia, so as to cast a wider net and hear from as many voices and groups as possible.

Short summary of key moments (key debates, breakthroughs, etc.)

➤ The first day kicked off with D. Kennefick's talk on the history of GWs, providing the attendees a common ground upon which to build. This was followed by J. Gair's talk on data analysis tools for GWs, many of which are common between different detectors, and a lively discussion of the state-of-the-art in the field. The rest of the day was dedicated to a well-attended social session on GatherTown, with an unconventional poster session in sub-groups, a wider mingle and virtual games.

➤ Tuesday's first session was dedicated to Diversity, Equity and Inclusion (DEI) and was certainly a highlight of the workshop. B. Kamai's talk on DEI in astrophysics prompted a constructive discussion, where specific issues faced by minorities in the community emerged, and several ideas of how to improve DEI were proposed. A key finding is that **we need to work towards a community that acknowledges promoting DEI as part of our job as good researchers**, and not a (laudable) free time endeavour. We must set aside work hours to discuss and promote DEI, and organise and participate more in DEI talks and workshops, encouraging the members of our research groups - early and late career - to do the same. The talks of S. Shah and J. Steinlechner on DEI in the LISA and LIGO collaborations respectively provided an overview of what is currently being organised to this end. Another important point which emerged is that **we must strive to invite members of minority groups in our field to give science talks at events such as this** and not limit our invitations to socially-centered topics, so that they may promote their science, and not burden them with the duty of explaining and defending social equity. The second half of Tuesday hosted the ground-based detector science session, with talks by L. Nuttall on LIGO/Virgo observations, and S. Bangalore on third

generation detector science. These underlined the fact that we are approaching the statistical detection era of GW astronomy. A highlight of the discussion that followed was **the topic of open data, and how the community will re-organise to face the ever-growing number of detections, which scales faster than the number of analysts**.

➤ Wednesday's first session saw a complete overview of LISA instrument and detection science, with in-depth talks from A. Petiteau, E. Rossi, and C. Caprini. The amount of potential scientific discoveries that LISA will bring about is momentous, hence the discussion focused around the detection challenges which this generation of early career scientists will face in ~15 years. In particular, **successful component separation in LISA data will determine our ability to produce meaningful science with this amazing detector**. The well-being and mental health talk by occupational therapist J. Perez followed, where the speaker provided us with detailed scientific descriptions of the causes and symptoms of stress, how to distinguish good stress from bad stress, and what to do to get out of unhealthy mindsets and into healthy work habits. This was followed by an anonymous discussion/Q&A session via Flinga, where participants were able to post questions anonymously, vote for questions they resonated with, and ultimately also intervene to provide their view on the topics at hand. Overall, what emerged is that **there is a prevalent inability to cope with the expectations society has for us as individuals, given the structure and mechanisms of success in academia**. There is **also wide-spread impostor syndrome in our community, which brings us to compare each other and ourselves unfavourably**.

➤ Thursday started with an overview of outreach activities for GWs by M. Hendry, followed by a talk on early career funding opportunities by D. Gerosa. The discussion was particularly engaging, focusing on extremely relevant topics for early careers such as how to carve out a career path and make life-changing decisions. What emerged is that **a key ingredient in a successful life in academia is achieving research independence** from our academic advisors **and highlighting our original creative contributions to work we carry out**, especially in the wake of big collaborations. Thursday's second session was dedicated to PTA science with talks by C. Tiburzi and M. Kramer. PTAs are incredibly close to their first detection of gravitational waves, and we have our eyes peeled for updates from the various international PTA collaborations.

➤ Friday's first session was dedicated to presenting early career groups in the community: M. Korobko introduced us to the LSC Academic Advisory Committee (LAAC); L. Haegel gave an overview of the Virgo Early Career Scientist (VECS) group; V. Korol, T. Kupfer, and R. Balasov gave an overview of the LISA Early Career Scientist (LECS) group. **The main goal of ECS groups is to share career opportunities, skills, and organise workshops just like this one**. The session and workshop closed with a round table about ECS groups, our role in the wider community, and what we expect from the future. What emerged is **the firm hope that this workshop will become a yearly event which will see a turn-over between "generations" of ECSs, and which will take the temperature of the community, making sure we continue to grow and keep everyone's ideas and interests in mind**.

Outcome(s)

Besides providing useful information for the professional and social development of early career scientists working on GWs, and a starting point to an integrated research community, the GWÆCS workshop produced two main tangible outcomes: a **legacy document** collecting a summary of few pages of each workshop session and the **coordination of common activities**

among different early career scientists groups in the GW community (LECS, VECS, LAAC, PTA, …).

Organization

Preparation (synchronous and asynchronous strategies – see our *Virtual Workshop Tips & Tricks* document for concept definitions)
The organisation of the workshop took place completely online, with regular telecons among the organisers (one per one/two weeks) and support from Slack.

Duration of the workshop and time management
See the schedule; time management was no problem given the generous amount of time for discussions in the schedule. The time was chosen in the afternoon so that participants in the Americas could join too.

Platform(s) used before and during the workshop
We used the MS Teams environment for the main events, supplemented by GatherTown for a 1-slide per person poster session and the social breaks. Additionally, we had a Slack channel to keep discussion going which was also accessible for the "offline" participants.

Short- and long-term plans for follow-up
We are writing a legacy document to be published next September.

Lessons learned for future virtual events
A one-slide poster presentation introducing yourself and your research on the first day works really well! We would keep this for future virtual events.

Comments/points for improvement for the Lorentz Center team.
Good idea to have a test session for the organizers and participants.

Organisers

Béatrice Bonga, Radboud University (Netherlands)
Tanja Hinderer, University of Amsterdam (Netherlands)
Arianna Renzini, California Institute of Technology (USA)
Lijing Shao, Peking University (China)
Nicola Tamanini, CNRS/L2IT (France)