

Final Report of the MITP Workshop:  
**“Probing New Physics with Gravitational Waves”**  
(25 July 2022 to 12 August 2022)

January 28, 2023

## **1 ORGANIZATION, ATTENDANCE AND FUNDING**

This workshop was part of the MITP offer for the year 2022. It began on July 25th and lasted until August 12th, for a total of three weeks. The organizers invited each participant to attend the event for an average period of two weeks to be compatible with the budget as well as office space at MIT. In some exceptional cases, three-week participation was allowed. The program was attended by approximately 40 scientists, and the average number of participants per week was approximately 20. The week with the peak of attendance, for reasons due to logistics, was the second one. The number of junior researchers (Ph.D. students and postdocs) was remarkably high. This event was an excellent opportunity for them to get educated and updated with this fascinating and quickly growing research area, and also to establish a network of international collaborators. The organizers paid particular attention to the participation of young researchers also because the summer of 2022 was the first one with many in-person events since the covid pandemic. All participants received support to cover lodging expenses whereas everybody was responsible for their travel expenses. MITP provided travel subsidence for external program organizers. The organizing team was supported by two local organizers, Enrico Morgante and Pedro Schwaller, and their contributions turned out to be very useful to the successful outcome of the event. Pedro Schwaller served as Equal Opportunities Officer. From the point of view of logistics, the organization was smooth thanks to the great support of MITP staff. Participants had usually lunch together on campus. Each week there was a social dinner, planned by the organizers and self-sponsored by the participants, to socialize in an informal setting.

## **2 SCIENTIFIC ACTIVITIES**

The main scientific theme of the workshop was about several aspects of gravitational wave physics, and in particular how this new observational wind could allow us to make progress in the physics of the fundamental interactions. Gravitational waves produced both in the early and late universe can deliver important information about new fundamental physics lying beyond the Standard Model.

The program brought together various parts of the community. The organizers assigned at most two talks each day in the morning, and all afternoons were left free to allow spontaneous discussions on the topics of the morning sessions. The environment was very relaxed and informal, and everybody was free to ask questions. which generated long discussions also after the presentations.

Speakers for week 1 were: Philipp Klose, Eric Madge, Miha Nemevšek, Gabriele Rigo, Andrea Tesi, Soubhik Kumar, Anish Ghoshal. Speakers for week 2 were: Gongjun Choi, Jorinde van de Vis, Evangelos Sfakianakis, Fazlollah Hajkarim, Camilo Garcia Cely, Jan Scütte-Engel, Bibhushan Shakya, Xiao Xue, Ryusuke Jinno, Lian-Tao Wang. Speakers for week 3 were: Zurab Berezhiani, Yuhsin Tsai, Marek Lewiki, Nicklas Ramberg, Laura Sagunski, Nemanja Kaloper, Peera Simakachorn, Kai Schmitz.

### 3 RESULTS

This event gathered world experts in theoretical particle physics and cosmology with the common interest of using gravitational waves to probe fundamental physics. Mechanisms to generate gravitational waves in the early universe (inflation, preheating, phase transitions, topological defects) were discussed in depth. And, consequently, workshop participants investigated the actual detectability of these signals by present and future instruments. Ultimately, this workshop identified the most promising scenarios for physics beyond the standard model that will be testable in the near future thanks to their gravitational wave signatures. Furthermore, this event encouraged interdisciplinary interactions among different areas of particle physics and cosmology and facilitated the participation of young people in the workshop to encourage their enthusiasm for this growingly important field.

On behalf of the organizers,  
Francesco D'Eramo

