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Avenues of Quantum Field Theory in Curved Spacetime, Genova, 14-16 Sep 2022

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The extreme conditions experienced in the early universe, close to a black hole or in the interior of a neutron star, provide the environment where the most violent natural phenomena take place. Our understanding of the physical processes occurring in these regimes is affected by the notorious difficulty in the development of a theory of quantum gravity, modelling the intertwining of the gravitational field and the quantum properties of the fields responsible for the other forces in nature. A different point of view is then achieved by defining a “mesoscopic” scale lying below the Planck energy scale but well away from the classical general relativity domain. At such a scale, the theoretical framework describing how quantized fields propagate in a curved background has accomplished outstanding results, like particle production in gravitational fields and black hole evaporation, establishing a highly non-trivial connection between thermodynamics, gravity, and quantum field theory.

Aside from suggesting novel intersections between quantum fields and gravity, an unexplored landscape of original ideas is taking shape and inspiring new exciting problems. Quantum field theory in curved spacetime has recently been proposed as a new tool to probe nuclear and condensed matter physics phenomenology, with the recent advances in research at the nanoscale offering an intriguing test to the semiclassical approach even from tabletop experiments.

Following this trend, the goal of *Avenues of Quantum Field Theory in Curved Spacetime* has been to bring together researchers working in different areas of quantum field theory with interest in its curved space applications in the area of gravity and beyond. The 3-days workshop - the third of a series initiated in 2018 in Japan, continued in Modena, and that had an unexpected stop due to the sadly well-known Covid19 facts - aimed to exchange ideas on what is (or is expected soon to become) topical and discuss potential interdisciplinary interactions in a stimulating and collaborative environment.

The conference took place from the 14th to the 16th of September in the XVII century Lecture Hall of the University of Genoa, with the goal to gather recognized leaders in the application



of methods and results of quantum field theory in curved space to different settings, from black holes to cosmology, from engineered topological materials to supersymmetry, from quantum information to quantum gravity.

During these three days, we received scientists coming from five continents (seventeen countries represented), for a total of 95 participants and a very dense schedule including 35 oral communications and 12 posters. This volume covers 17 of the longer talks presented in the workshop. The proceedings have been edited by S. Carloni, R. Cianci, O. Corradini, A. Flachi, S. Vignolo and V. Vitagliano and the accepted papers follow the order of presentation during the conference.

Several institutions supported the workshop and their representatives. We are grateful for the funding generously made available by the Italian National Group of Mathematical Physics (GNFM, INdAM) and by the University of Genova. We further acknowledge our sponsors: the National Institute for Nuclear Physics - INFN (through the Research Projects QGSKY and GAST) and the Italian Society of General Relativity and Gravitational Physics - SIGRAV.

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