Ph.D. student: Paolo Meda
Supervisor: Pierantonio Zanghì
Co-supervisor: Nicola Pinamonti

RESEARCH ACTIVITY

In the first part of the Ph.D. year, I concluded the joint work with N. Pinamonti, S. Roncallo, and N. Zanghì, about the analysis of black hole evaporation in spherically symmetric spacetimes using the semiclassical Einstein equation. In this paper, we studied the mechanism of evaporation when it is induced by the trace anomaly of the quantum stress-energy tensor, in the case of a free, conformally coupled quantum scalar field. We showed that evaporation can occur in this class of spacetimes whenever a vacuum-like condition is assumed on the quantum state in the causal past of the back hole, and after imposing a certain averaged quantum energy condition on the stress-energy tensor outside the horizon. Based on this paper, I have also written a proceeding paper for the Sixteenth Marcel Grossmann Meeting which was held online in July 2021; this proceeding is currently in preparation. This analysis has been continuing in another joint work with Eleni-Alexandra Kontou from University of Amsterdam, which aims to investigate black hole evaporation imposing some quantum energy inequalities on the renormalized stress-energy tensor. This work is currently under development.

After concluding that paper, I focused my attention on studying the stability of solutions of linearized semiclassical theories of gravity, in order to extend the results obtained in my previous cosmological paper. The issue about the existence of physical unstable solutions of the semiclassical Einstein equation is an open problem already investigated by several authors in previous works, where it was argued that semiclassical solutions become unstable under small perturbations, even in flat spacetime. In a joint work with N. Pinamonti we investigate such problem using a toy model in Minkowski spacetime in the linearized regime. This toy model mimics other semiclassical theories of gravity, whose dynamics is governed by the semiclassical Einstein equations. The main result consists of showing that the stability of the back-reacted system can be restored for arbitrary large times. We are currently preparing a draft containing the proof.

WORKSHOPS/ORAL TALKS

I joined the following workshops:

- BritGrav21, online meeting on Zoom and Slack platforms, April 12-16th, 2021.
  https://sites.google.com/view/britgrav21
- Sixteenth Marcel Grossmann Meeting, online on Zoom platform, July 5-10th, 2021.
  https://indico.icranet.org/event/1/overview
- Seminal Interactions between Mathematics and Physics. II in Rome (ITA), September 28th – October 1st, 2021.
  https://sites.google.com/view/sibmp2-lincei2020/home

I gave the following oral talks:

- Contributed online talk at BritGrav21 meeting, "*Evaporation of four-dimensional dynamical black holes sourced by the quantum trace anomaly*", April 15th, 2021.
- Invited online talk at University of Bologna, "*Evaporation of four-dimensional black holes induced by the trace anomaly in semiclassical gravity*", May 7th, 2021.
- Contributed online talk at University of Genova, "*Semiclassical gravity and evaporation of dynamical black holes sourced by the quantum trace anomaly*", May 26th, 2021.
- Contributed online talk at Sixteenth Marcel Grossmann Meeting, "*Evaporation of four-dimensional dynamical black holes sourced by the quantum trace anomaly*", July 5th, 2021.

PUBLISHED ARTICLES / CONFERENCES PROCEEDINGS

- ***Existence and Uniqueness of Solutions of the Semiclassical Einstein Equation in Cosmological Models*.** P. Meda, N. Pinamonti, and D. Siemssen. Ann. Henri Poincaré (2021). DOI: 10.1007/s00023-021-01067-8

- ***Evaporation of four-dimensional dynamical black holes sourced by the quantum trace anomaly.*** P. Meda, N. Pinamonti, S. Roncallo, and N. Zanghì. Class. Quantum Grav., **38** 195022 (2021). DOI: 10.1088/1361-6382/ac1fd2

- ***Trace anomaly and evaporation of spherical black holes.*** P. Meda. To appear in Proceedings of the MG16 Meeting on General Relativity, July 5-10th, 2021.

- ***Renormalization of linearized semiclassical theories.*** P. Meda, N. Pinamonti. In preparation (2021).