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Co-supervisor: Nicola Pinamonti

## RESEARCH ACTIVITY

In the first part of the Ph.D. year, I have concluded the joint work with N.Pinamonti and D.Siemssen about the existence and uniqueness of solutions of the semiclassical Einstein equation on cosmological spacetimes. We have proved in our analysis that this semiclassical equation cannot be computed using the standard methods, but it is needed to be rewritten in a new non-standard form. Preliminarily, we show that a vacuum-like state for the quantum matter can be always selected compatible with the first semiclassical Friedmann equation at the initial time. Then, we show that a new equation for the derivative of the vacuum polarization can be obtained after partially integrated the traced semiclassical equation. Here, the quantum contribution hides the source of the instability of the equation, because it contains a non-local unbounded operator which forbids to solve the equation directly. However, an inversion formula can be obtained for this operator and allows to solve the new semiclassical equation applying the Banach fixed-point theorem.

After concluding the drafting of that paper, the topic of my research activity has been focused on the analysis of the back-reaction in the framework of black hole physics. Studying the semiclassical Einstein equation on dynamical black holes can provide non-classical results, like the evaporation of the black hole and the so-called Hawking radiation, due to quantum effects in the vicinity of the apparent horizon. For instance, the emergence of an ingoing negative energy flux crossing the horizon is responsible of the shrink of the area of the black hole and hence the evaporation of its mass. We study this mechanism when it is induced by the trace-anomaly of the quantum stress-energy tensor and we compute the rate of evaporation in case of a null radiating black hole, namely for a time-dependent mass. In a second step, we address the issue of the evaporation for the most general spherically symmetric black hole, where we expect that a similar process works after imposing some conditions on the parameters of the black hole. Joint work with N. Pinamonti, S. Roncallo, P. Zanghì.

## COURSES / EXAMS / SCHOOLS / WORKSHOPS

I attended the following course: "Introduction to the Foundations of Quantum Mechanics and Applications" (P. Zanghì, P. Solinas) and I gave the exam. Title of the seminar: "Modelli relativistici di riduzione dinamica in gravità semiclassica".

I joined the following workshops:

- 44<sup>th</sup> LQP workshop "Foundations and Constructive Aspects of QFT" in Göttingen (GE), October 25<sup>th</sup>-26<sup>th</sup>, 2019.  
<https://www.lqp2.org/node/1575>
- MYR Meeting at DIMA, University of Genoa, November 8<sup>th</sup>, 2019.  
<https://myrmeeting.dima.unige.it/index.html>
- 45<sup>th</sup> LQP virtual workshop on Zoom, June 17<sup>th</sup>-19<sup>th</sup>, 2019.  
<https://www.entangled.eu/events/vlqp/>.

No summer schools have been attended due to the COVID-19 pandemic.

## PUBLISHED ARTICLES / CONFERENCES

P. Meda, N. Pinamonti, D. Siemssen, *Existence and uniqueness of solutions of the semiclassical Einstein equation in cosmological models*, arXiv e-print: [arXiv:2007.14665](https://arxiv.org/abs/2007.14665). Submitted to *Communication in Mathematical Physics*.

I gave an oral talk in the MYR Meeting (link: <https://myrmeeting.dima.unige.it/program.html>) and an online talk in the 45<sup>th</sup> LQP workshop (link: <https://www.entangled.eu/events/vlqp/programme.html#Meda>).