



MAP-fis Essay Proposal, 2015-2016

(please write in English)

Supervisor

Name: Orfeu Bertolami

e-mail: orfeu.bertolami@gmail.com

Title

Quantum black holes and the singularity problem

Area

(Materials, Optics, Condensed Theory, High Energy Theory,...);

Theoretical Physics

Summary of Proposal

Black holes and singularities are believed to be unavoidable predictions of the Theory of General Relativity [1]. In this essay, we propose a study on the conditions of defining a quantum black hole and of examining whether their singularities share some features with their classical counterparts [2].

Furthermore, we suggest a study on how extensions of the underlying algebra of Quantum Mechanics allow for quantum mechanically avoiding singularities. The example the phase-space noncommutativity is indicated as a case study [3,4,5].

(continue if necessary)



Universidade do Minho



References

(to allow students first look at topic)

- [1] See for instance, “The Large Scale Structure of Space-Time”, S. Hawking and G. Ellis (Cambridge University Press 1973).
- [2] Quantum black hole without singularity, C. Kiefer, [arXiv:1512.08346](https://arxiv.org/abs/1512.08346) [gr-qc].
- [3] Black Holes and Phase Space Noncommutativity, C. Bastos, O. Bertolami, N. Costa Dias, J. N. Prata, Phys. Rev. D80 (2009) 124038.
- [4] The singularity problem and phase-space noncanonical noncommutativity, C. Bastos, O. Bertolami, N. Costa Dias, J. N. Prata, Phys. Rev. D82 (2010) 041502.
- [5] Non-Canonical Phase-Space Noncommutativity and the Kantowski-Sachs singularity for Black Holes, C. Bastos, O. Bertolami, N. Costa Dias, J. N. Prata, Phys. Rev. D84 (2011) 024005.