

Summary of the Doctoral Thesis

University of Szczecin – Institute of Physics – Samuel Barroso Bellido, M. Sc.

Title: What Could a Pair of Universes Tell Us About the Multiverse?

Supervisor: prof. dr. hab. Mariusz Dąbrowski

The present work is aimed to falsify the multiverse as it is prescribed by the Third Quantization formalism of Canonical Quantum Gravity. The formalism naturally predicts pair creation of universes and so the possible existence of a twin antiuniverse of that we inhabit. We extensively study the quantum entanglement between them for different models, finding that it is relevant at the initial singularity, at the maxima and minima of expansion, and at some exotic singularities like the Little Rip singularity. We use the conclusions found from the entanglement research to constraint the interaction between our universe and its twin and thus recreate the semiclassical Friedmann equation from where we obtain the dynamics of the universe which takes the entanglement effects into account. We then apply it in order to get the observational imprints of our hypothetical twin antiuniverse on the spectrum of the cosmic microwave background. For the case we consider, the constant coupling which governs the strength of the interaction is calculated to be $\lambda_0 \lesssim \mathcal{O}(10^{-56}) \text{ s}^{-3}$ in order to reproduce the angular power spectrum obtained by Planck satellite. We finish by completing the Third Quantization formalism including a new particle in the multiverse accountable for the interaction between universes. That way, Third Quantization formalism is the true Quantum Field Theory it was supposed to be by construction.

Keywords: Entanglement Entropy, Quantum Cosmology, Third Quantization.

Date, signature: 20/05/2022 Samuel Barroso Bellido