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White Holes: Formation and Dynamics

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In this project, our first goal is to study the different possibilities for the behaviour of a FLRW universe, focusing on the recollapse solution, born from a White Hole in a Big Bang type of singularity. We start by briefly revising the maximal analytical extension of the white hole, followed by a deep study of the FLRW metric and universe. It was possible to obtain the Friedman equation, including the cosmological constant, which by looking at it as an energy conservation equation, allowed us to understand all the possible behaviours, depending on the space-time geometry.
To obtain the time-reversed Oppenheimer-Snyder collapse, so one can describe the FLRW universe with the White Hole at the Big Bang, one had to do the matching of the FLRW metric with the Schwarzschild-De Sitter metric (for the more general case). The extrinsic curvature was proven equal under some restrictions, allowing one to match these metrics and construct the Penrose Diagrams for some of the different behaviours in the Schwarzschild case.
Finally, we move to our second goal, focusing on the recollapse solution, where the sphere of dust coming out of the White hole reaches a maximum and collapses into a Black Hole. We aim to study the dynamics of this solution, starting from the presence of a scalar field and studying the Klein-Gordon, leading to the radial equation for the dynamics. In future work, we will impose initial conditions, consider specific cases and adapt the study of the dynamics for other fields and gravitational waves, culminating in the study of the quasi-normal modes of this solution.

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