Galileons and Gravity: Improving Computational Simulations[1]

MARY GERHARDINGER, TOM GIBLIN, Kenyon College — While Einsteins theory of gravity has been tested through experiments, his theory of General Relativity is not compatible with other ideas in physics, such as Quantum Mechanics. Hence, more rigorous study is necessary. In this project, we studied a place of extreme gravity, two binary stars orbiting each other, in order to test the limits of GR. Specifically, I performed computational simulations of these stars in the presence of 15 scalar and vector degrees of freedom to determine how they interact. I implemented this model into GABE (Grid And Bubble Evolver), a numerical tool which solves for the interaction of scalar fields in an expanding universe. I refined this program, adding equations of motion, outgoing boundary conditions, and power calculations. Finally, I compared this output to the full numerical solution to determine both the validity and usefulness of my own code and found a UV complete model improves code stability and reduces computational costs.

Mary Gerhardinger
Kenyon College

Date submitted: 09 Jan 2022   Electronic form version 1.4