ABSTRACT

With the solution to the missing mass problem continuing to elude physicists, information and inspiration relevant to guiding the development of solutions become of increasing importance. In this thesis the missing mass problem on galactic scales will be analyzed and insight and inspiration related to the properties expected of the solution will be provided. This thesis is separated into four parts. In the first part, the missing mass problem is introduced alongside the rotation curve database used for the data analyses performer throughout the thesis. In the second part, the missing mass problem and expectation of popular proposed solutions are formulated and analyzed in a space of centripetal accelerations defined as $g2$-space. $g2$-space provides an expedient test bed for proposed solutions to the missing mass problem since the space excellently highlight the features of the proposed solution. The different analyses employed in the second part disfavor a class of proposed solutions to the missing mass problem (including MOND modified inertia) and indicate support for other classes of proposed solutions to the missing mass problem (including MOND modified gravity and dark matter with an isothermal density profile), under different assumptions (e.g. on the validity to propagate the uncertainties associated with the applied data). In the final chapter of the second part, a curious relationship between observed and expected dynamics is highlighted with the intention to inspire model builders.

In the third part, the missing mass problem on galactic scales is analyzed beyond $g2$-space. In the first chapter of the third part, an analysis with many parallels to that of $g2$-space is conducted. This analysis has similar challenges and advantages, however with some differences; the analysis is, for example, affected by severe systematic uncertainties which dominate the error-budget, leading to more conservative results relative to the analyses in the second part of this thesis. In the second chapter of the third part, correlations between features in the observed rotation curve and the rotation curve from baryonic matter is analyzed (Renzo's rule). Correlations between anomalies in the baryonic and observed rotation curves that are significantly higher than random are found – as required by Renzo's rule. This is interesting because different proposed solutions to the missing mass problem yield different levels and characteristics of correlations between features. Hence, this result can act as inspiration for model builders.

The fourth part consist of the Authors publications which are included in this thesis.