

Title of Project: General relativistic models of galaxies and clusters

Project Number: 276

University Project Leaders/Departments: Associate Professor David Wiltshire; Physics and Astronomy

Brief outline of project

In the standard approach to cosmology Newtonian dynamics is used to describe galaxies and galaxy clusters, and as a result of such modelling large amounts of exotic dark matter are inferred to exist. In the case of galaxies, for example, dark matter is assumed to form large spherical halos. The Cold Dark Matter paradigm is extremely well developed, and a number of its detailed predictions appear to be at odds with observations in our local group and nearby galaxies (Kroupa et al, 2010). On the other hand the nonlinear dynamics of extended mass distributions in general relativity is relatively little explored. Models of galaxies with rotating dust have been proposed by Cooperstock and Tieu (2006, 2007) and by Balasin and Grumiller (2008); but these results remain controversial. Cooperstock and Tieu have also considered a very simple model for a galaxy cluster (2008). This project will critically review general relativistic models of extended structures, such galaxies or galaxy clusters, to definitively answer the question of whether any models are realistic, and possibly seek to extend existing models to make them realistic.

Specific student requirements:

Please indicate below any specific academic requirements you have for the summer scholarship student (e.g., specific level; specific courses, or equivalents, completed)

The project is suitable for either a 400-level student, or an exceptionally good 300-level student. In the latter case, the student should have completed double major in Physics and Mathematics (i.e., intending Mathematical Physics Honours majors) in the case of 300-level UC students, or otherwise possess a very strong record in both theoretical physics and geometrical methods in mathematics if applying from elsewhere.

Special condition:

n/a