

## MDPH480/PHYS480/ASTR480/MAPH480 Research Projects 2009

Project Title: Averaging and backreaction in a lumpy universe

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### **Abstract of the Proposed Research** (use this page only)

At the present epoch matter in the universe displays a complex structure, with clusters of galaxies strung in filaments and sheetlike walls that thread and surround large voids, which are remarkably empty. Yet our standard cosmology ignores the effect of this structure in cosmic evolution, assuming that the geometry of the universe evolves just as if it were a featureless fluid. To match observations such a fluid must contain a mysterious component called "dark energy" which does not clump like ordinary matter, but is a repulsive anti-gravity in the vacuum of space, causing the expansion of the universe to start accelerating in the relatively recent past. Over the last few years a small but growing minority of cosmologists have questioned whether the coincidence that the epoch of apparent acceleration coincides with the epoch of formation of large structures is more than just a coincidence - have we got the model of the universe wrong? I have developed an alternative model universe which takes account of the average variance in cosmic geometry, which passes three key observational tests, but much work remains to be done. The Honours project will examine the inclusion of radiation in the evolution equations, and would suit a student who enjoys theoretical and conceptual challenges while being happy working with dynamical systems (nonlinear coupled ODEs) by both analytic and numerical techniques.

For further details see:

<http://www2.phys.canterbury.ac.nz/~dlw24/universe/>