TESTS OF NON-STANDARD COSMOLOGICAL THEORIES

Abstract

by

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This dissertation investigates some propositions that fall outside the mainstream of the standard big bang cosmology. We begin with partial evidence from the Cosmic Microwave Background (CMB) that the universe may be finite, compactified and flat, or at least nearly flat. The simplest interpretation of a flat universe is that it is infinite and non-compact. However, there are a great variety of ways that infinite universes can be 'wrapped up' and given a compact finite volume, without the need to modify general relativity. Detailed analysis of the CMB could potentially tell us the nature of the compactification, except that there is considerable uncertainty over sources of error. Another approach is to correlate the positions of distant luminous objects. While this cannot probe so broad a set of possibilities, it may be more sensitive for those that it can. In this thesis a new technique is developed that is much more sensitive to the very-nearly flat cases than previous tests of this type. Application to existing catalogs rules out a compact dimension smaller than 90% of the present horizon radius. The test requires that the position of objects is corrected for relativistic aberration. This gives rise to a second piece of work that systemizes corrections for objects and also the microwave background.

The final part looks at an unusual explanation for galaxy rotation curves. These are conventionally thought to be the result of a dark matter halo that

enshrowds each galaxy. Such dark matter also helps to account for the large quantity dark matter deduced from observations of the CMB. However, it has been suggested that the rotation curves could be a classical general relativistic effect, despite the non-relativistic velocities and densities involved. Such a claim is very unusual and has created considerable contraversy. The chapter presents a conclusive analysis to demonstrate that the suggested model is unphysical by implying an infinite mass for each galaxy.