ABSTRACT

A Model For Dark Matter in Spiral Galaxies

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The universe is thought to possess vast quantities of Dark Matter (DM) which has not yet been observed by radiation it may have emitted. Much of this DM is clustered in halos around spiral galaxies and is therefore indirectly observed by its gravitational effects, a prime example being the levelling off of the rotation curves for these galaxies at large distances. This asymptotic behaviour cannot be explained by the observable matter. In this thesis, four models of increasing sophistication are developed to fit the observed rotation curves of a set of 13 selected spirals. The model composed of a disk with an exponential density variation containing a point nucleus all embedded in a spherical halo of DM fits the data best.

Having determined parameters of the theoretical rotation curve to give the best fits, masses and sizes of the various components of the model are deduced. Assuming the DM is composed of Weakly Interacting Massive Particles (WIMPs), mass constraints on these particles

are imposed by requiring stability of the halo against dispersion. The mass constraints are found to depend on the nature of the statistics of the distribution function relevant to the halo gas. The gravitational lensing effects of the model galaxies are also examined where it is shown that multiple images of a distant source are possible with angular separation not exceeding about 2" for images produced by a single galaxy.

Finally, the spectra of radiation resulting from an assumed radiative decay mode of the WIMPs are examined, both within a halo and on a cosmic scale. The properties of the spectra are different in both cases and this decay mode offers the best promise of detecting the existence of WIMPs.