# Chapter 7

## CONCLUSIONS.

Effort has been given to characterized this unknown type of matter (dark matter) since 1930s when the legendary astronomer Fritz Zwicky first noticed the dark matter problem. But, a little is known about the nature of the dark matter. It is known that dark matter is attractive in nature and it neither emits nor absorbs light or other forms of electromagnetic energy like baryonic matter. Realizing the necessity to disclose the mystery of this self gravitating structure, scientists are trying to introduce new thoughts/theories. When all the present models fail to figure out the DM problem, Mannheim and O'Brien remark that it may actually not exists. It is the modified Newtonian theory that can explain the flat rotational curve which we have assumed as the only input of the DM problem. We are providing a chapter-wise summary of our concerned work bellow.

In Chapter 2, success and failure of the CDM model has been discussed. The observed rotational curve of the galaxies can be reproduced by considering the contributions from luminous matter, gas and the scalar field. Thus the dark matter in the universe could be in the form of the scalar field. We have shown that why we have to be cautious to choose the arbitrary constants of the solution of a spherical symmetric and static line element describing the dark matter halo. Otherwise, it may give wrong physical interpretations on the nature of the DM.

In Chapter 3, Lane-Emden equation describing the structure of the static gravitationally bounded Bose-Einstein condensate dark matter and its solution are discussed here. A limit on the central density, radius and mass of the condensates star are obtained here. Also a limit, having good concordance with cosmological observation, on the mass of the particle in the condensate has been obtained. BEC model has a better agreement with the cosmological observations than the cuspy CDM one and may be a viable alternative model to describe dark matter paradigm. It has also shown that tangential velocity and the density in the region far away from the centre of the galaxies are nearly constant for NFW profile and PI profile though they emerge from different points of view with different postulations.

Chapter 4, elaborates the possibility of the perfect fluid as a dark matter candidate. A single field equation for both the perfect fluid and scalar field DM has been obtained. It has been shown that any extra assumption to solve the system of field equation may convey the true nature of the DM. Stresses have been given on the facts that the measurement of the deflection angles and mass function can be efficient tools to determine which type of matter is actually composing the DM halo.

In Chapter 5, an expression for rotational velocity by considering the local and global contribution of the matter in conformal gravity to the rotational velocity of the test particles around a spherically source, has been obtained. This rotational velocity is not only due to the Schwarzschild-like potential $V_{\beta^*} = N^*\beta^* c^2/R$ which depends only on the matter interior to its location but also due to three other potential term, namely, a local $V_{\gamma^*} = N^*\gamma^* c^2 R/2$ associated with the matter distribution within a galaxy and a global $V_{\gamma_0} = \gamma_0 c^2 R/2$ associated with the cosmological background and finally a universal de Sitter-like quadratic potential term $V_\kappa = -\kappa c^2 R^2$ induced by inhomogeneities in the cosmic background. The last three potentials are new inputs into the MO model designed to interpret the rotational curve data. With only one free parameter $N^*$, the observed rotational curve can be reproduce with no dark matter is needed. The best fitted values of the constants are: $\beta^* = 1.48 \times 10^5$ cm, $\gamma^* = 5.42 \times 10^{-41}$ cm$^{-1}$, $\gamma_0 = 3.06 \times 10^{-30}$ cm$^{-1}$, $\kappa = 9.54 \times 10^{-54}$ cm$^{-2}$. A constraint on stability of the circular orbit is given by $r \leq 3\gamma_0/8\kappa$.

In Chapter 6, solving the gravitational field equations of the EiBI model, the properties of dark matter halos in the EiBI theory has been investigated. With the input $R_{\rm DM} = R_{\rm WR}$ from Weyl gravity, a constrain on the central dark matter density $\rho_0$ satisfying $\rho_0 \leq \rho_0^{upper} \sim 10^{12} M_\odot$ kpc$^{-3}$ for stability of circular orbits is found. Many profile dependent values of $\rho_0$ covering a large class of galaxies satisfy the EiBI predicted interval $\rho_0^{lower} \leq \rho_0 \leq \rho_0^{upper}$. Though the upper limit $\rho_0^{upper} \propto R_{\rm WR}^{-2} \sim 10^{12} M_\odot$ kpc$^{-3}$ is purely a stability induced constraint on all galaxies with dark matter but $(\alpha - 1)M_{\rm lum}R_{\rm WR}^{-3} \propto \rho_0^{lower} \leq \rho_0$ is not, due to uncertainties in $\alpha$. In fact, the reported data on $R_{\rm last}$ for individual samples have so far been found to obey $R_{\rm last} < R_{\rm WR}$. Even our own galaxy, the Milky Way, satisfies these constraints.

The present investigation may supply a better platform for testing different dark matter halo model and observations in the galactic halo.

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