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THE ROLE OF SPACE-BASED TELESCOPES IN UNRAVELING THE EXISTENCE OF DARK MATTER: (FROM HUBBLE TO NANCY GRACE ROMAN TELESCOPE)

Abstract

Dark matter is a mysterious form of matter that accounts for 27% of the Universe's total mass and is among the least understood components of the Universe. Its bizarreness makes it one of the most intriguing mysteries in astrophysics and cosmology. Exploring the nature of dark matter is an essential scientific endeavor as it contributes to understanding the structure and evolution of the Universe. The attempts to confirm the existence of dark matter started in the early 1930s when Swiss American astrophysicist Fritz Zwicky noticed that galaxies in the Coma Cluster were moving faster than expected. He hypothesized that the extra gravitational force needed to explain this motion was supplied by an invisible, non-luminous form of matter that he called "dark matter." Since then, astronomers have used various methods to search for dark matter. These include studying the motion of stars in galaxies, measuring the gravitational lensing of distant galaxies, and analyzing cosmic microwave background radiation. Scientists have employed space-based telescopes to provide significant clues about the nature of dark matter and its distribution in the Universe. These telescopes have not been able to detect dark matter candidates directly, but they have been used to measure their effect on the space environment. The examples of the most successful space telescopes that contributed to confirming the existence of dark matter are The Hubble Space Telescope (HST), the Chandra X-ray Observatory, the XMM-Newton, the Compton Gamma Ray Observatory (CGRO), and the Wilkinson Microwave Anisotropy Probe (WMAP). Hubble has imaged galaxies and galaxy clusters to measure their mass and study the distribution of dark matter. In contrast, Chandra and XMM-Newton have studied X-ray sources in galaxies, clusters, and the intergalactic medium to measure the amount of dark matter in these regions. The Compton Gamma-ray observatory allowed scientists to measure gamma-ray bursts (GRB) which are believed to result from the annihilation of dark matter particles. Moreover, the WMAP allowed scientists to map out the Universe's structure and determine the amount of matter it contained. In this paper, we aim to shed light on the roles of the space telescopes such as Hubble, Chandra, XMM-Newton, Compton Gamma-ray observatory, and Wilkinson probe in identifying and validating the presence of dark matter. We also plan to discuss the anticipated contributions of brand-new space missions like the Euclid mission (ESA-2023) and the Nancy Grace Roman Space Telescope (NASA-2026) in thoroughly understanding dark matter.