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ORIGINAL ARTICLE

The prolate Bok globules evidence for the existence of dark matter sub-halo

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Abstract Although the existence of dark matter is generally accepted by the mainstream scientific community, there is no generally agreed direct detection of it. Also, observations show that some Bok globules are prolate in some regions without suitable explanation for its cause. In this paper, we investigate the effect of dark matter sub-halo in transformation of the Bok globules from spherical to the prolate shape. We limit the investigation to a particular case that the magnetic field and turbulent effects are negligible through the Bok globule. We consider the gravitational effect of dark matter sub-halo on the isothermal Bok globule that is exposed to suitable distance of it. The results show that the dark matter sub-halo can justify the transformation of Bok globules in some regions. In this paper, we introduce a new method for proving the existence of dark matter sub halo.

Keywords Dark matter · ISM: evolution · Hydrodynamics · Stars: formation

1 Introduction

The infamous dark matter still remains invisibly mysterious. The dark matter is one of the interesting problem in astrophysics. In astronomy and cosmology, dark matter is a type of matter hypothesized to account for a large part of the total mass in the universe. Dark matter cannot be seen directly with telescopes; evidently it neither emits nor absorbs light or other electromagnetic radiation at any significant level (Trimble 1987). One way of indirect detection of dark matter is its gravitational effects. Astrophysicists assumed dark matter due to difference between the mass of large astronomical objects determined from their gravitational effects and the mass calculated from the luminous matter they contain: stars, gas, and dust. It was first supposed by Oort (1932) to account for the orbital velocities of stars in the Milky Way and by Zwicky (1933) to account for evidence of missing mass in the orbital velocities of galaxies in clusters. On the other hand, a dark matter halo is a hypothetical component of a galaxy that envelops the galactic disk and extends well beyond the edge of the visible galaxy. The halo's mass dominates the total mass. Since they consist of dark matter, halos cannot be observed directly, but their existence is inferred through their effects on the motions of stars and gas in galaxies. Dark matter halos play a key role in current models of galaxy formation and evolution (Spark and Gallagher 2007). Also, dark matter sub-halo may be anywhere in the galaxy that the accumulation of them and other objects create the dark matter halo.

Bok globules are dark clouds of dense cosmic dusts and gases in which star formation sometimes takes place through them. Bok globules are found within H II regions, and typically have a mass of about 2 to 50 solar masses contained within a region about a light year or so across (e.g., Stahler and Palla 2004). Bok globules were first observed by astronomer Bart Bok in the 1940s. Bok and Reilly (1947) hypothesized that these clouds were similar to insect's cocoons that were undergoing gravitational collapse to form new stars from which stars and star clusters were born.

Near-infrared imaging observations show that some Bok globules such as CB 87 and CB 131 have prolate shape without suitable explanation for its cause (Kandori et al. 2005). Although, the magnetic field was introduced as a candidate for elongation of Bok globules, but there are a lot of prolate

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