Dark Matter in a Galaxy

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An false-color infrared image of the faint, edge-on galaxy UGC 7321 as seen with the Spitzer Space Telescope IRAC camera. Astronomers modeling the galaxy have concluded that dark matter plays an important role in determining the dynamics of the inner as well as the outer regions of this galaxy. Credit: NASA, and Lynn Matthews/Kenneth Wood

(PhysOrg.com) -- Stars, the most familiar objects in the night sky, make up only a tiny percentage of the total amount of matter in the universe -- about 2%.

Another approximately 8% of the matter is in objects that have never been directly seen because, for example, they might be too cool to radiate much visible light; scientists estimate this percentage indirectly, from the relative abundances of hydrogen and helium gas and other sensitive monitors of the existence of other kinds of atoms.

The vast majority of matter however, nearly 90% of the total, is in some unknown form. Its presence is inferred from the motions of galaxies: their rotations, their motions as members of clusters of galaxies, and their behaviors in the expanding universe. This dominant and mysterious type of matter has been dubbed "dark matter." We do not know what dark matter is, only that it is unlike the particles that comprise normal atoms. Clues to its nature, however, may be found in where it is located and how it is distributed. Astronomers therefore probe galaxies looking for these elusive hints.

The galaxy UGC 7321 is a spiral galaxy, seen edgewise, with a highly flattened disk of stars lacking the central bulge commonly seen in many spirals. Many studies have modeled dark matter based on the way its gravity influences the rotation of the galaxy's disk at radii far from the center, but recently astronomers have tried examining how dark matter might be influencing the behavior of matter perpendicular to a galaxy's disk. SAO astronomer Lynn Matthews, along with two colleagues, used UGC 7321 to study this perpendicular influence for the first time in a faint, thin galaxy.

The astronomers modeled the stars and gas of the galaxy with a halo of dark matter whose gravity constrains both the radial and the perpendicular shape of the system.

They conclude that a consistent picture emerges with a dark matter halo whose average density is equivalent to about 500 earth-masses per cubic light-year, and whose presence is influential even within the inner spiral regions of the galaxy (a few thousand light-years), in contrast to the case in more luminous, massive galaxies where stars and gas overwhelmingly dominate the dynamics of the inner regions.

The new results imply that dark matter permeates a galaxy, and is not constrained to exist in the cold outer regions of intergalactic space.

Although this does not seem to be a surprising conclusion, with matter that is a mystery every bit of information is valuable.

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