Physicists and Mathematicians establish for the first time ever the size of a galaxy according to its dark matter

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Dark matter is an enigmatic energy that makes up most of the mass in the Universe, whose nature has not been identify yet, thus being a challenge for scientists. Now, astronomers in the Theoretical Physics and Cosmos Department of the University of Granada, led by Eduardo Battaner, in collaboration with researchers in the Applied Mathematics Department, have made great progress: establishing the distribution and behaviour of the dark matter in a galaxy.

Thanks to the new mathematical calculations on the dark matter, the density profiles which suitably define how the dark matter changes in a galaxy, have been described. This had not been specified in the astronomy field yet. Until now, the behaviour of the dark matter had been estimated through simulations, but the new mathematical description approach based on equations and functions which describe each characteristic of the dark matter make this result much more reliable.

Specifically this new discovery allows understanding better what the real size of a galaxy is. The collaboration of astronomers and mathematicians has allowed the developing of the density function of dark matter in a galaxy, describing how the dark matter is arranged from the galactic centre to its outermost part. When watching a galaxy to study the dark matter, a much larger size of a galaxy can be seen compared to that identified when watching the visible radiation. At the same time, it has been concluded that the density of the dark matter in a galaxy is maximum in the centre and it gradually decreases as it gets to the outermost part, but increases considerably the total size of the galaxy. This finding introduces new criteria into the study of galactic dynamics and, of course, of the dark matter.

Dark matter is a main component of the Universe, which has not been directly observed yet. In fact it is the component that makes up the greatest part of the Universe mass. This concept was used for the first time by Fritz Zwicky in 1933. He deduced the existence of a considerable quantity of mass that could not be observed but had to exist as an explanation to the phenomenon of galaxy movements. Currently, the quantity of dark matter in the Universe is well known: 23% vs. just over 4% of visible matter. The rest, up to 100%, is enigmatic dark energy. Despite the fact that we know well the quantity of dark matter and its behaviour, its nature has not been identified yet. This is one of the most important challenges in cosmology.

'With these results, we cannot establish what dark matter is, but we have defined its behaviour and we have information that helps to know other characteristics like its temperature', Eduardo Battaner said with regard to the results of his research. It is a work considered as a Project of Excellence by the Andalusian Ministry of Innovation, funded with 75,100€.

Starting from the wide knowledge of the group of astronomers on the dynamics of a galaxy, and applying it through the mathematical modelling knowledge, some complex descriptive functions have been developed which represent the dynamics of the dark matter. Professor Juan Soler, of the university of Granada, has been the coordinator of the research part related to the mathematical calculus. This inter-group collaboration shall keep on going more deeply into astronomic phenomenon in order to get new results.

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