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Prediction of the Dark Matter Distribution and Fraction in Individual Galaxies Based Solely on Their Rotation Curves

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Abstract : Recently, the author proposed an observationally-based relativity theory termed information relativity theory (IRT). The theory is simple and is based only on basic principles, with no prior axioms and no free parameters. For the case of a body of mass in uniform rectilinear motion relative to an observer, the theory transformations uncovered a matter-dark matter duality, which prescribes that the sum of the densities of the body's baryonic matter and dark matter, as measured by the observer, is equal to the body's matter density at rest. It was shown that the theory transformations were successful in predicting several important phenomena in small particle physics, quantum physics, and cosmology. This paper extends the theory transformations to the cases of rotating disks and spheres. The resulting transformations for a rotating disk are utilized to derive predictions of the radial distributions of matter and dark matter densities in rotationally supported galaxies based solely on their observed rotation curves. It is also shown that for galaxies with flattening curves, good approximations of the radial distributions of matter and dark matter and of the dark matter fraction could be obtained from one measurable scale radius. Test of the model on five galaxies, chosen randomly from the SPARC database, yielded impressive predictions. The rotation curves of all the investigated galaxies emerged as accurate traces of the predicted radial density distributions of their dark matter. This striking result raises an intriguing physical explanation of gravity in galaxies, according to which it is the proximal drag of the stars and gas in the galaxy by its rotating dark matter web. We conclude by alluding briefly to the application of the proposed model to stellar systems and black holes. This study also hints at the potential of the discovered matter-dark matter duality in fixing the standard model of elementary particles in a natural manner without the need for hypothesizing about supersymmetric particles.

Keywords : dark matter, galaxies rotation curves, SPARC, rotating disk
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