An Analysis of the Gravitational Energy of Galactic Mass and Its Application to Dark Matter and Dark Energy

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The purpose of this investigation was to analyze and quantify the effects of gravitational fields that occur in galactic matter across the universe. It is well known that gravitational fields possess negative energy density, i.e. energy densities below that of the unperturbed vacuum state, the effects of which have been called into question on multiple occurrences. It is also known that negative energy densities cause gravitational repulsion. Gravitational repulsion emulates the effect of universal expansion in the sense that it reverses the sign of the geodesic in curved spacetime- that is, it reverses the sign of the gravitational fields, whilst keeping the magnitude invariant. The significance of both future-pointing and past-pointing four-vectors is analyzed. In order to provide a consistent description of these four-vectors, the proposal is made that general relativity requires both a future-oriented metric tensor and a past-oriented metric tensor invariant of the temporal orientation of the observer. A consequence of this is that the definition of energetic 'time-orientation' is not absolute, but instead depends on the four-velocity of the observer in question. A simplified model shows that, in an idealized universe, the effects of dark energy and dark matter can be modeled using clusters of positive energy populated alongside clusters of negative energy.

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