Abstract: K01.00071 : Exotic Spacetime Topology as an Alternative to Dark Matter and Energy*

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Dark matter and energy are widely accepted features of the current cosmological standard model, but they suffer from troubling questions of theoretical interpretation and a lack of direct experimental support. The standard model is based on Einstein’s general relativity, which implicitly assumes that spacetime in locally inertial frames is Euclidean. It may instead be smooth, but topologically exotic (homeomorphic, but not diffeomorphic to Euclidean spacetime). Since gravity is the physical manifestation of spacetime curvature, such a change could mimic the effects of dark matter and/or energy (Brans conjecture). Exotic versions of Euclidean space exist in the case of four dimensions, where there are uncountably many of them. If this is a coincidence, it is surely a remarkable one. Recently, C. Duston has used techniques pioneered by C.H. Taubes to derive metrics for two such exotic smooth manifolds. We revisit the classical light deflection test of general relativity with one of these metrics and use observational data on gravitational lensing by galaxy clusters in an attempt to put quantitative constraints on exotic topology as an alternative to dark matter.

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