Charged wormholes with a quintessence dark-energy field in the galactic halo

Rounak Manna, Ujjal Debnath

Based on the widely recognized Karmarkar condition, or embedding class 1 technique, the current work searches for charged wormhole solutions with spherical symmetry for the Einstein field equations. With charged traversable wormhole geometry, we use the Karmarkar condition to derive a wormhole shape function. The obtained shape function satisfies the necessary traversability conditions. In addition, we talk about the embedding diagram in Euclidean space, both two and three dimensions, and verify the proper radial distance to display the wormhole configurations. Next, we examine a model with a quintessence field and a second field that represents regular matter and has an anisotropic pressure, providing energy for developing wormhole spacetime. Then, we obtain the Einstein field equations to verify the energy conditions. After that, we take three density profiles, which are the pseudo-isothermal density profile, the Navarro-Frenk-White density profile, and the density profile of Einasto Dark Matter of the galactic halo, and observe that for all of these density profiles, the NEC is violated. Hence, wormhole structures are firmly maintained by the composition of exotic matter within them. Furthermore, we use the volume integral quantifier to determine the necessary quantity of exotic matter near the wormhole throat.