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Composite vacuum Brans-Dicke wormholes

Sushkov S., Kozyrev S.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

We construct a new static spherically symmetric configuration composed of interior and exterior Brans-Dicke vacua matched at a thin matter shell. Both vacua correspond to the same Brans-Dicke coupling parameter ω; however, they are described by the Brans class I solution with different sets of parameters of integration. In particular, the exterior vacuum solution has C ext(ω) 0. In this case the Brans class I solution for any ω reduces to the Schwarzschild one being consistent with restrictions on the post-Newtonian parameters following from recent Cassini data. The interior region possesses a strong gravitational field, and so the interior vacuum solution has C int(ω)=-1/(ω+2). In this case the Brans class I solution describes a wormhole spacetime provided ω lies in the narrow interval $-2-\sqrt{33}<\omega<-2$. The interior and exterior regions are matched at a thin shell made from an ordinary perfect fluid with positive energy density and pressure obeying the barotropic equation of state $p=k\sigma$ with $0\leq k\leq 1$. The resulting configuration represents a composite wormhole, i.e. the thin matter shell with the Schwarzschild-like exterior region and the interior region containing the wormhole throat. © 2011 American Physical Society.

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