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Wormhole and the Universe

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The research on wormhole is an important issue in study of spacetime physics. The wormhole usually consists of exotic matter which satises the are-out condition and violates weak energy condition, even though there have been attempts to construct wormhole with non-exotic matter. There were also solutions of cosmological wormhole model as well as the cosmological black hole solutions. The interaction of wormholes with dark energy distributed over the universe can be one of the most important issues. Moreover, they can show a generalized theory of global and local physics, that is interested in the unification of interactions.

There had been various solutions of this structure by combining wormhole models with cosmological models, There was the solution of a wormhole inflationary expanding universe model. Also there was a wormhole solution in FLRW cosmological model which showed the expansion of the wormhole throat at the same rate as that of the scale factor. Hochberg and Kepart tried to extend the Visser type wormhole into a surgical connection of two FLRW cosmological models. Similarly there was a solution for the connection of two copies of Schwarzschild-de Sitter type wormhole as the cosmological wormhole model.

In this paper, a cosmological model with an isotropic form of the Morris-Thorne type wormhole was derived in a similar way to the McVittie solution to the black hole in the expanding universe. By solving Einstein's field equation with plausible matter distribution, we found the exact solution of the wormhole embedded in Friedmann-Lemaitre-Robertson-Walker universe. We also found the apparent cosmological horizons from the redefined metric and analyzed the geometric natures, including causal and dynamic structure according to the matter distributions of the bacground cosmological model.

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