

On wormholes leading to extra dimensions

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In 6D general relativity with a scalar field as a source of gravity, a new type of static wormhole solutions is presented: such wormholes connect our universe with a small 2D extra subspace with a universe where this extra subspace is large. We consider manifolds with the structure $M_0 \times M_1 \times M_2$, where M_0 is 2D Lorentzian space-time while each of M_1 and M_2 can be a 2-sphere or a 2-torus. After selecting possible asymptotic behaviors of the metric functions compatible with the field equations, we give explicit examples of wormhole solutions with spherical symmetry in our space-time and toroidal extra dimensions. In one example, with a massless scalar field (it is a special case of a well-known more general solution), the extra dimensions have a large constant size at the “far end”; the other example contains a nonzero scalar field potential which provides a 6D anti-de Sitter asymptotic behavior, where all spatial dimensions are infinite.

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