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Tidal properties of D-dimensional Tangherlini spacetime

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The geodesic deviation equation $\frac{D^2\xi^\mu}{d\tau^2} = R^\mu_{.\nu\alpha\beta}u^\nu u^\alpha \xi^\beta$, where u^μ is 4-velocity vector tangent to geodesic and ξ^μ is geodesic deviation vector, which connects two points corresponding to the same value of the affine parameter τ on two close geodesics, was studied in multidimensional Tangherlini spacetime with line element

$ds^2 = g_{\mu\nu}dx^\mu dx^\nu = f(r)dt^2 - \frac{dr^2}{f(r)} - r^2 d\Omega^2_{D-2}$,

where $d\Omega^2_{D-2}$ and $f(r)$ are

$d\Omega^2_{D-2} = d\theta_1^2 + \sum\limits_{j=2}^{D-2} d\theta_j^2 \left(\prod\limits_{k=1}^{j-1} \sin^2\theta_k\right),\ f(r) = 1 - \frac{\mu_D}{r^{D-3}} + \frac{q_D^2}{r^{2(D-3)}}$,

where μ_D and q_D are proportional to the mass and charge of the black hole. We have constructed a basis set of vectors, with respect to which the equation acquires a diagonal form. In the case of radial geodesics, when the angular momentum L is zero, all spatial components of the equation can be explicitly integrated by quadratures. Their local behaviour are $\xi^r \propto \frac{1}{r^{D-3}}$, $\xi^a \propto r$, $a = \theta_1, .., \theta_{D-2}$. But in the case of non-radial geodesics we constructed solutions of spatial components geodesic deviation equation in the vicinity of physical singularity using Fromebius method for Fuchs class equation in form of power series. This made it possible to determine that solutions in the main order have form $\xi^r \propto \frac{1}{r^{D-3}}$, $\xi^a \propto r$, $\xi^{\theta_{D-2}} \propto const$, $a = \theta_1, .., \theta_{D-3}$. This allows us to conclude that the tidal stretching of the test object along the radial direction depends on the spacetime dimension, while the tidal compression along the transverse directions in the leading order does not depend on the dimension.

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