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Rindler trajectories and Rindler horizons in the Schwarzschild spacetime

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We investigate radial Rindler trajectories in a Schwarzschild spacetime. We assume the trajectory to remain linearly uniformly accelerated (LUA) throughout its motion, in the sense of the curved spacetime generalisation of the Letaw-Frenet equations. For the Schwarzschild spacetime, we arrive at a bound on the magnitude of the acceleration $|a|$ for radially inward moving trajectories, in terms of the mass M of the black hole given by $|a| \leq 1/(\sqrt{27}M)$ for a particular choice of asymptotic initial data h, such that, for acceleration $|a|$ greater than the bound value, the linearly uniformly accelerated trajectory always falls into the black hole. For $|a|$ satisfying the bound, there is a minimum radius or the distance of closest approach for the radial LUA trajectory to escape back to infinity. However, this distance of closest approach is found to approach its lowest value of $r_b = 3M$, greater than the Schwarzschild radius of the black hole, when the bound, $|a| = 1/(\sqrt{27}M)$ is saturated. We further show that a finite bound on the value of acceleration, $|a| \leq \mathcal{B}(M, h)$ and a corresponding distance of closest approach $r_b > 2M$ always exists, for all finite asymptotic initial data h. We further investigate the past and future Rindler horizons for these radial Rindler trajectories. The analytical solution for the radial LUA trajectories along with its past and future intercepts $calC$ with the past null infinity $calJ^-$ and future null infinity $calJ^+$ are presented. The Rindler horizons, in the presence of the black hole, are found to depend on both the magnitude of acceleration $|a|$ and the asymptotic initial data h, unlike in the flat Rindler spacetime case wherein they are only a function of the global translational shift h. The implications for the corresponding Unruh effect are discussed.

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