Summary: The regular Hayward model describes a non-singular black hole space-time. By analyzing the behaviors of effective potential and solving the equation of orbital motion, we investigate the time-like and null geodesics in the regular Hayward black hole space-time. Through detailed analyses of corresponding effective potentials for massive particles and photons, all possible orbits are numerically simulated. The results show that there may exist four orbital types in the time-like geodesics structure: planetary orbits, circular orbits, escape orbits and absorbing orbits. In addition, when \( \ell \), a convenient encoding of the central energy density \( \frac{3}{8\pi \ell^2} \), is \( 0.6M \), and \( b \) is \( 3.9512M \) as a specific value of angular momentum, escape orbits exist only under \( b > 3.9512M \). The precession direction is also associated with values of \( b \).

MSC:
83C57 Black holes
83C10 Equations of motion in general relativity and gravitational theory
53Z05 Applications of differential geometry to physics

Keywords:
geodesic structure; precession direction; precession velocity; effective potential

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References:

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