Contribution ID: **124** Type: **Poster**

Geodesic Dynamics in a Time-Dependent Schwarzschild Metric

The study of geodesic dynamics in non-static spacetimes makes it possible to investigate how the evolution of gravitational geometry affects the free motion of test particles. In this context, trajectories and their deviation provide complementary information about the influence of curvature on dynamical behavior. This work analyzes a Schwarzschild-type metric with prescribed time dependence, taking the static solution as a reference. Changes in orbital trajectories and in the separation between initially nearby particles are examined for different values of the temporal parameter. To this end, the geodesic equations and the geodesic deviation equation are considered, the structure of the latter being determined by the Riemann curvature tensor. A comparison between the two regimes will make it possible to establish how the temporal evolution of the geometry modifies particle behavior relative to the static scenario.

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Session Classification: Posters & Empanadas

Track Classification: Cosmology and Gravitation