

Coordinates in general relativity: the time from perihelion to aphelion

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With a coordinate transformation, the Schwarzschild metric in the standard coordinate can become the one in the Kerr-Schild coordinate. In this work, we derive the second post-Newtonian solutions for the test particle's motion in the Schwarzschild spacetime under these two coordinates, and show that the calculation results for the time from the perihelion to the aphelion are different. Since the time from the perihelion to the aphelion of the celestial body is an observable quantity in astronomy, this example demonstrates that the solutions achieved in the specific coordinates may not be the final answer to the investigated problem even they are formulated in terms of the physical quantities such as the orbital energy and angular momentum. They should be mapped into the observer's reference frame before being compared with the observations.

Primary authors: Prof. LIN, Wenbin (University of South China); Mr LI, Jie (University of South China); Dr YANG, Bo (University of South China)

Presenter: Prof. LIN, Wenbin (University of South China)

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