CHAPTER OVERVIEW

6: Vacuum Solutions

In this chapter we investigate general relativity in regions of space that have no matter to act as sources of the gravitational field. We will *not*, however, limit ourselves to calculating spacetimes in cases in which the entire *universe* has no matter. For example, we will be able to calculate general-relativistic effects in the region surrounding the earth, including a full calculation of the geodetic effect, which was estimated in Section 5.5 only to within an order of magnitude. We can have sources, but we just won't describe the metric in the regions where the sources exist, e.g., inside the earth. The advantage of accepting this limitation is that in regions of empty space, we don't have to worry about the details of the stress-energy tensor or how it relates to curvature. As should be plausible based on the physical motivation given in Section 5.1, the field equations in a vacuum are simply $R_{ab} = 0$.

Thumbnail: This artist's concept illustrates a supermassive black hole with millions to billions times the mass of our sun. Supermassive black holes are enormously dense objects buried at the hearts of galaxies. (Public Domain; NASA/JPL-Caltech).