CONTENTS, Exploring Black Holes, Second Edition

Constants and Conversion Factors, Questions   Inside Front Cover

Chapter 1. Speeding
Background in special relativity. Invariance; interval; worldline; energy and momentum from the Principle of Maximal Aging; limits on the local inertial frame due to spacetime curvature.

Chapter 2. The Bridge: SR to GR
Curvature of Earth's surface as an analog to curvature of spacetime. Local and global metrics for both space and spacetime. Road map of Kansas, USA as analog to the local inertial frame in which we make every measurement in curved spacetime. The difference between space and spacetime. Goodbye "distance," goodbye "time."

Chapter 3. Curving
Describe curved spacetime outside Earth and down to the center of a non-spinning black hole. Global coordinates and the Schwarzschild global map of events. One-way event horizon.

Chapter 4. The Global Positioning System (GPS)
Locate yourself anywhere on Earth with a hand-held device whose operation depends crucially on general relativity.

Chapter 5. Global and Local Metrics
The global metric describes curved spacetime with global "map" coordinates that we choose arbitrarily. Over a small enough spacetime patch, however, curved spacetime is effectively flat, so special relativity applies. Our rule: Describe every experiment and observation in a local inertial frame on a flat patch.

Chapter 6. Diving
Dive into a black hole. How fast do you move? How do you feel? How long do you live? Global map energy as a constant of motion from the Principle of Maximal Aging. Local rain frame. Local gravitational acceleration.

Chapter 7. Inside the Black Hole
A relaxed life with spectacular effects behind and ahead of you, and an ending certain. Global rain coordinates. Tetrad forms of the metric.

Chapter 8. Circular Orbits
Map angular momentum as a constant of motion. Your spaceship rides in a circular "parking orbit" around a black hole. Predict this orbit at a glance.

Chapter 9. Orbiting
Insert your spaceship into a circular orbit. Transfer between circular orbits. Look out! Killer tides threaten humans and robots.

Chapter 10. Advance of Mercury's Perihelion
An early victory of Einstein's brand new general relativity theory.

Chapter 11. Orbits of Light
Trajectories of light around a black hole. Predict these orbits at a glance. Which light beam connects that star with this observer?

Chapter 12. Diving Panoramas
A diver rides her local rain frame to the center of a black hole. What changing panoramas surround her? What is the last thing she sees?

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