Mini-review of General Relativity (GR)

1. Principle of Equivalence

2. Bending of Light

\[ \Delta \theta = \frac{4GM}{c^2 R} \]  
or  
\[ \Delta \theta = 1.76 \text{ arcsec for light near sun} \]

3. Gravitational Lensing

4. Black Holes – light can not escape for \( R < R_{\text{sch}} \)

\[ R_{\text{sch}} = \frac{2GM}{c^2} \]

5. Precession of Perihelion of Mercury – see here. The GR contribution is

\[ \frac{\Delta \theta}{\Delta t} \sim \frac{360^\circ}{88 \text{ days}} \left( \frac{v}{c} \right)^2 \]  
exact calculation gives \( \frac{\Delta \theta}{\Delta t} \simeq 43 \text{ arcsec/century} \)

6. Today. Gravitational Red-shift and applications
Equivalence Principle

- There is no experiment a person could conduct (in a small volume) that can distinguish gravitational forces from accelerated motion.

Things move the same way in a gravity field as those in a reference frame accelerating upward with the same magnitude.
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Measuring the bending of light

- Measure the deflection of starlight as it goes near the sun
- Compare angles between the stars during a solar eclipse, and at night at a different time of the year

source http://undsci.berkeley.edu/article/0_0_0/fair_tests_04
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Gravitational Lensing in Observational Astronomy

source - Wikimedia
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