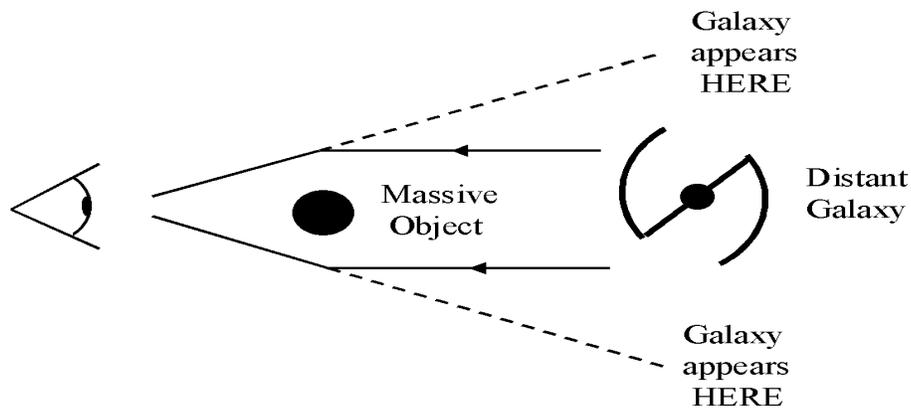


3.3 The Consequences of Einstein's Theory

Note. Since we postulate that gravity is a curvature of spacetime and that photons follow geodesics in spacetime, we find that “gravity bends light” (precisely, its the spacetime which is bent). The effect was experimentally verified in the famous 1919 eclipse expedition of Arthur Eddington. During a total eclipse of the Sun, the position of a star very near the Sun's limb was measured. The star's position was found to be shifted by an amount predicted by the general theory. See Figure III-4 on page 183. This experiment played a big role in making Einstein the “science genius” and public figure that he was to become in the 20's, 30's and 40's. This experiment has been reproduced a number of times using radio sources. A more contemporary example which is also a consequence of this “bending of light” is *gravitational lensing*. If a very distant galaxy is precisely along our line of site with a massive foreground object, then we will see multiple images of the background galaxy as the foreground object “focuses” the light rays. In some situations, the image appears curved and is a segment of the so called *Einstein ring*.



Note. A second example of experimental evidence for the general theory is the precession of the orbit of Mercury. Mercury orbits the Sun in an elliptical orbit ($e \approx .2$) and therefore experiences different accelerations due to the Sun. This results in a precession (or shifting) of the perihelion (point of the orbit furthest from the Sun) over consecutive orbits (see Figure III-5, page 185). The observed precession is $43.11 \pm 0.45''$ per century and general relativity predicts a precession of $43.03''$ per century (see Section 3.9 and Table III-2, page 230).

Note. Another prediction is the *gravitational redshift* of a photon in a strong gravitational field. We'll explore this in Sections 3.7 and 3.8.