Mass

Imagine three parallel straight lines lying in a plane in space. A stationary sphere with large mass is centred on the middle line and is seen by a stationary observer. An identical sphere is centred on the line to the left and another on the line to the right, both at equal distances from the central line.

The left and right spheres move in opposite directions at high speed such that they narrowly miss the middle one at the same time. The gravitational attractions mean the central sphere stays still but the paths of the outer spheres begin to curve inwards.

However there is also an observer moving at the same speed as the sphere on the left. In this frame the left sphere is at rest. According to SR, special relativity, the middle (moving) sphere has more mass and the other sphere has even more. So this observer should see the middle sphere drift off line to the right. On the other hand, for an observer moving with the right sphere the situation is reversed and the middle sphere should instead move to the left. (Assume the positions of the observers and the spheres approximately coincide at the same instant.)

So does the middle sphere move left or right or stay on line?

(Suppose the speed of an outer sphere relative to the stationary observer is 0.9c, so $\gamma=2.3$. For the first moving observer the central sphere travels at 0.9c and, using SR's equation for transforming velocities, the right sphere travels at 0.994c - for which γ is 9.5. So if the left sphere has a mass of 1 then the one on the right has a mass of 9.5.)