Non gravitational deflection of light in Special Relativity

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We show that even Special Relativity predicts, as a consequence of length contraction, a kind of light’s deflection for an observer having a relativistic speed relative to the source. Let S a source of light at a distance $L$ and a height $h$ from an observer O at rest. The horizon angle $\phi$ must verify:

$$\tan \phi = \frac{h}{L}. \quad (1)$$

If the observer O starts an inertial motion at a relativistic speed $v$ along $L$ (the figure above), according to Special Relativity, the distance $L$ is contracted to become:

$$L' = L \sqrt{1 - \left(\frac{v}{c}\right)^2}, \quad (2)$$

which gives to the angle $\phi$ a new value $\phi'$ that verifies:

$$\tan \phi' = \frac{h}{L'}. \quad (3)$$

Let us put:

$$\Delta \phi = \phi' - \phi. \quad (4)$$

Together, Eqs. (1,2,3,4) lead to:

$$\Delta \phi = \arctan \left( \frac{\tan \phi}{\sqrt{1 - (v/c)^2}} \right) - \phi. \quad (5)$$

One can note that more $\phi$ is near 0 more $\Delta \phi$ is greater. Thus, objects appear higher-deeper-larger when faced by a relativistic observer. For example, a vertical meter at a distance 1 km gains 1 mm for an observer at the speed:

$$v \simeq \frac{c}{22.38} \simeq 13397 \text{ km/s}.$$  

To conclude, light’s deflection is not exclusive to General Relativity, it arises also in Special Relativity as a consequence of length’s contraction. But such effect is very difficult to be verified since the needed experience must display high relativistic speeds.