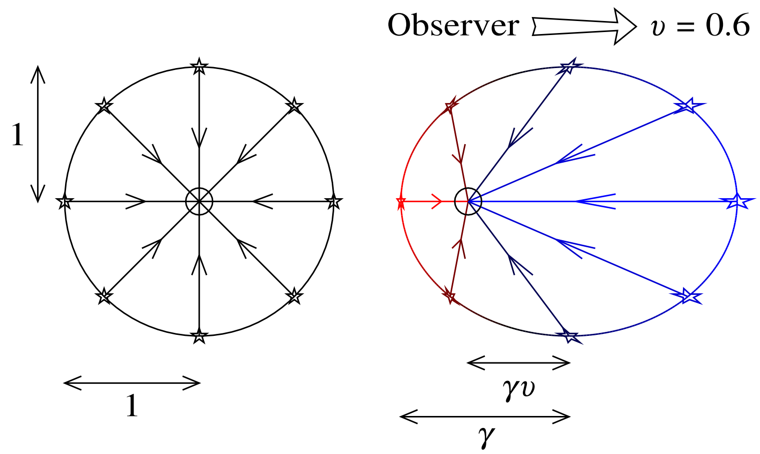
The rules of 4-dimensional perspective

The diagram below illustrates the rules of 4-dimensional perspective, also called "special relativistic beaming", which describe how a scene appears when you move through it at near light speed.



On the left, you are at rest relative to the scene. Imagine painting the scene on a celestial sphere around you. The arrows represent the directions of light rays (photons) from the scene on the celestial sphere to you at the center.

On the right, you are moving to the right through the scene, at some fraction of the speed of light. The celestial sphere is stretched along the direction of your motion into a celestial ellipsoid. You, the observer, are not at the center of the ellipsoid, but rather at one of its foci (the left one, if you are moving to the right). The scene appears relativistically aberrated, which is to say concentrated ahead of you, and expanded behind you.

The lengths of the arrows are proportional to the energies, or frequencies, of the photons that you see. The lengths are also proportional to the brightness, the number of photons per unit time, that you see. When you are moving through the scene at near light speed, the arrows ahead are longer, so you see the scene ahead is brighter, and photons ahead are blueshifted, increased in energy, increased in frequency. Conversely, the arrows behind you are shorter, so you see scene behind is dimmer, and the photons behind are redshifted, decreased in energy, decreased in frequency. Since photons are good clocks, the change in photon frequency also tells you how fast or slow clocks attached to the scene appear to you to run.

Want to know the numbers I used to make the figure? On the right, you are moving through the scene at $v = 0.6\,c$. The celestial ellipsoid is stretched along the direction of your motion by the Lorentz gamma factor, which here is $\gamma = 1/\sqrt{1 - 0.6^2} = 1.25$. The focus of the celestial ellipsoid, where you the observer are, is displaced from center by $\gamma v = 1.25 \times 0.6 = 0.75$.