

# Relativistic beaming

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Beaming is a consequence of [aberration of light](#). ↗

See:

<http://math.ucr.edu/home/baez/physics/Relativity/SR/Spaceship/spaceship.html> ↗

The URL contain no mathematics, but the mathematics behind these illustrations is the well known equation for aberration:

$$\cos \theta' = \frac{\cos \theta - \frac{v}{c}}{1 - \frac{v}{c} \cos \theta}$$

where  $\theta$  is the angle of the wave vector in some arbitrary inertial frame and  $\theta'$  is the angle of the wave vector in a frame of reference which is moving with the speed  $v$  relative the first.

However, if we instead define  $\theta$  to mean the the direction to a star as observed by an observer in the 'stationary frame', and  $\theta'$  to mean the direction to the star as observed by an observer in the 'moving frame', these directions are opposite to the directions of the wave vectors, and the equation becomes:

$$\cos \theta' = \frac{\cos \theta + \frac{v}{c}}{1 + \frac{v}{c} \cos \theta}$$

Fig. 1 illustrates how observed angle depend on the speed of the moving observer for six different values of  $\theta$ :

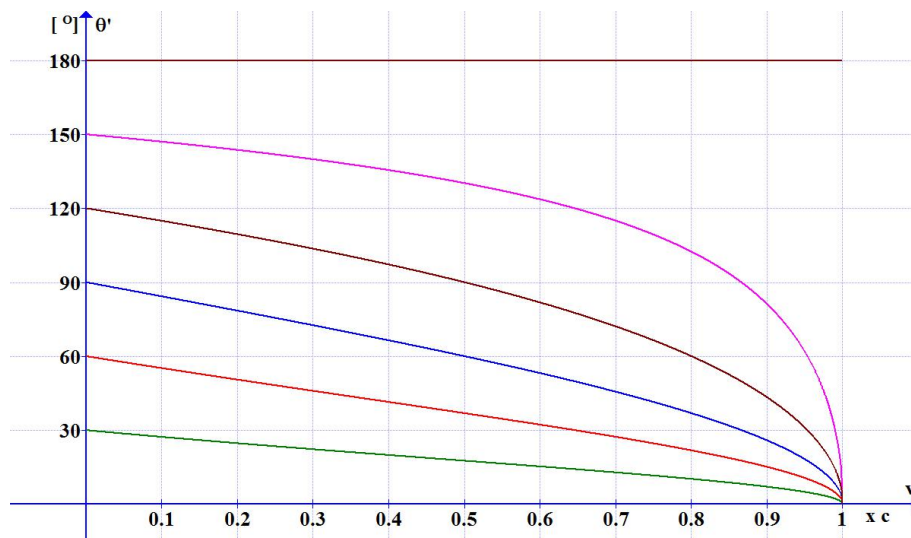


Figure 1: *The aberration as a function of the speed of the observer*

Fig. 2, 3 and 4 illustrates the angle  $\theta'$  for six  $\theta$  at three different speeds.

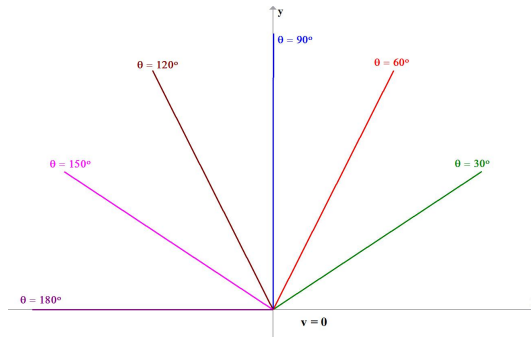


Figure 2: *The angle  $\theta$  to the stars in the stationary frame*

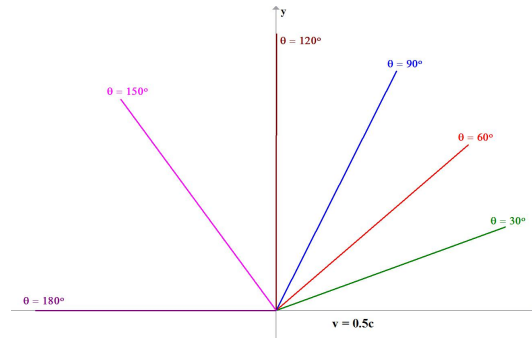


Figure 3: *The angle  $\theta'$  to the stars in the moving frame at  $v = 0.5c$*

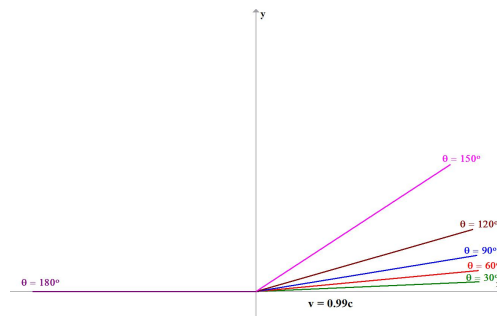


Figure 4: *The angle to  $\theta'$  the stars in the moving frame at  $v = 0.99c$*