the general science journal

Generalized Doppler Effect

C. P. Viazminsky
Department of Physics
University of Aleppo
Aleppo-Syria
Kayssarv@mail2world.com

Let $S \equiv OXYZ$ and $s \equiv oxyz$ be inertial frames in standard configuration, and assume that s translates parallel to *OX* with a constant velocity *u* (*u*>0). Let b be a source of light that is stationary in s, and hence moving with a constant velocity *u* relative to S. suppose that the source b is radiating a monochromatic light of wave-length λ. This will be received by *o* as monochromatic light of the same wave-length. Let (R,θ,φ) and $((r,\theta,\varphi)$ be the spherical coordinates of the source b in S and s respectively.

The moment at which light first reaches the contiguous observers *o* and *O* corresponds to *r=ct*. Setting r=ct in the generalized Lorentz transformations [1] yields

(1) $$R = \gamma r(\sqrt{1-\beta^2 \sin^2\theta}\, r + \beta\cos\theta)$$

Now assume that the distance *r* in the moving frame corresponds to one wave-length, i.e. $r = \lambda$. With respect to the observer *O* the distance *R* corresponds to one wave-length λ'.

Generalized Doppler's formula
Substituting in the last equation $r = \lambda$ *and* $R = \lambda'$, we obtain:

(2) $$\lambda' = \gamma(\sqrt{1-\beta^2 \sin^2\theta} + \beta\cos\theta)\lambda,$$

with $\gamma = 1/\sqrt{1-\beta^2}$, which determines the wave length as measured by the stationary observer. Note that the radiating source here is at a position of azimuth angle θ , and that the polar axis is *OX*.

Longitudinal Doppler's Formula
Setting $\theta = 0$ in the generalized formula (1) we obtain

(3) $$\lambda' = \sqrt{\frac{1+\beta}{1-\beta}}\lambda$$

which is the red shift Doppler's formula, corresponding to the source and the observer receding from each other. For $\theta = \pi$ we obtain the blue shift Doppler's formula

(4) $$\lambda' = \sqrt{\frac{1-\beta}{1+\beta}}\lambda$$

corresponding to the source and the observer approaching each other.

Traverse Doppler's Effect
Setting $\theta = \pi/2$ in (2) we find

(5) $$\lambda' = \lambda.$$

Hence, and contrary to the relativistic prediction, there is no traverse Doppler's effect.

References
[1] C P Viazminsky, Generalized Lorentz transformations and Restrictions on Lorentz Transformation, Research Journal of Aleppo University, 48, 2007.