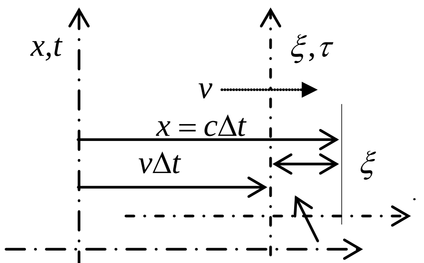
<u>Resolution of Einstein's time paradox</u>

The *time paradox* is the reciprocal time relation of two systems of reference, relative motion to each other with constant speed. There is no way to decide which system is in motion relative to the other, the time system of which is in time delay relative to the other. The description of the relation of the two systems shall take this fact into account.

Lorentz' transformation, the classical description of the event is:

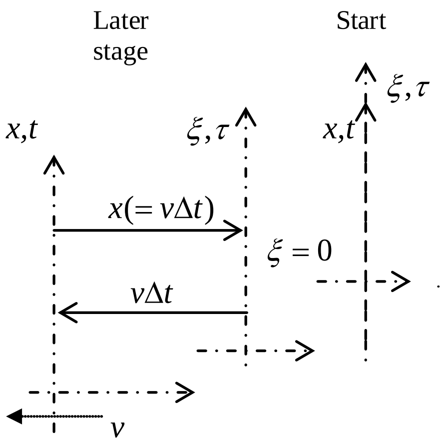
$$\Delta\tau_{motion} = \frac{\Delta t - (vx/c^2)}{\sqrt{1-(v^2/c^2)}}; \quad \text{and} \quad \xi_{motion} = \frac{x - v\Delta t}{\sqrt{1-(v^2/c^2)}};$$

<u>The original relation of the two systems</u>:



the EVENT, subject of the assessment happens while ξ,τ makes distance ξ

<u>*Einstein's* interpretation however represents the following case:</u>



SoR of x,t is moving away from SoR of ξ,τ with $v = c$

$x = v\Delta t$ the *EVENT* or space coordinate gives $\xi = \dfrac{x - x}{\sqrt{1-(v^2/c^2)}} = 0$

The motion is reciprocal, but $\xi = 0$ means in this case that SoR of ξ,τ is <u>taken as stationary</u>!

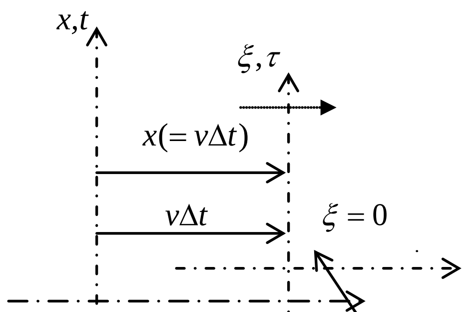
System of reference (SoR) of ξ,τ is in motion within x,t with speed v.

Einstein had made a note about the reciprocal character in his assessment, but there is no reference to this fact in his formulas.
Instead He substitutes in the formula

$x = v\Delta t$ ***instead of*** $x = c\Delta t$,

as measured event or subject.

This is rather strange, because $x = c\Delta t$ would be the end of the measured event or coordinate within the system of reference of x,t. The case, with this particular substitution becomes like this:



the EVENT, subject of the assessment disappears

And the solutions gives the result as:

$$\Delta\tau = \frac{\Delta t - (vx/c^2)}{\sqrt{1-(v^2/c^2)}} = \frac{\Delta t - \Delta t\,(v^2/c^2)}{\sqrt{1-(v^2/c^2)}} = \Delta t\sqrt{1-\frac{v^2}{c^2}}$$

which is convergent with all relevant equations, the Doppler formula and the Minkovsky's space-time interval indeed, BUT there is <u>NO EVENT</u> in System of Reference of ξ,τ to count with.

Einstein's solution represents the case on the left hand side: event x within SoR of x,t in motion with $v = c$.

If SoR of ξ, τ taken as stationary,

$$\Delta\tau_{rest} = \frac{\Delta t - (vx/c^2)}{\sqrt{1-(v^2/c^2)}} = \frac{\Delta t - \Delta t\,(v^2/c^2)}{\sqrt{1-(v^2/c^2)}} = \Delta t_{motion}\sqrt{1-\frac{v^2}{c^2}}\;;\text{ and }\;\Delta t_{motion} = \frac{\Delta\tau_{rest}}{\sqrt{1-(v^2/c^2)}}$$

which has in this case only theoretical meaning since $\Delta t_{motion} = \Delta\tau_{rest} = 0$

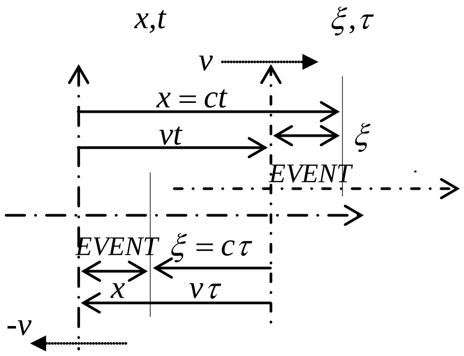
(as should be because $v = c$)

<u>The correct solution is:</u>

The reciprocal approach gives the reciprocal description of the *Lorentz's* transformation equations:

$$\tau_{motion} = \frac{t-(vx/c^2)}{\sqrt{1-(v^2/c^2)}}\;;\quad\text{and}\quad \xi_{motion} = \frac{x - vt}{\sqrt{1-(v^2/c^2)}}\;;\quad\text{and also}$$

$$t_{motion} = \frac{\tau - (v\xi/c^2)}{\sqrt{1-(v^2/c^2)}}\;;\quad\text{and}\quad x_{motion} = \frac{\xi - v\tau}{\sqrt{1-(v^2/c^2)}}$$



x,t taken as basis ξ, τ as in motion

$$\xi_{motion} = \frac{x - v\Delta t}{\sqrt{1-(v^2/c^2)}} = \frac{ct - v\Delta t}{\sqrt{1-(v^2/c^2)}} = c\Delta\tau_{motion}$$

ξ, τ taken as basis, x,t as in motion

$$x_{motion} = \frac{\xi - (-v)\Delta\tau}{\sqrt{1-(v^2/c^2)}} = \frac{\xi + v\Delta\tau}{\sqrt{1-(v^2/c^2)}} =$$

$$= \frac{c\Delta\tau + v\Delta\tau}{\sqrt{1-(v^2/c^2)}} = c\Delta t_{motion}$$

The (+) positive direction of the motion is our free choice and the equations also may be written as:

$$\xi_{motion} = \frac{ct + v\Delta t}{\sqrt{1-(v^2/c^2)}} = c\Delta\tau_{motion}\quad\text{and}\quad x_{motion} = \frac{c\Delta\tau - v\Delta\tau}{\sqrt{1-(v^2/c^2)}} = c\Delta t_{motion}$$

Summarising the equations $2\frac{\Delta\tau_{motion}}{\Delta t} = \frac{2}{\sqrt{1-(v^2/c^2)}}$; and $2\frac{\Delta t_{motion}}{\Delta\tau} = \frac{2}{\sqrt{1-(v^2/c^2)}}$

as well as $\frac{\Delta\tau_{motion}}{\Delta t} + \frac{\Delta t_{motion}}{\Delta\tau} = \frac{1-(v/c)+1+(v/c)}{\sqrt{1-(v^2/c^2)}} = \frac{2}{\sqrt{1-(v^2/c^2)}}$

The time relations are <u>*equal*</u> and <u>*reciprocal*</u>: $\frac{\Delta\tau_{motion}}{\Delta t} = \frac{\Delta t_{motion}}{\Delta\tau} = \frac{1}{\sqrt{1-(v^2/c^2)}}$

The motion itself and its direction have physical impact on the frequency relations. The energy component of the motion is important.
Time relations are *no more reciprocal.*

$1 \mp \frac{v}{c}$ components, introduced above give <u>*natural*</u> *correction*: $f_v = f_o\sqrt{\frac{1\pm\frac{v}{c}}{1\mp\frac{v}{c}}}$

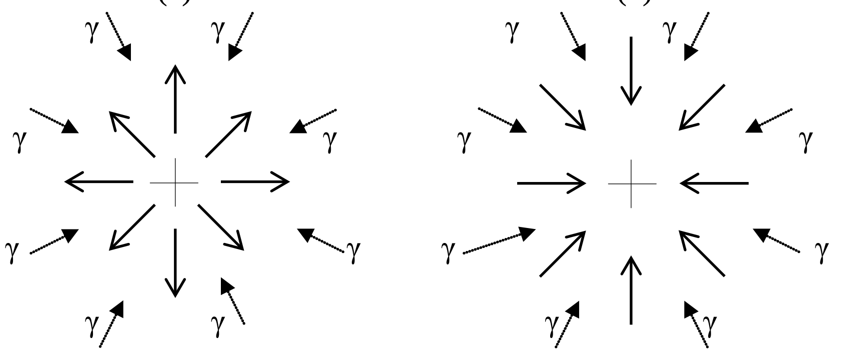
There are two sides of the same energy transfer:

- By granting energy to the radiation, the energy of the system of reference in motion must also be corrected. The correction results in less kinetic energy, in slower speed of the system of reference of the collision. With slower speed the consequence of the change of the time relations is the increase of the frequency. This change is reflected by the $[1-(v/c)]$ correction.
- Due to the energy transfer from the radiation, the kinetic energy of the system of reference in motion increases. With increasing speed the time relations will change and, as a consequence, the frequency will decrease. The balance is made through $[1+(v/c)]$.

The results are fully corresponding to the *Doppler* formula.

Alongside with the experienced frequency relations, consequence of the impact of external energy, the *sphere symmetrical expanding acceleration* and *accelerating collapse*, processes of the internal mass-energy balance can be fully described by the comprehensive *Doppler* formula.

(a) (b)



a./ Collision from in front of the motion: $\dfrac{f_\alpha}{f} = \sqrt{\dfrac{1-(v/c)}{1+(v/c)}}$; $\Delta E = (f - f_\alpha)H = \Delta f H$

speed difference between the *Quantum Membrane* and the mass *system of reference is*: $v = c - \upsilon$

$\Delta E = 0$ *no energy transfer*	$\Delta f = 0$	$\dfrac{df_\alpha}{df} = 1$	$\sqrt{\dfrac{1-(v/c)}{1+(v/c)}} = 1$	*v = 0; υ = c* $f_\alpha = f$
$\Delta E > 0$ *radiation gives off energy*	$\Delta f > 0$	$\dfrac{df_\alpha}{df} < 1$	$f_\alpha = f\sqrt{\dfrac{1-(v/c)}{1+(v/c)}}$	*0 < υ < i* = = lim *c* $f_\alpha < f$
$\Delta E < 0$ *mass system of reference gives off energy*	$\Delta f < 0$	$\dfrac{df_\alpha}{df} > 1$	$f_\alpha = f\sqrt{\dfrac{1+(v/c)}{1-(v/c)}}$	*υ = i* = lim *c* $f_\alpha > f$

b./ Collision from behind of the motion: $\dfrac{f_\omega}{f} = \sqrt{\dfrac{1+(v/c)}{1-(v/c)}}$; $\Delta E = (f - f_\omega)H = \Delta f H$

speed difference between the Quantum Membrane and the mass *system of reference*: $v = c - \upsilon$

ΔE = 0 *no energy transfer*	$\Delta f = 0$	$\dfrac{df_\omega}{df} = 1$	$\sqrt{\dfrac{1+(v/c)}{1-(v/c)}} = 1$	*v = c; υ = 0* $f_\omega = f$
ΔE < 0 *mass system of reference gives off energy*	$\Delta f < 0$	$\dfrac{df_\omega}{df} > 1$	$f_\omega = f\sqrt{\dfrac{1+(v/c)}{1-(v/c)}}$	*i* = lim *c > υ > 0* $f_\omega > f$
ΔE > 0 *radiation gives off energy*	$\Delta f > 0$	$\dfrac{df_\omega}{df} < 1$	$f_\omega = f\sqrt{\dfrac{1-(v/c)}{1+(v/c)}}$	*υ = i* = lim *c* $f_\omega < f$