Wave-Theoretical Insight into the Relativistic-Length-Contraction and Time-Dilation of Super-Nova-Light-Curves

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Abstract

Einstein's Relativity-theories predict: length-contraction, time-dilation, transverse-Doppler-shift, gravitational-spectral-shifts, expansion-of-space, time-dilation-of-super-nova-light-curves...etc. This letter attempts to gain some insight into two of them in terms of wave-theory. For example, the observations of time-dilation of 'super-nova-light-curves' are currently considered as a confirmative-test of expansion-of-time; whereas it is shown here that the super-nova-light-curve can be viewed as a 'gate-function' in the 'time-domain'; and it can be Fourier-transformed into frequency-domain; and it is this *wide band of waves* which travels in space and reaches us after millions of years. During its travel, when this wide-band of waves gets red-shifted due to any mechanism, including the tired-light-interpretation of the 'cosmological-red-shift', then its band-width shrinks in the frequency-domain; so

when it is transformed back into time-domain we find that the duration of the curve has got increased. Thus, time-dilation of super-nova-light-curves is not an independent observation from the observations of the 'cosmological-red-shift' due to any mechanism. Similarly, the relativistic length-contraction with speed is also explained in terms of waves, with the help of Fourier-transform.

Key Words: Gate-function, Fourier-transform, Relativistic-time-dilation, Length-contraction, Time-dilation-of-super-nova-light-curves

Introduction:

Reconciliation of the Relativity-Theory [1] with quantum-mechanics, is one of the major goals of science. As a rudimentary-attempt in this direction, we intend here to gain some wave-theoretical insight into the relativistic length-contraction and time-dilation with speed; and the observations of time-dilation of super-nova-light-curves. Any physical-process taking some 'duration' of 'time' can be mathematically described as a 'gate-function' in the 'time-domain'; and then it can be Fourier-transformed into the 'frequency-domain'[2], as shown in fig.1. Fig.2 shows that compression in 'time-domain' means expansion in the 'frequency-domain', i.e. widening of the spectrum; and expansion in 'time-domain' means shrinking of

Fig.:1 (a) A gate function.   (b) Transform of a gate function.

Fig.:2 Compression in the time domain is equivalent to expansion in the frequency domain.
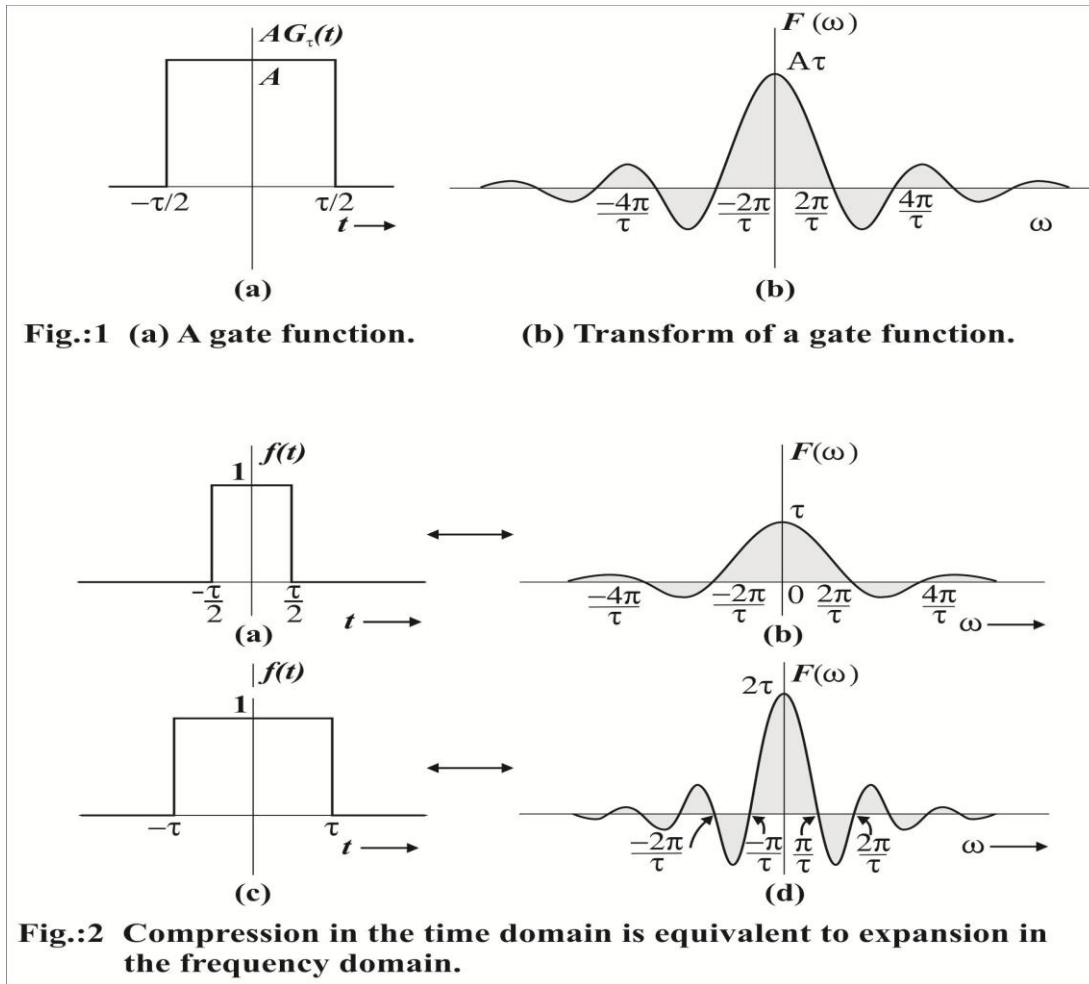
spectrum in the frequency-domain. In addition to the 'amplitudes' of every spectral-component in the frequency-domain, there is a phase-spectrum also, not shown in the figures. Shifting of the 'gate' in time does not change the amplitude-spectrum, but it does change the 'phase-spectrum'; i.e. a gate of one-second-duration at the origin of the graph, differs from another gate of one-second-duration between fifth-and-sixth seconds on the graph in terms of phase-difference of every corresponding-spectral-components. Similarly, an object of one meter length at the origin can be mathematically-represented as a 'gate-function' in 'space-domain' and can be Fourier-transformed into 'wave-number-domain'. And another object of one meter

length at a distance *x* meters from the origin will have the same 'amplitude-spectrum' in the wave-number-domain, but a different 'phase-spectrum'; i.e. each and every component of the spectrum, say thousand-waves-per-meter, has some phase-shift compared to its peer-component at the origin. With this back-ground let us now try to understand the relativistic length-contraction first; and then relativistic-time-dilation-of super-nova-light-curves, as discussed in the next section.

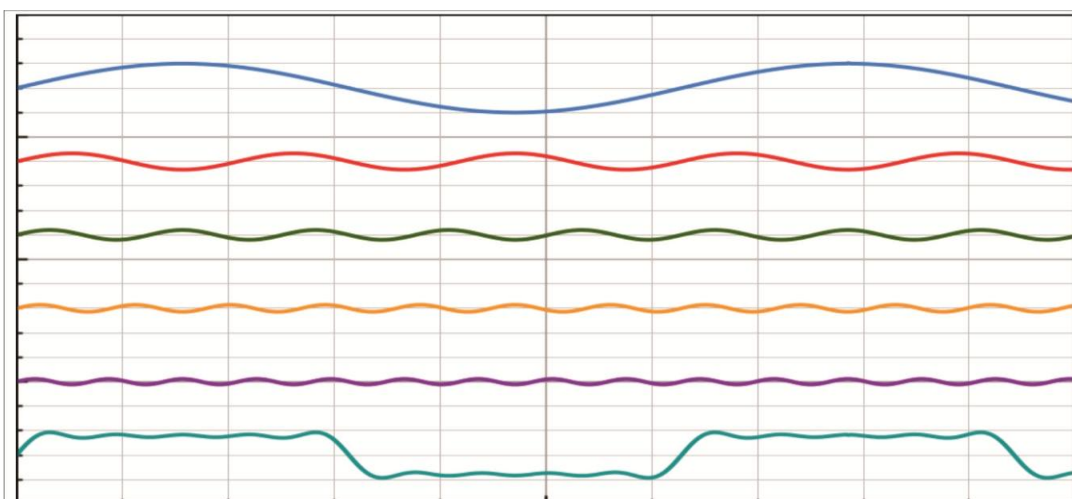## 2. Relativistic Length-Contraction with Speed:

Fig.3: Graphs of spectral-components sin(x), sin(3*x)/3, sin(5*x)/5, sin(7*x)/7, sin(9*x)/9 and their superimposition: sin(x)+sin(3*x)/3+sin(5*x)/5+ sin(7*x)/7+ sin(9*x)/9 forming a 'gate-function'. All components are at the same phase 0° at the origin x=0, but they are at different phase-angles at different values of x.

As discussed in the presiding paragraph, an object-of-one-meter-length-at-a-distance *x* meters from the origin, differs from the object-of-one-meter-length-at-the-origin in terms of 'phase-difference' of each-and-every component of its 'wave-number-spectrum'; though its 'amplitude-spectrum' is identical to the 'amplitude-spectrum' of the object at the origin. Now, when the object at the distance *x* moves with a velocity *v*, then the 'phase-difference' of each-and-every spectral-component will

keep changing with time; i.e. there will be some 'rate-of-change-of-phase'; and we know, that 'rate-of-change-of-phase' means 'frequency'! That is, when an object moves with respect to the other object at the origin at some speed, then there is a shift in wave-number of each-and-every spectral-component, by some factor, say each spectral component gets multiplied by a factor 1.2. Therefore, if the spectrum corresponding to an object at rest, at the origin, is from one-wave-per-meter to ten-waves-per-meter then the spectrum of the object moving with a speed v will have 1.2 waves-per-meter to 12 waves-per-meter. So, the width of the spectrum, which was $10 - 1 = 9$ wave-numbers, changes to $12 - 1.2 = 10.8$ wave-numbers. And from the fig.2 we can find that 'expansion of spectrum in 'wave-number-domain' means 'shrinking-of-length' in 'space-domain'. Special-Relativity describes it as 'Relativistic-length-contraction-with-speed' where as here we understood it in terms of 'Wave-Theory' with the help of Fourier-transform! And super-nova-light-curve can be viewed as a 'gate-function' in the 'time-domain'; and it can be Fourier-transformed into frequency-domain; and it is this wide band of waves which travels in space and reaches us after millions of years. During its travel, when this wide-band of waves gets red-shifted due to any mechanism, including the tired-light-interpretation of the 'cosmological-red-shift', then its band-width shrinks in the frequency-domain; so when it is transformed back into time-domain we find that the duration of the curve has got increased.

Conclusion:

Thus, time-dilation of super-nova-light-curves is not an independent observation from the observations of the 'cosmological-red-shift' due to any mechanism. Tired-light-interpretations of the 'cosmological-red-shift' have been rejected on the ground that they are not consistent with the observations of time-dilation of super-nova-light-curves; but now we understand that it is the 'cosmological-red-shift', due to any

mechanism, which causes the time-dilation of super-nova-light-curves! Similarly, the 'Relativistic-length-contraction' can also be alternatively-explained.

References:

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[2] B.P. Lathi, Communication Systems, Oxford University Press, 1998.