The transformation of the matter wave's the frequency and the wavelength in the 2-Dimension inertial coordinate system

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ABSTRACT

In the special relativity theory, in the 2-Dimension inertial coordinate system, study the transformation of the matter wave's the frequency υ and the wavelength λ.

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I.Introduction

Treat the transformation of the matter wave's the frequency υ and the wavelength λ.

The total energy E', the momentum p' in 2-Dimension inertial coordinate system $S'(t',x')$ and the total energy E, the momentum p in 2-Dimension inertial coordinate system $S(t,x)$ is

$$t = \gamma(t' + \frac{v_0}{c^2}x')\ ,\ x = \gamma(x' + v_0 t')\ ,\ V = \frac{dx}{dt} = \frac{u + v_0}{1 + \frac{v_0}{c^2}u}\ ,\ u = \frac{dx'}{dt'}\ ,\ \gamma = \frac{1}{\sqrt{1 - \frac{v_0^{\ 2}}{c^2}}} \quad (1)$$

$$E = \frac{m_0 c^2}{\sqrt{1 - \frac{V^2}{c^2}}}\ ,\ p = \frac{m_0 V}{\sqrt{1 - \frac{V^2}{c^2}}}\ ,\ E' = \frac{m_0 c^2}{\sqrt{1 - \frac{u^2}{c^2}}}\ ,\ p' = \frac{m_0 u}{\sqrt{1 - \frac{u^2}{c^2}}} \quad (2)$$

$$E=\frac{E'+v_0p'}{\sqrt{1-\frac{v_0^2}{c^2}}},\quad p=\frac{p'+\frac{v_0}{c^2}E'}{\sqrt{1-\frac{v_0^2}{c^2}}} \quad (3) \qquad E'=\frac{E-v_0p}{\sqrt{1-\frac{v_0^2}{c^2}}},\quad p'=\frac{p-\frac{v_0}{c^2}E}{\sqrt{1-\frac{v_0^2}{c^2}}} \quad (4)$$

In this time, the frequency υ and the wavelength λ about the matter wave is

$$E=h\upsilon,\quad E'=h\upsilon',\quad (5)$$

$$\lambda=\frac{h}{p},\quad \lambda'=\frac{h}{p'},$$

$$\frac{1}{\lambda}=\frac{p}{h},\quad \frac{1}{\lambda'}=\frac{p'}{h} \quad (6)$$

$$\omega=2\pi\upsilon,\omega'=2\pi\upsilon',\quad k=\frac{2\pi}{\lambda},k'=\frac{2\pi}{\lambda'} \quad (7)$$

$$V=\frac{dx}{dt}=\frac{d\omega}{dk}=\frac{u+v_0}{1+\frac{v_0}{c^2}u}=\frac{\frac{d\omega'}{dk'}+v_0}{1+\frac{v_0}{c^2}\frac{d\omega'}{dk'}},\quad u=\frac{dx'}{dt'}=\frac{d\omega'}{dk'} \quad (8)$$

$$\upsilon\lambda=\frac{E}{h}\cdot\frac{h}{p}=\frac{c^2}{V},\quad \upsilon'\lambda'=\frac{E'}{h}\cdot\frac{h}{p'}=\frac{c^2}{u} \quad (9)$$

In this time, Eq(9) is the pure mathematical equation of the frequency υ and the wavelength λ therefore $\upsilon\times\lambda$ isn't the physical concept in the matter wave.

II.Additional chapter

Therefore, if Eq(3) is inserted by Eq(5),Eq(6)

$$E=h\upsilon=\frac{h\upsilon'+v_0\frac{h}{\lambda'}}{\sqrt{1-\frac{v_0^2}{c^2}}}=\frac{h\upsilon'+hv_0(\frac{u}{c^2}\upsilon')}{\sqrt{1-\frac{v_0^2}{c^2}}}=\frac{1+\frac{v_0}{c^2}u}{\sqrt{1-\frac{v_0^2}{c^2}}}h\upsilon' \quad (10)$$

In this time, $\frac{1}{\lambda'}=\upsilon'\frac{u}{c^2}$

$$p=\frac{h}{\lambda}=\frac{p'+\frac{v_0}{c^2}E'}{\sqrt{1-\frac{v_0^2}{c^2}}}=\frac{\frac{h}{\lambda'}+\frac{v_0}{c^2}h\upsilon'}{\sqrt{1-\frac{v_0^2}{c^2}}}=\frac{\frac{h}{\lambda'}+\frac{v_0}{c^2}h(\frac{c^2}{u}\frac{1}{\lambda'})}{\sqrt{1-\frac{v_0^2}{c^2}}}=\frac{1+\frac{v_0}{u}}{\sqrt{1-\frac{v_0^2}{c^2}}}\frac{h}{\lambda'} \quad (11)$$

In this time, $\upsilon'=\frac{c^2}{u}\frac{1}{\lambda'}$

$$\frac{h}{\lambda}=\frac{1+\frac{v_0}{u}}{\sqrt{1-\frac{v_0^2}{c^2}}}\frac{h}{\lambda'} \rightarrow \lambda=\frac{\sqrt{1-\frac{v_0^2}{c^2}}}{1+\frac{v_0}{u}}\lambda' \quad (12)$$

Therefore, in Eq(10),in Eq(11),in Eq(12), the frequency υ's and the wavelength λ's transformation is

$$\upsilon = \frac{1+\frac{v_0}{c^2}u}{\sqrt{1-\frac{v_0{}^2}{c^2}}}\upsilon' \quad , \quad \lambda = \frac{\sqrt{1-\frac{v_0{}^2}{c^2}}}{1+\frac{v_0}{u}}\lambda' \qquad (13)$$

If Eq(4) is inserted by Eq(5),Eq(6)

$$E' = h\upsilon' = \frac{h\upsilon - v_0\frac{h}{\lambda}}{\sqrt{1-\frac{v_0{}^2}{c^2}}} = \frac{h\upsilon - hv_0(\frac{V}{c^2}\upsilon)}{\sqrt{1-\frac{v_0{}^2}{c^2}}} = \frac{1-\frac{v_0}{c^2}V}{\sqrt{1-\frac{v_0{}^2}{c^2}}}h\upsilon \qquad (14),$$

In this time, $\frac{1}{\lambda} = \upsilon\frac{V}{c^2}$

$$\upsilon' = \frac{1-\frac{v_0}{c^2}V}{\sqrt{1-\frac{v_0{}^2}{c^2}}}\upsilon = (1-\frac{v_0}{c^2}\cdot\frac{u+v_0}{1+\frac{v_0}{c^2}u})\upsilon/\sqrt{1-\frac{v_0{}^2}{c^2}}$$

$$= (\frac{1+\frac{v_0u}{c^2}}{1+\frac{v_0u}{c^2}} - \frac{v_0}{c^2}\cdot\frac{u+v_0}{1+\frac{v_0}{c^2}u})\upsilon/\sqrt{1-\frac{v_0{}^2}{c^2}} = \frac{\sqrt{1-\frac{v_0{}^2}{c^2}}}{1+\frac{v_0u}{c^2}}\upsilon \qquad (15)$$

$$p' = \frac{h}{\lambda'} = \frac{p-\frac{v_0}{c^2}E}{\sqrt{1-\frac{v_0{}^2}{c^2}}} = \frac{\frac{h}{\lambda}-\frac{v_0}{c^2}h\upsilon}{\sqrt{1-\frac{v_0{}^2}{c^2}}} = \frac{\frac{h}{\lambda}-\frac{v_0}{c^2}h(\frac{c^2}{V}\frac{1}{\lambda})}{\sqrt{1-\frac{v_0{}^2}{c^2}}} = \frac{1-\frac{v_0}{V}}{\sqrt{1-\frac{v_0{}^2}{c^2}}}\frac{h}{\lambda} \qquad (16)$$

In this time, $\upsilon = \frac{c^2}{V}\frac{1}{\lambda}$

$$\frac{1}{\lambda'} = \frac{1-\frac{v_0}{V}}{\sqrt{1-\frac{v_0{}^2}{c^2}}}\frac{1}{\lambda} = (1-v_0\frac{1+\frac{v_0u}{c^2}}{u+v_0})\frac{1}{\lambda}/\sqrt{1-\frac{v_0{}^2}{c^2}}$$

$$= (\frac{u+v_0}{u+v_0} - v_0\frac{1+\frac{v_0}{c^2}u}{u+v_0})\frac{1}{\lambda}/\sqrt{1-\frac{v_0{}^2}{c^2}} = \frac{u\sqrt{1-\frac{v_0{}^2}{c^2}}}{u+v_0}\frac{1}{\lambda} = \frac{\sqrt{1-\frac{v_0{}^2}{c^2}}}{1+\frac{v_0}{u}}\frac{1}{\lambda} \qquad (17)$$

$$\rightarrow \quad \lambda' = \frac{1+\frac{v_0}{u}}{\sqrt{1-\frac{v_0{}^2}{c^2}}}\lambda \qquad (18)$$

Therefore, the frequency υ's and the wavelength λ's transformation is

$$\upsilon' = \frac{\sqrt{1-\frac{v_0{}^2}{c^2}}}{1+\frac{v_0 u}{c^2}}\upsilon \quad , \quad \lambda' = \frac{1+\frac{v_0}{u}}{\sqrt{1-\frac{v_0{}^2}{c^2}}}\lambda \qquad (19)$$

III.Conclusion

Therefore, by Eq(13) and Eq(19) ,the frequency υ 's and the wavelength λ 's transformation is in the matter wave

$$\upsilon = \frac{1+\frac{v_0}{c^2}u}{\sqrt{1-\frac{v_0{}^2}{c^2}}}\upsilon' \quad , \quad \upsilon' = \frac{\sqrt{1-\frac{v_0{}^2}{c^2}}}{1+\frac{v_0 u}{c^2}}\upsilon \quad , \quad \lambda = \frac{\sqrt{1-\frac{v_0{}^2}{c^2}}}{1+\frac{v_0}{u}}\lambda' \quad , \quad \lambda' = \frac{1+\frac{v_0}{u}}{\sqrt{1-\frac{v_0{}^2}{c^2}}}\lambda \qquad (20)$$

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