OPTICS – *Emission theories and the principle of Doppler-Fizeau.*
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To explain the optical phenomena of moving bodies, we may use either the concept of a propagation medium: ether in absolute rest (theory of Lorentz-Einstein), or the image of emission (Ritz theories of J.J. Thomson and Stewart, Tolman).

The theory of Lorentz-Einstein requires, as one knows, a change of the concepts of time, space, mass, force and temperature.

The emission theories have the advantage of not involving any modification of this kind. They return account, at least to a certain extent, of the Doppler Effect. All, indeed, agree to regard the speed of light emitted by a moving source as being the geometrical resultant the speed of the source and speed of light resulting from a motionless source. It is shown that, under these conditions, the wavelength is not changed and that an observer which measures the period of reception of the waves notes a variation of the period obeying the law of Doppler-Fizeau.

Michelson, Fabry and Buisson, and, more recently, Majorana ([1]), thought that by receiving the light emitted by a source moving in an interferometer one could measure the wavelength independently of the propagation velocity, and, consequently, to decide between the theory of Lorentz and the emission theories.

The result of the experiments is in favor of the theory of Lorentz. I propose to show that, if it puts indeed in defeat the theories of Thomson-Stewart and Tolman, it is nevertheless in conformity with the theory of Ritz.

We will limit ourselves if the interferometer is simply made up by a plane mirror receiving the light normally and having which are formed standing waves. Thus neither blades of glass nor lenses are interposed on the way of the luminous rays.

If the source moves with a speed v in the direction of the propagation of the emitted beam, the speed of the radiation, according to the emission theories, will be V + v (V = the speed of light resulting from a motionless source). Let us indicate by u the speed of the mirror counted gradually when

([1]) *Comptes rendus*, vol. **167**, 1918, p. 71.

the mirror flees in front of the radiation. That is to say:

$$y_0 = a \sin \frac{2\pi t}{T_m}$$

movement in the incident plane of the mirror. At a distance x of the mirror movement y due to the incident light will be identical to the movement in the plane of the mirror at the time $t + \frac{x}{V + v - u}$. We will therefore have:

$$y = a \sin \frac{2\pi}{T_m}\left(t + \frac{x}{V + v - u} \right)$$

The reflection taking place with change of sign, the mirror functions as a source whose movement is:

$$y'_0 = a \sin\left(\frac{2\pi t}{T_m} - \pi \right) = -a \sin \frac{2\pi t}{T_m}$$

Reflected light is propagated with an absolute velocity that or can indicate by $V + v'$, i.e. a speed relative $V + v' + u$ compared to the mirror. At the distance x from the mirror, the considered movement will be thus

$$y' = -a \sin \frac{2\pi}{T_m}\left(t - \frac{x}{V + v + u} \right)$$

That gives for the resulting movement

$$\begin{aligned} Y = y + y' = 2a \sin \frac{\pi x}{T_m}\left(\frac{1}{V + v - u} + \frac{1}{V + v' + u} \right) \\ \times \cos \frac{2\pi}{T_m}\left[t + \frac{x}{2}\left(\frac{1}{V + v - u} - \frac{1}{V + v' + u} \right) \right]. \end{aligned}$$

We deduce, for the distance between two nodes, or half-length the apparent wave,

$$\frac{\lambda_m}{2} = \frac{T_m}{\dfrac{1}{V + v - u} + \dfrac{1}{V + v' + u}}$$

The period T_m of reception of the waves on the mirror is calculated easily according to the period T of the source: it is a problem similar to that of the letters. One finds

$$T_m = \frac{TV}{V + v - u} = \frac{\lambda}{V + v - u}$$

While carrying in the equation giving λ_m and by taking account of what V is very large compared to v and with v', one obtains the approximate expression

$$\lambda_m = \lambda \left(1 + \frac{v'}{2V} - \frac{v}{2V} + \frac{u}{V}\right)$$

According to the formula of Doppler one must have

$$\lambda_m = \lambda \left(1 + \frac{u}{V} - \frac{v}{V}\right)$$

The two formulas coincide if $v' = -v$.

However, in the theory of Tolman, a mirror behaves like a new source. That would give, with our notations, $v' = -u$.

In the theory of Thomson-Stewart, all occurs as if the mirror did not exist and that or with source deals which moves like the image given by the mirror. One thus has $v' = v - 2u$.

In the theory of Ritz, the light, after reflection, is propagated as if it came from a center which moves with the speed of the source. Then $v' = -v$. It is well the result obtained presently.

Consequently, the fact that the formula of Doppler is checked when one measures the wavelength by means of an interferometer invalidates the theories of Tolman and Thomson-Stewart, but happens to be consistent with both the theory of Lorentz and that of Ritz.

When the light, resulting from a fixed source as compared to the ground, is reflected on a mirror moving, it preserves, according to the theory of Ritz, a constant speed V compared to ground. The movement of the mirror produces an effective change wavelength which is the same one in the theory of Ritz as in that of Lorentz. There is still, in this case, complete identity between the results given by the two theories.