The Doppler Effect and the Ballistic Principle about the Speed of Light.

(Reply to a communication from Prof. *W. de Sitter*.) By M. La Rosa.

In the last issue of the Bull. Astr. Institute of the Netherlands [1]) Prof. *de Sitter* is busy with my astronomical prove the applicability of the rule of the addition of the velocities of classical mechanics the light and with the general explanation of the phenomenon of the "variability of the stars" which I deduced from it have [2]).

Although he was the correctness and novelty of my conclusions .recognises, he says, that they have no argument for the ballistic hypothesis, but probably a new one against added the same.

In fact, he claims that when the variability the stars on the effect I foresaw, namely that is dependent on the periodic movement of the light source changes in brightness, based on the changes in the apparent magnitude with enormous much larger displacements the spectral lines by Doppler effect than the previously measured it should go hand in hand. After all, according to *de Sitter* photometric effect (as I precede mine~and Doppler effect in the same way depend on one and the same size.

If this were correct, then of course the ballistic hypothesis in full contradiction with the results astronomical observations, which are always right small line displacements (a fraction of the Angstrom unit) and on the other hand, detect changes in brightness, who can achieve the ratio 6o,ooo:1, as those the jumps of about I are 2 steps in the scale of the sizes correspond.

It is therefore my duty to lay the foundations of the verifying *de Sitter's* assertion and those elements of judgment to are suitable to confirm the same or to deny it.

The essential key of the execution of *de Sitters* is expressed in the following lines:

"When the light source is switched off during the time interval dt emitted waves to the observer during the intervals dt' = dt (1 + q); then the observer will on the one hand, the brightness of the moving star $i = t_0 / (r + q)$, where i_0 is the true brightness, and on the other hand the radial velocity $v = cq$ in the wetness of Doppler vision attributing principles ... So, both effects are from the it depends on the q factor."[3])

Here an important question immediately arises for us: Is it possible to determine the extent of the Doppler effect on the the basis of ballistic theory using the simple the ratio dt'/dt, which is the classical theory (and which is served by relativity), to calculate?

That is, when calculating the type of this effect, the the profound change affecting the ballistic hypothesis due to the variability of the speed of light, no influence whatsoever.?

It is easy to understand that there must now be an influence.

In the case of classical theory, the connection can be between the departure time Δt certain group of waves from the light source and the time of arrival $\Delta t'$ at the observers as a

result of the assumed constancy of the speed of light no other elements except the relatively speed of the light source and the observer. In the case of the ballistic hypothesis, on the other hand, the same connection the successive changes of these speed and distance d between light source and observers included.

It is therefore necessary to examine in detail the role which these new factors, namely the law of change the speed of propagation of light and the distance d, in relation to the Doppler effect, just as I have analyzed the role they play in relation to play the photometric effect.

Therefore, I want the consideration that leads to the adoption of the Doppler effect and leads to the establishment of its laws, both in classical theory and in ballistic start again from scratch.

We start with the classic: Let's assume that the light source has the radial velocity v in relation to the observer. Is n the number of waves emitted in one second, so distribute waves along the radius of vision on a length $c + v$ (v speed of the distance of the light source from the observer) jamming on the length c, and therefore receives the observer, since c is the rate of reproduction of the there are as many waves in a second as there are on a length c, i.e., a number n', which is given by equation:

$$n/n' = (c+v)/c$$

which, within the first order of the ratio v/c, gives:

$$n' = n(1-v/c). \tag{1}$$

We can also say that the observer in a second, the waves that the light source receives in the time $c/(c+v)$ or, with the usual approximation, in the time $(1-v/c)$ is emitted.

This reference to time rather than number the wave is therefore not essential; it is only through the hypothesis of the constancy of the reproductive organs: the speed of the light waves is justified; for these alone can the intact preservation of the temporal and spatial ensure sequence of running waves, which is a necessary condition in order to get from the assumption about the number of waves passing at the time can.

We now come to the ballistic theory.

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1) Vol. II, No. 57, pp. 121, 31 May 1924.

2) Rend. Ace. Lincei, vol. 32, Zeitschr. f. Phys., Vol. 2I, H. 6.

3) The same conclusion had already been made by Dr. *Zurhellen* (*Zurhellen*, AN 198. I, 1914).

Is n the value given by a light source in one second number of waves (it does not need to be pointed out that it is no longer possible to be here by "waves" in the same sense as in the classical theory happens, but from impacts, projectiles, etc.) and is c the speed at which you are moving from the light source they will be expelled, while these (in relation to the observer) with the velocity v[1]), so the waves will always be independent of v distribute the length c and counteract it with the speed c-v the observer is walking. This can therefore be done in a second as many as there are c-v on the length, and thus one number n', which is given by:

$$n' = n \cdot (c-v)/c = n(1-v/c) \qquad (1')$$

a result that is (within the usual order) with what is foreseen by classical theory cover.

Thus, the ballistic hypothesis preserves unchanged the law of the dependence of the Doppler effect on the conditions of observation: that is, it preserves its independence from the relationship between speed the light source and time, and the distance between light source and observer; it preserves the same connection (1) between the n and the velocity v. The But the transition from the ratio of the numbers n to the the ratio of departure and arrival times is in this no longer legal.

The variability of the speed of reproduction obviously, the consequence is that the sequence with which the waves are observed by the observer arriving, is not the same as with the emission.

The waves that left at a certain moment catch up with previously departed waves and leave them behind are caught up by waves that have departed later and left behind by these. Note, however, that the location of the lines in the spectrum is not different from the total number which depends on the waves that occur in a very short interval Δt arrives at the spectral apparatus, but from the the rhythm with which they follow each other. The change in the rate of propagation, however, produces densifications and dilutions of waves, causes the density with which they flow together in front of the spectral apparatus to increase or decrease, but the task of this apparatus is precisely to discipline the tangle, to analyze and isolate the individual superimposed components in order to order them according to the magnitude of their rhythm; according to that magnitude of the time interval that characterizes each elementary radiation. This magnitude of the interval may undergo changes based on the movement of the light source, but these are the ones calculated above and represented by the formula (1) or (1').

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1) In view of the extreme smallness of the periods of light oscillations in relation to the rotation period of the celestial body (which however it may be), it can always be assumed that in the time in which the considered n waves are emitted - namely in one second -, the radial velocity of the star does not change.

In short, the light densifications and dilutions that I foresee, which are caused by the temporal variability of the radial velocity of the star, are quite analogous to those that we could artificially cause, for example, by covering a part of the surface of a luminous body located at a great distance with some periodic regularity. To the extent that the uncovered area grows, the strength of the flood of light undoubtedly grows. Waves emanating from different points of the emitting body are superimposed and overlapped along each direction, but no one will ever think that on this compaction a shift of the spectral lines must follow, although there is no doubt that the total number of rays passing in one second on the spectral apparatus arrive, have to change. The position of the line is changing not because the rhythm of the waves does not change!

After that, the incorrectness is completely clarified, which one falls into when one applies the Doppler effect on the the basis of Ballistic theories on the basis of the ratio $\Delta T/\Delta t$, and it is therefore the first of Dr. *Zurhellen* and now raised objections by Prof. *de Sitter* completely obsolete.

I could stop here if I didn't do it for I would like to take this opportunity to share my opinion - which I have already expressed on another occasion -about another seemingly more serious objection to speak out against the ballistic theories raised it is also used by people who also rely on the supports Doppler effect.

We have seen above how we can use the Ballistic Theory (since the speed of the "waves" in terms of the light source remains independent of its movement) it is necessary that the n waves emitted in one second spread over a length c, both at rest and in even when moving in relation to the observer light source. In other words, according to the Ballistic Hypothesis the wavelength must remain independent of the speed of the light source, and therefore – close the opponents - the Doppler effect would have to be omitted.

Now this objection presupposes that the situation of the Spectral lines are dependent on the wavelength, while, as is known, it is not yet possible at present to assert whether this situation - always according to the classical theories of light- of wavelength or of vibrational number is dependent. Rather, it is yon importance- to establish, that both in the study of the dispersion phenomenon as with the calculation of the Doppler effect, the classical Theory and electromagnetic theory are forced, always focus on the vibration number and not on the to support wavelength.

But not enough with that; the term wavelength is no primary element of the light phenomenon, such as the the whole complex of acquired experiences. These only teach us that the light has periodic properties which means that the light emitted by a monochromatic all of these occurrences over a certain period of time, the period of special radiation, are linked.

The wavelength is an addition of ours, a whole and even to the image, to the arbitrary mental scheme, that we have formed from the appearance, bound fiction and falls as soon as we abandon this image.

So there is no sense of constancy of waves·speaking at length on the ground of ballistic theories; and also the relative objection regarding the Doppler effect can have no

meaning, unless one is a priori a special arbitrary scheme value and power of a wall·I wanted to acknowledge the free "truth".

Before I close, may I be permitted, with a few to respond to another small objection, which Prof. *de Sitter* gives me. He doesn't think it's right to assert - as I have done - that the only Stars for which Kepler's laws are currently confirmed which are optical double stars, and reminds I am reminded that even for the spectroscopic double stars these laws can be considered confirmed, since they in the railway regulations with the help of the measurements of the radial velocities are assumed.

Speed measurements have been calculated where Kepler's laws are accepted as true were considered to be known by other means. But without insisting on this point, I still mention will, that it is said in my work: "the double stars, for which Kepler's laws have been "directly" confirmed they are telescopic," and this alone interested it in order to establish it as proven to in the case of telescopic observations (the the only ones who support those of Prof. *de Sitter* in his communication from 1914, could suffer disruptions) the condition *Kb* specified in my work is less than 1/30 is more than fulfilled.

Finally, I have the confidence that these are my explanations will be enough to lift any doubt, and on the other hand, I hope that the same is true for astronomers would like to get to know my views and to deal with them for the purpose of sharp verification, thus, my attempt to understand the abstractions of "relativity" strong factual evidence, and the great·similar and dark phenomena of the "variable stars" to give a coordination, either to support or reject it.

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