

PHYSICAL ASTRONOMY. – *Variable stars with continuous variation and the Ritz hypothesis.*

Note by MM. **Charles Nordmann** and **C. Le Morvan**.

It is known that the remarks made by Mr. de Sitter about double stars were referred to by Einstein in the following terms in favor of the constancy of the speed of light: "A reasoning deduced from the observation of double stars made it possible for Dutch astronomer de Sitter to show that the speed of propagation of light could not depend on the speed of motion of the light source" ⁽¹⁾. Mr. de Sitter's argument essentially consists in the remark that if

⁽¹⁾ *The restricted and generalized theory of relativity* (Carrying translation), p. 15 (Gauthier-Villars).

the light rays sent to us by the components of orbiting double stars combine their speed with that of the source, this would produce *overlappings* between the rays emitted by star at the different phases of its movement. Indeed, the rays emitted when the star moves away from us would propagate towards the Earth with a speed less than those which it emits when it moves towards us ⁽¹⁾. These overlappings, Mr. de Sitter points out, could not enable us to accurately follow the movement of the revolving star and discover its laws, contrary to what results from the observations made of double stars.

Recently, Mr. La Rosa, of Palermo, took up the detailed analysis of Mr. de Sitter's argument ⁽²⁾. The conclusion of this analysis is that the overlappings in question, supposing that they exist, could only produce unobservable effects in certain cases, notably when the time taken by the star's light to reach us is not a very large multiple of its period; such would be precisely the case of known spectroscopic double stars, and one could conclude from this that the observation of these stars shows nothing either for or against the hypothesis of the constancy of the speed of light.

Without wishing to intervene in the discussion which currently continues on this subject between Messers de Sitter and La Rosa, we should like to make a remark given rise to by the latter's recent research. Pushing his argument further and rejecting as not demonstrated the principle of the constancy of the speed of light, Mr. La Rosa admits on the contrary, in accordance with Ritz's ballistic hypothesis, that speed of light is combined with that of the source. The overlappings which were in question must therefore, according to him, always occur; and in a large number of cases, notably when the orbital double star is sufficiently distant, they must result in, for the observer on Earth luminous fluctuations of the star. It is thus that Mr. La Rosa ⁽³⁾ is led to explain the light curves of variable stars with continuous variation by the means of these overlappings.

Now, there is a fact of experience which appears incompatible to us with

⁽¹⁾ *Phys. Z.*, vol. **14**, 1913, p. 421.

⁽²⁾ See in particular *Nuovo Cimento*, January-February 1924, p. 324-357.

⁽³⁾ See in particular *Memoirs of the Italian Astronomical Society*, vol. **2**, no.4, 1924, p. 324-357.

this theory or at least unexplainable by it and which was previously demonstrated by one of us (¹). This fact is that the amplitude of the luminous variation of variable stars with continuous variation is not the same in the different regions of their spectra. We showed that for β Lyrae and δ Cephei, which are the two typical stars of this category, the variation expressed in photometric stellar magnitudes have the following amplitudes: for β Lyrae: 0.66 in the red; 0.94 in the green; 1.34 in the blue; – for δ Cephei: 0.67 in the red; 0.77 in the green; 1.16 in the blue. These results have since been confirmed, notably by the astronomers of Yerkes Observatory and extended to all stars of these types which have been studied. In particular, Mr. F.-C. Jordan (²) in 1919 took up this study by a photographic method which significantly corresponded to the same medium wavelengths as those corresponding to the green and blue screens of our heterochromatic stellar photometer, found that for δ Cephei the amplitudes of the variation in the two studied regions of the spectrum are respectively 0.73 and 1.20. These figures and especially their ratio are almost identically the same as we had found fifteen years ago.

If the luminous fluctuation of stars with continuous variation was due to the mechanism which Mr. La Rosa invokes, the amplitude of the variation would be necessarily the same in all the regions of the luminous spectrum, since moreover it is observed that the phases of the fluctuation are practically synchronous for all the rays of the spectrum.

This conclusion is of such a nature as to invalidate the interesting and bold extension, which was made by Mr. La Rosa, of Ritz's ballistic hypothesis.

(¹) Ch. Nordmann, *New research on variable stars* (*Comptes Rendus*, vol. **146**, 1908, p. 518-520).

(²) *Astrophysical Journal*, vol. **50**, October 1919, p, 174.