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Comment on *A Lecture Course in Natural Sciences* by O E Akimov

N V Kupryaev

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O E Akimov ***A Lecture Course in Natural Sciences*** (Moscow: YUNITI-DANA, 2001) 639 pp. ISBN 5-238-00268-8.

In 2001, the YUNITI-DANA publishing house in Moscow issued a book under the title *A Lecture Course in Natural Sciences* (and recommended, parenthetically, as an undergraduate-level textbook by the Teaching and Methodical Center 'Professional Textbook'), in which relativistic physics and indeed many aspects of basic classical physics as a whole came under sharp and harsh language criticism from O E Akimov, the author. What suffered most were the classical Doppler effect and the Michelson – Morley experiments. Mr. Akimov claims that the classical Doppler effect formulas that are found in thousands upon thousands handbooks, textbooks, and books around the world are incorrect, that they were thought up by nasty and evil people who made a mockery of science only to be able to move on with their serene and happy lives on Olympus, and, finally, that the only correct formula is a 'constructive' one he himself derived.

Actually, nothing is wrong with the Doppler effect formulas or Michelson – Morley experiments, nor, for that matter, with all those people through whose efforts these phenomena were predicted, discovered, and investigated. The search for knowledge is a natural process, and surely it was not the author of the textbook but the special theory of relativity which first explained (or more precisely, predicted and discovered) the transverse Doppler effect. The negative result of the Michelson – Morley experiments, as is known, is explained by the Lorentz longitudinal shrinkage of length of moving bodies. Apparently, it is the author himself who is not entirely OK.

Turning, then, to the textbook, here is what we read on its 96th page: " ... Today it is difficult to establish for certain who was the first author of the following formulas that appear in all modern handbooks or textbooks:

$$\lambda' = \lambda\,\frac{1-\beta_2\cos\theta_2}{1-\beta_1\cos\theta_1}\,, \quad f' = f\,\frac{1-\beta_1\cos\theta_1}{1-\beta_2\cos\theta_2}\,, \tag{1}$$

and it is only guesswork what the logic behind them was. It seems that the author, manifestly not a constructivist-minded person, considered it enough to append to the relative velocities β_1 and β_2 the respective factors $\cos\theta_1$ and $\cos\theta_2$ in order to account for all the directions the vectors $\mathbf{v}_1$ and $\mathbf{v}_2$ can have...

... This unknown author", Akimov goes on, "apparently was of the view that a fixed observer A looking at a right angle ($\theta_2 = 90°$) at moving source i will see no change either in the wavelength λ' or the vibration frequency f':

$$\lambda' = \lambda(1-\beta_2\cos 90°) = \lambda\,, \quad f' = \frac{f}{1-\beta_2\cos 90°} = f\,. \tag{2}$$

But this logic is clearly wrong. Our Fig. 4. 16 (reproduced as Fig. 1 here, N V K) demonstrates (see the dashed line, N V K) that at the observation angle $\theta_2 = 90°$ the Doppler effect clearly shows up because $\lambda' < \lambda$ ... By using elementary logic — or directly measuring on the drawing — it is found that the only true values of the perceived wavelength λ' and vibration frequency f' are

$$\lambda' = \lambda\sqrt{1-\beta_2^2}\,, \quad f' = \frac{f}{\sqrt{1-\beta_2^2}}\,. \tag{3}$$

If 'classical' physics rejects the possibility of the so-called *transverse Doppler effect* at $\theta_2 = \pm 90°$, relativistic physics, on the contrary, admits it, and the fact that the received frequency f' increases relative to f is explained in this wonderful theory as resulting from the time (τ) dilation:

$$\tau' = \tau\sqrt{1-\beta_2^2}\,. \tag{4}$$

In one of his early works titled "On the possibility of a new test of the relativity principle", Einstein directly points to this 'relativistic' effect as a possible experimental verification of

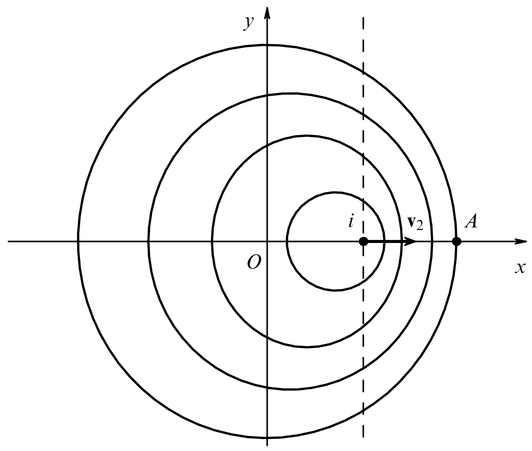

Figure 1. The Doppler effect: receiver A is at rest, source i is moving with a velocity $\mathbf{v}_2$ in the direction toward the receiver A.

N V Kupryaev. Samara Branch of the P N Lebedev Physics Institute, RAS
ul. Novo-Sadovaya 221, 443011 Samara, Russian Federation
Tel. (7-8462) 926 12 26
E-mail: kuprjaev@front.ru

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the relativity theory. So it happened that, unnoticed by *classical* physics, the transverse Doppler effect started 'working' for the benefit of *nonclassical* physics. The reader can easily see for himself that the natural phenomenon we are considering is of quite 'classical' origin. I think it can hardly be objected to that the way circles spread over the surface of water is as shown in Fig. 4.1b. What grounds, then, do the relativists have to think the propagation of electromagnetic waves has a different nature? None whatsoever! All imagination-lacking phenomenalists are strongly advised to use a ruler and compasses to make a drawing of a moving source. Taking $\lambda = 30$ mm and $\beta_2 = 2/3$ then will yield $\lambda' \approx 22.4$ mm at the observation angle $\theta_2 = \pm 90°$, precisely corresponding to the original wavelength λ being reduced by a factor of $(1-\beta_2^2)^{1/2}$. The case $\lambda' = \lambda$ is possible, but the corresponding observation angle is different: $\theta_2 \approx \pm 110°$.

So, to sum up, does it all mean that the 'classical' formulas

$$\lambda' = \lambda(1 - \beta_2 \cos\theta_2)\,, \quad f' = \frac{f}{1 - \beta_2 \cos\theta_2} \tag{5}$$

are incorrect? That all the handbooks, textbooks, and books in the world tell us outrageous lies about a simple discovery made a hundred and fifty years ago? Yes, my dear reader, this is unfortunately the case. For a century and a half, bad and evil people have been entering good old science to make mockery of it. They devised that space contracts and time slows down, but is it not their own brains where such weird things occur? While some not very clever people indulged themselves in fantasies about space and time, others sang their praises. Never believe their cranky idea of the special nature of light. What these slippery little liars actually have in mind is that the Olympic heights of science will be theirs forever — and they will not stop at doing the meanest things one can think up to achieve this goal. They have already corrupted the lives of many thousands of true scientists, and you have my word on it that there are many hundreds more all the world over to follow. This is by no means to say that Einstein or a handful of exalted people are to blame for all this. It is in fact a huge complex of social and psychological factors which is at issue here, and so our task here is not to provide a correct formula describing the Doppler effect — which, of course, is important — or not even to subject the formal phenomenological theory of relativity to severe constructivism-based criticism — which of course we will; our main task here is a larger-scale one — to identify the fundamental social and psychological mechanisms responsible for the hideous troubles that plague modern natural science. The subsequent sections will show the reader the real position of a science totally unprotected from even very severe mistreatment. Meanwhile, however, in the remainder of this section and in the next, the Doppler effect and all directly related topics will be further discussed ..."

So, first of all, the author might note, of course, that in relativistic physics the transverse Doppler effect is by no means described by Akimov's formulas (3) but rather is given by the expressions

$$\lambda' = \frac{\lambda}{\sqrt{1-\beta_2^2}}\,, \quad f' = f\sqrt{1-\beta_2^2}\,, \tag{6}$$

meaning that it does not lead to a violet shift, as in 'constructive' Akimov's theory, but rather to a red shift. There is therefore no way for Akimov's formula to play into the hands of relativistic physics.

Second, the author, being apparently the captive of his own misconceptions, distorted the physical meaning of the angle θ_2, and Fig. 4.1b in this case has no relation to the transverse Doppler effect. The wave detected by observer A was emitted by the source not at point i but at point O. θ_2 is the angle, at the instant of emission, between the radius vector $\mathbf{R}$ of the observation [the wave (photon) propagation direction] and the source velocity vector $\mathbf{v}_2$, as shown in Fig. 2. The direction in which observer A sees the source is not along the dashed line, as the author mistakenly indicated in Fig. 4.1b, but rather toward point O where, as shown in Fig. 2, the source was when the first wave was emitted (note the finite wave velocity). Hence, for the situation illustrated in Fig 4.1b, the angle $\theta_2 < 90°$. These are elementary facts which should of course be familiar to the author. And he should also observe that the dashed line in Fig. 4.1b does not coincide with the normal to the propagating wave. The observed wavelength λ' of the radiation which is detected by observer A (hence the term 'observed wave') is not $\lambda' = \lambda(1-\beta_2^2)^{1/2}$, as the author claims, but is equal to the distance between the last two neighboring wave crests as measured along the dashed line in the direction toward point O_1 (see Fig. 2), where the second wave was emitted (and not in the direction toward point i) — which is approximately $\lambda' \approx \lambda(1 - \beta_2 \cos\theta_2)$. The wave emitted from point i has not yet reached observer A. In the limiting case, this formula goes over to the exact classical Doppler effect formula $\lambda' = \lambda(1 - \beta_2 \cos\theta_2)$, provided that the distance between observer A and the source is very large compared to the radiation wavelength λ' (in which case the dashed line in Fig. 2 practically coincides with the radius vector $\mathbf{R}$ of the observation).

At the instant of time when the observer A detects the wave emitted by the radiation source at point O, the source may be anywhere and is still inaccessible to the observer A in the sense that the information (i.e., the wave) has not yet reached him. To take an example, what would the author do to observe the Doppler effect of a distant star 10 billion light years away? Where would he direct his telescope? Right you are, he would direct his telescope at the apparent position of the star, the place where it was 10 billion years ago — not toward a point where it may presumably be at the instant of observation. Precisely where the star is at the instant of observation is anybody's guess, including, perhaps, the

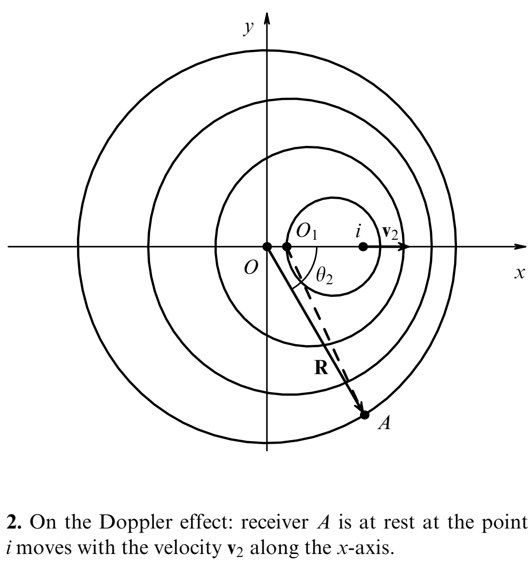

Figure 2. On the Doppler effect: receiver A is at rest at the point (x, y); source i moves with the velocity $\mathbf{v}_2$ along the x-axis.

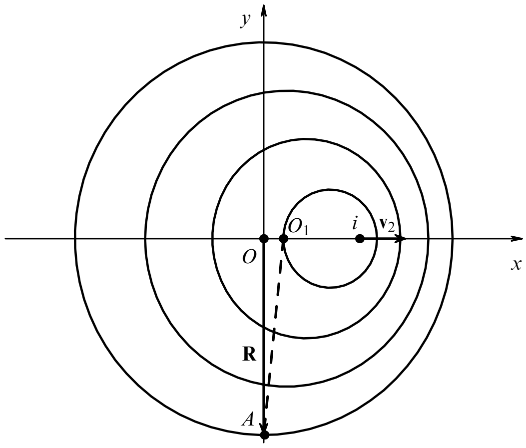

Figure 3. On the transverse Doppler effect: receiver A is at rest on the y-axis; source i moves with the velocity $\mathbf{v}_2$ along the x-axis.

author's. In the course of these 10 billion years, the star may have moved far away from the position where the wave was emitted, or it may have burned out, or exploded, or changed its direction of motion, and so on, and so forth — and it will take another 10 billion years to learn what exactly has happened to it.

To observe the transverse Doppler effect, observer A must be placed as shown in Fig. 3. In this case, $\theta_2 = 90°$, and the observed radiation wavelength λ' is indeed approximately equal to $\lambda' \approx \lambda$, where λ' is the distance between the last two neighboring wave crests, as measured along the dashed line in the direction of O_1, as shown in Fig. 3. The source itself can be anywhere by the time of observation. In the limit, this formula goes over to the exact classical formula for the transverse Doppler effect: $\lambda' = \lambda$, corresponding to the case in which the distance of observer A from the radiation source greatly exceeds the radiation wavelength. Which means that the transverse Doppler effect does not show itself in classical physics.

To conclude, dear reader, it is a physics ignoramus by the surname of Akimov who makes a mockery of the good and great science, not the evil people who entered it a century and a half ago. And recommending his lecture course as an undergraduate-level textbook is, in my view, a less than advisable idea on the part of the Teaching and Methodical Center 'Professional Textbook'.

N V Kupryaev