makes evident the vast possibilities of using hybrid nanomaterials. Combining colloidal semiconductor nanoparticles (quantum dots) and organic interfaces does lead to a qualitatively new display type, which possesses a long operating lifetime, a high luminous efficiency, and the possibility of tuning the output radiation wavelength throughout the visible spectral range. It is evident that optoelectronic devices of this kind would be in demand by the industry. On the other hand, the complexity of the organic interface–quantum dot system is of considerable interest for fundamental physics.

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Direct experimental demonstration of the second special relativity postulate: the speed of light is independent of the speed of the source

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In memory of S I Vavilov
and his Postdoc A M Bonch-Bruevich

1. Introduction

Special relativity is undoubtedly the most famous physical theory. The popularity of the special theory of relativity (STR) is related to the simplicity of its main principles, the imagination-staggering paradoxicality of the conclusions, and its key position in 20th-century physics. Special relativity has brought unprecedented fame to Albert Einstein, and it is this fame that became one of the reasons for incessant attempts to revise the theory. Among professional physicists, the debates around STR ended more than 50 years ago. A quotation from Wikipedia: "All the experimental data of the high-energy physics, nuclear physics, spectroscopy, astrophysics, electrodynamics, and other fields of physics, within the experimental errors, perfectly agree with the STR. In particular, in quantum electrodynamics (unification of the STR, quantum theory and Maxwell equations), the value of the anomalous magnetic moment of electron coincides with theoretical calculations to within 10^{-9}."

Still, editorial boards of physical journals continue to be bombarded by amateurish proposals to revise the STR [1] (see also paper [2]). In spite of an infinite amount of evidence of the validity of the STR available nowadays, efforts to refute or to essentially revise it do not cease, being motivated by the insufficient reliability of experimental confirmations of its basic principles, including, in particular, its second postulate, which states the constancy of the speed of light for all inertial reference systems regardless of the light source velocity. It is noteworthy that, most frequently, the criticism is directed at earlier experiments aimed at searching for the 'ether wind' [3], which were traditionally considered as almost the only experimental proof of the validity of the STR. While not penetrating into the pages of serious scientific literature, the attempts to revise the STR overwhelm the mass media and Internet, which cannot help disorienting unprofessional readers, including schoolchildren and students. The situation was additionally aggravated in the years of celebration of the centenary of the relativity theory, counted from the date of publication of the historical article by Einstein [4], considered as the birthday of the STR.[1] At the same time, distrust of the STR (from the side of social community unencumbered by knowledge) also existed 60 years ago, when S I Vavilov charged his PhD student A M Bonch-Bruevich with the experiment on direct verification of the second postulate of the special relativity [10].

The incessant attacks on the STR are motivated by discrepancies in evaluation and interpretation of the first relativistic experiments by Fizeau, Michelson, and others. Specifically, one of Michelson's successors — Miller [11] — insisted, until his last years, that, in those experiments, a certain seasonal systematic effect was observed, which he interpreted as a partial drag of the 'luminiferous ether' by Earth upon its orbital motion around the Sun. After definitive establishment of the validity of the STR these experiments have practically ceased to be reproduced, with the accuracy of such measurements still remaining rather low.

There are few who know that the first famous negation of the existence of the 'ether wind' was made by Michelson [12] in 1881 on the basis of rather unconvincing observations. The achieved accuracy of the measurements only slightly exceeded the magnitude of the effect proper expected based on the

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[1] Of the innumerable critical publications, we will restrict ourselves by mentioning only two: the review article of N Noskov, divesting 'centennial relativistic fraud' [5], and the recent publication by Sokolovs [6] reviving the old 'ballistic' hypothesis of Ritz [7]. The jubilee of the STR was celebrated in a peculiar way by St. Petersburg Polytechnical University, which published again, in 2009, the pretentious monograph *Myths of the Relativity Theory* by A A Denisov [8], whose extravagant constructions had been refuted by lecturers of the same university 20 years ago [9].

hypothesis of a 'fixed luminiferous ether'. (It is not a surprise that Einstein did not want to acknowledge this experiment as the one that inspired him to create the STR). In subsequent experiments, much more definite results have been obtained. However, usually some systematic component of the velocity of ether wind (about 10% of the velocity V of the orbital motion of Earth) was observed. Only in the late 1920s was a sufficiently definite negative result achieved: the upper bound of the ether wind velocity was reduced to $\sim 3\%$ of V [3]. Further refinement of these results soon lost its topicality in view of much indisputable evidence of the STR validity accumulated in the process of development of nuclear physics and accelerators, which themselves could not be constructed without using the relativity theory. This knowledge, however, remained the domain of professionals, while popular presentations of the STR traditionally appealed to the Michelson experiments as the only justification of the STR. It is exactly this gap between understanding the measure of validity of the STR by professionals and the wider public that stimulated President of the Academy of Sciences of the USSR S I Vavilov to demonstrate in the middle of the last century the independence of the speed of light from the source velocity in a 'first-order' experiment. Vavilov planned direct measurements of the speed of light c emitted by a source moving with a high speed v, in contrast to indirect measurements in Michelson's experiment, where the expected effect was to be proportional to the square of the ratio v/c.

At that time, the postulate of the independence of the speed of light was explicitly supported only by astronomical observations of double stars. According to de Sitter's idea [13], if the speed of light is dependent on the source velocity, the trajectories of motion of binaries should crucially differ from the observed ones (consistent with celestial mechanics). His argument, however, encountered objection (reproduced in Ref. [6]) related to the role of interstellar gas which, as a refracting medium, should have been regarded as a secondary source of light. From this point of view, the light emitted by a moving source loses the memory of its initial velocity, while propagating in the interstellar medium. Since the characteristics of this medium are known with poor accuracy (as are the absolute distances to the stars), such a position allows one to cast doubts upon most astrophysical proofs of the constancy of the speed of light. (In particular, this kind of criticism was directed at a far more later publication [14], in which the question of existence of variable stars was used as radical proof of the validity of the second postulate of special relativity: for the linear dependence of the speed of light on the source velocity, the light of star of a variable brightness should lose the intensity modulation with increasing distance due to thermal spread of the ray velocities of elementary emitters. So, such stars, in this case, would have been unknown.)

S I Vavilov proposed that his Postdoc working for the degree of Doctor of Sciences, A M Bonch-Bruevich, design a setup with a beam of fast excited atoms as the light source. In the process of detailed elaboration of the would-be experiment, it was found that there was no chance of getting a reliable result because, for the experimental technique of that time, it was impossible to produce beams with the needed velocity and density: the increment of the speed of light in the framework of ballistic theory was expected to be about a few percent, while the light beam intensity was estimated to be too low. The experiment was not realized. After the premature death of S I Vavilov in January 1951, the plan of the experiment was revised on G S Landsberg's initiative, who proposed comparing the speed of the light emitted by two equatorial edges of the rotating Sun. A M Bonch-Bruevich wrote 50 years later [10]: "This proposal deprived the experiment of its original elegance, but was perhaps the only opportunity to lead it to the end even in a strongly deformed shape." The result of this experiment, however, could not be considered proof of the independence of the speed of light of the source velocity, because the light from the Sun was transmitted through a glass objective of a telescope which, in conformity with the concept of reemission of light by the refracting medium, should have equalized the velocities of the two light beams (to say nothing of the effect of Earth's atmosphere).

Since then, attempts to experimentally prove the second postulate of the STR have been repeatedly undertaken (see, e.g., monographs [15, 16] and recent comprehensive reviews by G B Malykin [17, 18]). All the authors of these papers arrived at the conclusion of the validity of the postulate. But this could not cease the flow of critical publications, in which objections against the ideas of the experiments were put forward or their accuracy was questioned. The latter was related, as a rule, to the smallness of the light source velocity compared to the speed of light. The revival of interest in the ballistic hypothesis happened in 1962, when the experimental work of W Kantor, who allegedly discovered changes in the speed of the light passed through a moving glass plate was published [19]. Kantor's work raised a wide discussion, but soon after its results were refuted on the basis of test experiments. Nevertheless, the ballistic hypothesis still remains popular among critics of the STR. In 1980, the Presidium of the Academy of Sciences of Ukraine supported setting up large-scale experiments with M I Duplishchev to check the Ritz hypothesis. The experimentalist, following Kantor's concept, measured the speed of the light passing through a fastly moving refracting medium, which was considered a secondary light source. The author came to the conclusion of the validity of the idea of summation of the speed of light and light source velocity in agreement with the 'corpuscular (ballistic) Newton-Ritz theory,' but did not manage to publish his results in respectable journals. In 2008, an account of these experiments [20] was published by his daughter on a commercial basis.

It seems to us that it is high time to return to S I Vavilov's proposal. Now, that idea can be realized in its 'original elegance', because at present physics has at its disposal an extremely bright ultrarelativistic source. This is a synchrotron emitter with the light emitted by a bunch of electrons moving along a curved trajectory with velocity very close to the speed of light. Under these conditions, the speed of light in a perfect laboratory vacuum can be easily measured. Following the logic of the ballistic hypothesis, this speed should be equal to double the speed of light from a fixed source! This is a very rough effect whose discovery (if it exists) would not require resorting to any special tricks. Indeed, it suffices, for this purpose, to measure the time of flight of a measured distance by the light pulse in a vacuum.

Leaving aside for the moment the details and concrete versions of the experiment, it makes sense to summarize arguments in favor of the expediency of its arranging. Of course, for professional physicists, there are no doubts about the results of such an experiment. In this sense, the experiment seems useless. However, the direct demonstration of the constancy of the speed of light has great tutorial value,

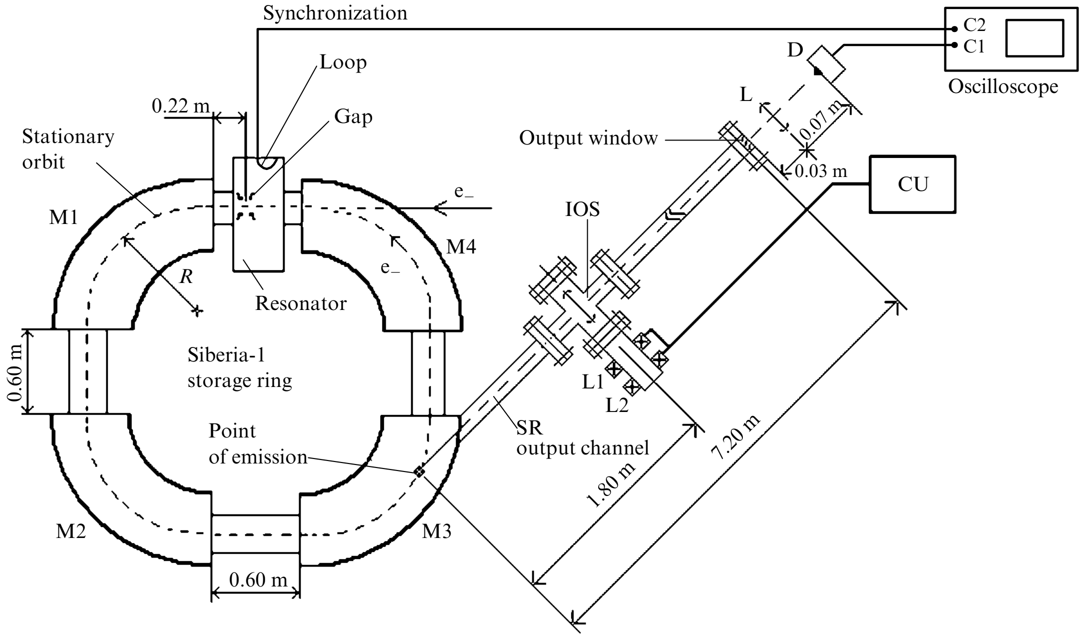

Figure 1. Schematic of the experiment: M1–M4 — corner magnets, IOS — glass plate input/output system, L — collecting lens, D — photodetector, CU — control unit for the IOS, L1 and L2 — induction coils.

restricting the room for further speculations about the insufficient reliability of the foundations of the theory of relativity. Physics, in its evolution, returned repeatedly to the reproduction or refinement of its basic experiments by implementing them with new technical tools. In this case, we do not mean to measure the speed of light with a higher accuracy; we are talking about filling the gap in the experimental validation of the STR basic principles, which should simplify the perception of this fairly paradoxical theory. We may say that we are dealing with a demonstrative experiment for future textbooks on physics.

2. Experimental

As a pulsed light source, we utilized in these experiments a source of synchrotron radiation (SR) — the Siberia-1 electron storage ring at the Kurchatov Center of Synchrotron Radiation and Nanotechnologies of the National Research Centre 'Kurchatov Institute' (NRC KI) [21]. A general view of the Siberia-1 storage ring with a schematics of the SR output and experimental setup is presented in Fig. 1.

The magnetic system of the Siberia-1 electron storage ring forming the closed electron orbit comprises four corner magnets (M1–M4) separated by four 60-cm-long rectilinear segments. The magnetic field induction in the stationary electron orbit reaches 1.5 T. The radius R of the stationary electron orbit in the corner magnets is $R = 1$ m. The nominal electron energy in the storage ring amounts to 450 MeV. Synchrotron radiation created by relativistic electrons in the corner magnets extends over a wide spectral range — from IR and visible to X-ray, with the characteristic wavelength of 61.3 Å. The SR leads to an energy loss of 3.69 keV per round trip for each electron in the beam.

To compensate for the radiative loss of the electron beam in each turn, a radio-frequency (RF) resonator is placed in segment *1* of the storage ring. The power provided by the RF oscillator creates, at the accelerating gap of the resonator, a voltage with an amplitude of 15 kV and a frequency of 34.53 MHz, equal to that of the electron bunch orbital rotation. Under these conditions, the longitudinal distribution of electron density in the bunch is Gaussian with a standard halfwidth of 0.3 m.

Figure 2. Vacuum unit of the glass plate input/output system.

The angle between the axis of the SR output channel, which is tangent to the stationary orbit in magnet M3, and the axis of the fourth rectilinear segment, succeeding magnet M3, comprises 30°. This means that the emission point (the beginning of the path of the SR along the channel axis) is at a distance of $\pi R/3$ from the input end of magnet M3. The length of the channel from the point of emission to the output sapphire window measures 7.2 m.

A glass plate input/output system was placed in the SR channel, at a distance of 1.8 m from the point of emission. It was designed as a vacuum unit (Fig. 2) with a movable frame inside it with two apertures. One of these apertures is supplied with a 1 mm-thick glass window. The frame is mounted on small wheels so that it can move across the axis of the SR channel and be fixed in two extreme positions: in one position, the SR beam passes through the glass plate, while in the other, it passes through the open aperture. The butt end of the movable frame is supplied with a small permanent magnet, while on the outer tube, surrounding the frame, two magnetic coils are mounted, connected oppositely. Upon feeding a DC voltage from the control unit to the coils with one polarity or the other (Fig. 3), due to the interaction of the permanent magnet with the field of the coils, the frame moves in one direction or the other. In this way, the glass window is moved into the zone of the SR beam or is removed from this zone.

The experiment was run using two setups. In the *first*, the time of flight of the light pulse through a fixed distance in a vacuum was measured for two cases: (i) the SR pulse entered the test segment passing through the open aperture of the frame, and (ii) the SR pulse entered the test segment passing through a hole with a thin glass window transparent in the visible spectral range. In the *second* setup, the speed of the light pulse in the vacuum was measured in a straightforward manner: the distance passed by the light was divided by the time of flight.

At the butt end of the vacuum tube of the channel was mounted the output flange with a sapphire window 2.4 cm thick (transmission range 0.17–5.5 μm). At a distance of 3 cm from the output window was placed a collecting lens 1.4 cm thick which focused the SR beam on the sensitive area of the photodetector mounted at a distance of 7 cm from the lens. As the photodetector, we used an Si pin-photodiode Hamamatsu S5972 (spectral range 0.32–1 μm, bandwidth 500 MHz, effective area of sensitivity 0.5 mm^2). A schematic of the pin-diode circuit is shown in Fig. 4.

When the light pulse hits the pin-diode, the voltage created by the photocurrent on the load resistor (50 Ω) is fed, through an RF cable, to one of the inputs (50 Ω) of a Tektronix TDS3052C two-channel oscilloscope (bandwidth 500 MHz). On the other input (50 Ω) of the oscilloscope, a synchronizing sinusoidal RF signal is fed from the pick-up loop of the resonator. To exclude errors related to phase shifts of the signals, we used cables of the same type (RC-50) and the same length (8 m) for transporting the useful signal from the load resistor of the pin-diode and the signal of synchronization.

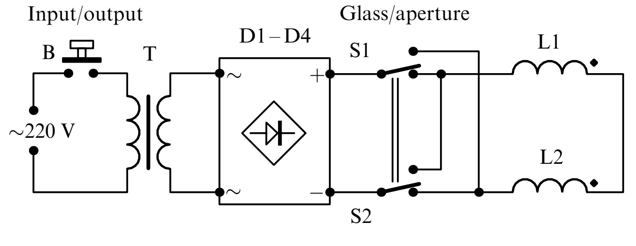

Figure 3. Schematic of the control unit.

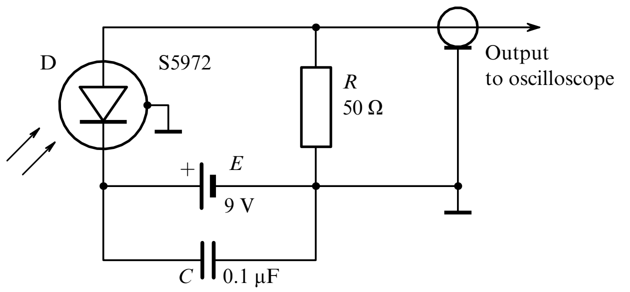

Figure 4. Schematic electric circuit of the photodetector with pin-diode.

Thus, the observer should see in the ideal case a comb of successive near-Gaussian periodic SR pulses with a standard width of 1 ns following each other with a frequency of 34.53 MHz, which are overlapped onto a sinusoidal signal with a frequency of 34.53 MHz.

3. Experimental results

***Setup* 1.** Figures 5 and 6 display experimental oscillograms of pulses of the pin-diode and synchronization signals from the resonator loop. The oscillograms were recorded for the same electron current in the storage ring. As one can see, they are identical from the viewpoint of phase relations between the signals. In other words, the position of the pulses from the pin-diode remained the same with respect to the synchronization signals, regardless of whether the light passed through the glass plate or not.

This means that the speed of the light emitted by the relativistic electrons in a vacuum is equal to the speed of the light that passed through the glass plate in a vacuum, i.e., it does

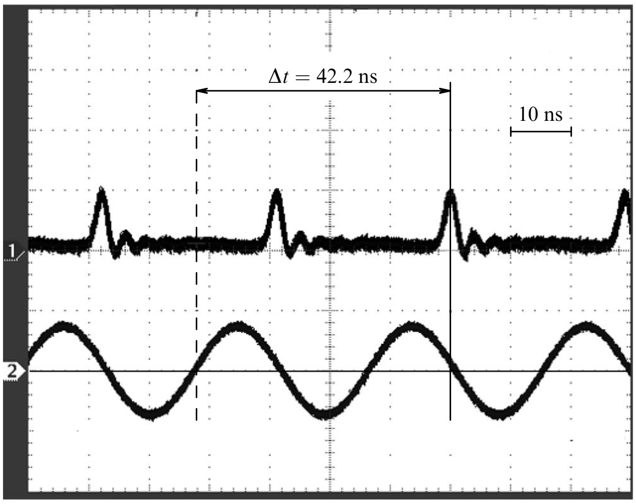

Figure 5. The light signal (channel 1) for the case of light traveling in a vacuum through the test segment with an open input aperture and the synchronization signal (channel 2).

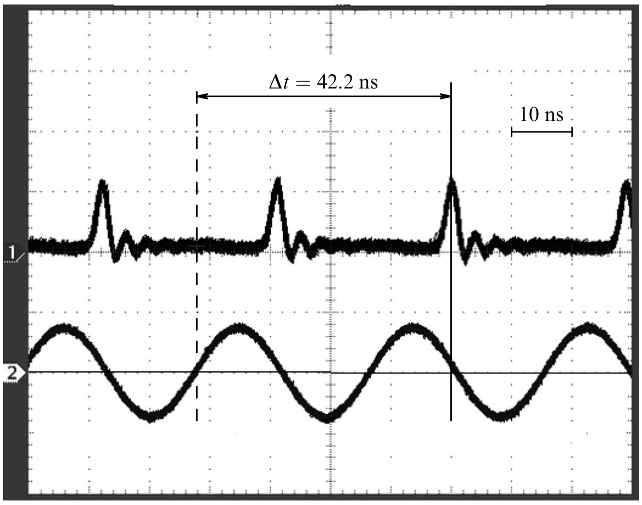

Figure 6. The light signal (channel 1) for the case of the light traveling in a vacuum through the test segment with the input aperture closed by the glass plate and the synchronization signal (channel 2).

not depend on the light source velocity. This result refutes the Ritz ballistic hypothesis.

Indeed, if the speed of the light emitted by the relativistic electrons in a vacuum were equal to $2c$, the light would move along a path 7.2 m long from the point of emission to the output sapphire window in 12 ns.

On the other hand, if the glass plate is placed in the path of the SR beam at a distance of 1.8 m from the point of emission, this plate becomes a source of secondary emission propagating in the forward direction with the velocity c. In this case, the time taken by the light to pass the distance of 7.2 m should be the sum of the times needed to pass the distance from the point of emission to the glass plate (1.8 m) and the distance from the glass plate to the output sapphire window (5.4 m). This would give, in total, 3 ns + 18 ns = 21 ns.

Thus (neglecting the short time delay of light in the glass plate related to its own refractive index $n > 1$), we should detect, on the oscillograms presented in Figs 5 and 6, a phase shift between the optical signals, corresponding to the different instants of appearance of the two input signals:

$$21\ \text{ns} - 12\ \text{ns} = 9\ \text{ns}.$$

It should be noted that the amplitude of the light signal on the oscillogram of Fig. 5 (the aperture with no glass plate) is slightly smaller than that on the oscillogram of Fig. 6 (the aperture with the glass plate), which is explained by insignificant vignetting of the light beam in the horizontal direction by the side edges of the glassless aperture.

***Setup* 2.** Now, using the oscillograms obtained in the first experimental setup, we can estimate the speed of the light emitted by relativistic electrons in vacuum.

The path length l passed by the light pulse from the point of emission to the output sapphire window equals 7.2 m. To calculate the speed of light, we have to measure the time taken by the light to traverse this distance. To do this, we have to know the instant when the electron bunch passes the point of emission in the stationary orbit of the storage ring inside the magnet M3 (see Fig. 1). As a synchronizing signal, we can use the voltage from the pick-up loop of the RF resonator. This loop is oriented in the resonator in such a way that the phase of its output voltage is shifted by 180° with respect to the voltage across the accelerating gap of the resonator. The synchronized electrons pass through the gap at a certain phase φ_s of the accelerating voltage. With a knowledge of this phase and taking into account the configuration of the stationary orbit of the Siberia-1 storage ring, we can calculate the instant of time (phase) when the electron bunch passes the point of emission.

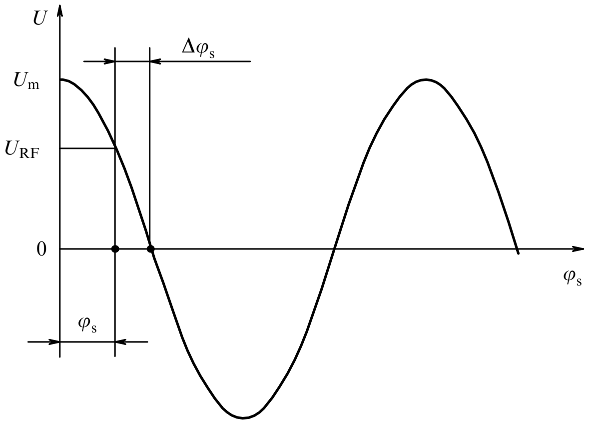

Figure 7. Variation of the resonator voltage in time: φ_s — phase of the synchronized particle.

Figure 7 shows phase dependence of the voltage across the accelerating gap of the resonator. The condition of stability of motion of relativistic electrons in the storage rings requires the electron bunch to pass through the gap of the RF resonator when its voltage decreases. In other words, the equilibrium phase φ_s corresponds to the falling portion of the RF-voltage curve.

The quantity φ_s can be calculated based on the following reasons. Each time that the synchronized particle passes through the gap of the RF resonator, it acquires the energy increment $\Delta W = 3.69$ keV compensating for the SR-related loss per round trip. In turn, one has

$$\Delta W = qU_{RF}\,, \tag{1}$$

where $q = 1$ is the electron charge, and U_{RF} is the voltage across the gap of the resonator at the moment of passage of the synchronized particle. It is known that

$$U_{RF} = TU_m \cos\varphi_s\,. \tag{2}$$

Here, φ_s is the phase of the synchronized particle counted from the peak of the voltage, $T = 0.99$ is the time-of-flight coefficient defined as a result of averaging of the accelerating RF voltage in the resonator gap, both over time and over longitudinal coordinate. Notice that in the case of a uniform strength of the RF field in the accelerating gap of the resonator of length d, we have

$$U_{RF}(t) = U_m \cos(\omega t + \varphi)\,, \quad T = \frac{\sin\psi}{\psi}\,,$$

where $\psi = \pi d/\lambda_{RF}$, λ_{RF} is the wavelength of the accelerating voltage, and $U_m = 15$ kV is the RF voltage in the resonator.

From Eqn (2), with allowance for Eqn (1), we find

$$\varphi_s = \arccos\left(\frac{\Delta W}{qTU_m}\right). \tag{3}$$

Substituting all the known values into formula (3), we obtain

$$\varphi_s = \arccos\left(\frac{3.69}{0.99 \times 15}\right) = 75.61^\circ\,.$$

From here, in accordance with Fig. 7, one finds

$$\Delta\varphi_s = 90 - 75.61 = 14.39^\circ\,,$$

or, in time units, with allowance made for the fact that the RF oscillation period (with a frequency of 34.53 MHz) is equal to 28.96 ns, it gives

$$\Delta t_s = \frac{14.39^\circ \times 28.96\ \text{ns}}{360^\circ} \approx 1.16\ \text{ns}.$$

Let us calculate the electron-bunch time of flight, t_e, of the path L from the accelerating gap in the resonator to the point of emission in the magnet M3. First, based on the geometry of the Siberia-1 storage ring (see Fig. 1), we find the path length L:

$$L = 0.22\ \text{m} + \frac{\pi R}{2} + 0.6\ \text{m} + \frac{\pi R}{2} + 0.6\ \text{m} + \frac{\pi R}{3}$$
$$= 0.22 + 1.57 + 0.6 + 1.57 + 0.6 + 1.05 = 5.61\ \text{m}\,,$$

where $R = 1$ m.

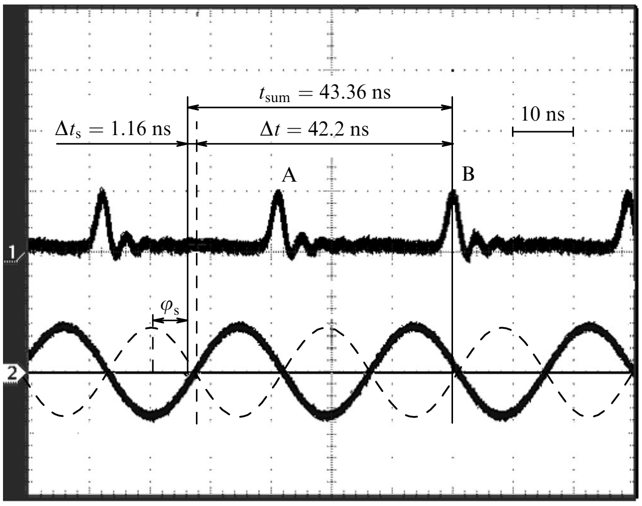

Figure 8. Measuring the light pulse delay in the photodetector with respect to the phase of the synchronized particle in the accelerating gap.

Now, taking into account that the velocity of the ultrarelativistic electrons is virtually equal to the speed of light ($c = 2.997924 \times 10^8$ m s^{-1}), for the time of flight $t_{\rm e}$ of the path length L by the electron bunch, we have

$$t_{\rm e} = \frac{L}{c} = \frac{5.61\ \rm m}{2.998 \times 10^8\ \rm m\,s^{-1}} \approx 18.71 \times 10^{-9}\ \rm s = 18.7\ ns.$$

Consider now the oscillogram depicted in Fig. 8, which reproduces the oscillogram of Fig. 5. In our case, the phase of the voltage (synchronization signal taken from the pick-up loop in the resonator) is shifted by 180° with respect to that of the voltage across the accelerating gap (which is schematically shown in Fig. 8 by the dashed line).

Summing up the above time interval $\Delta t_{\rm s} = 1.16$ ns and the time interval $\Delta t \approx 42.20$ ns measured by the oscilloscope between the fixed cursors (solid and dashed vertical lines on the oscillograms), we find, from the oscillogram of Fig. 8, the time delay $t_{\rm sum}$ in the light signal appearance in the detector with respect to the moment of passing through the accelerating gap by the corresponding electron bunch:

$$t_{\rm sum} \approx 43.36\ \rm ns\,.$$

We consider here the light pulse B emitted by the electron bunch entering the accelerating gap of the resonator at the phase $\varphi_{\rm s}$, whereas the light pulse A is emitted by the electron bunch that had entered the gap one round trip earlier. By subtracting, from this delay, the time of flight $t_{\rm e}$ of the path length L by the electron bunch, we find the time $t_{\rm d}$ for the light to traverse the path from the point of emission to the detector:

$$t_{\rm d} = t_{\rm sum} - t_{\rm e} \approx 43.36\ \rm ns - 18.71\ ns = 24.65\ ns.$$

The total path length of the light pulse counted from the entrance into the sapphire window to the detector equals 13.8 cm: 2.4 cm (sapphire window, refractive index of sapphire $n = 1.765$) + 10 cm (air, 3 cm before the lens and 7 cm after the lens) + 1.4 cm (glass of the lens with the refractive index $n = 1.52$). Light characterized by a speed in a vacuum of 30 cm ns^{-1}, with allowance made for the refractive indices in sapphire and glass, traverses this path in 0.55 ns. The time delay of the electric signal formation in the detector is neglected here.

Bearing in mind the last remark, we find $t_{\rm SR}$ — the time taken by the light to pass the distance from the point of emission to the output sapphire window ($l = 7.2$ m):

$$t_{\rm SR} = 24.65\ \rm ns - 0.55\ ns = 24.10\ ns\,.$$

And, finally, we evaluate the speed of the light emitted by relativistic electrons in a vacuum to be

$$c_{\rm SR} = \frac{l}{t_{\rm SR}} = \frac{7.20\ \rm m}{24.10 \times 10^{-9}\ \rm s} \approx 2.99 \times 10^8\ \rm m\ s^{-1}.$$

The result thus obtained differs from the CODATA recommended value of the speed of light in vacuum by no more than 0.5%.

4. Remarks

In the course of the experiments, considerable efforts were made to eliminate stray pick-up of the accelerating RF voltage to the optical signal detection channel. This synchronized pick-up contained several harmonics of the fundamental frequency and thus strongly distorted initially the useful signal. We managed to get rid of it practically completely using double-screened cables, both in the signal and in the synchronizing channels. The degree of suppression of the interference is demonstrated in Fig. 9, which reproduces Fig. 6 with the photodetector covered with black paper.

The width of the observed optical signal well correlated with the expected value, while its shape revealed a spurious 'ringing' at the trailing edge of the pulse, related to oscillatory processes in the photodetector electric circuits. This distortion of the signal, however, did not affect the accuracy of the measurements. Some idea about achieved measurement accuracy is given by Fig. 10, demonstrating oscillograms of the optical and synchronization signals after digital averaging. The time scale is here extended by a factor of 2.5 compared to the previous oscillograms.

A brief synopsis of this paper is given in Ref. [22].

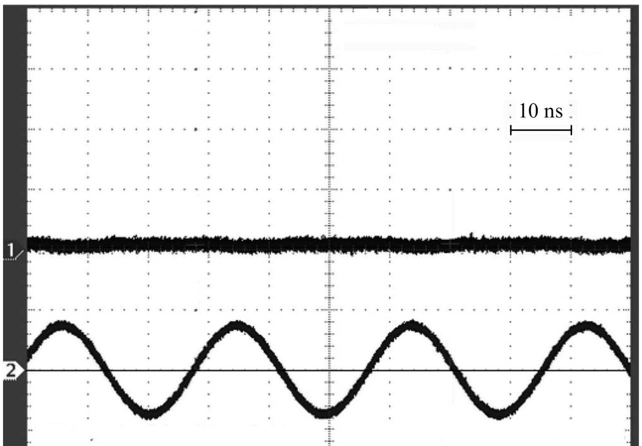

Figure 9. Residual signal of the RF stray pick-up (channel 1) and the synchronization signal (channel 2).

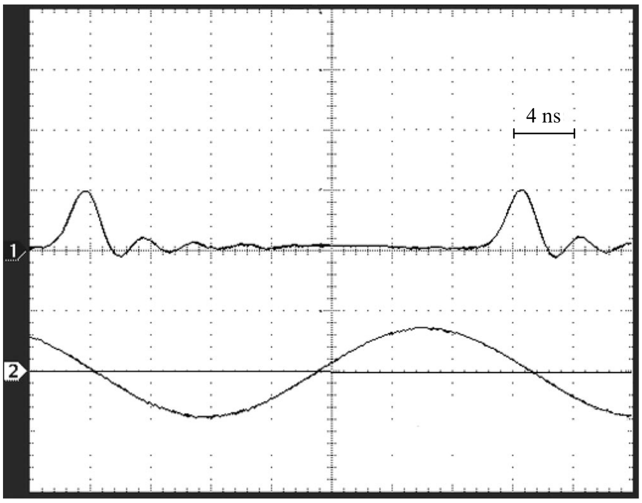

Figure 10. The noise-suppressed signal extended in time.

5. Conclusions

In this work, we directly measured for the first time (to the best of our knowledge) the speed of the light emitted by an ultrarelativistic source. The results obtained here are incompatible with the Ritz ballistic hypothesis which implies adding the speed of light to the light source velocity. It is shown that inserting a glass plate into the light beam does not affect the speed of its propagation to within fractions of a percent, whereas, according to Ritz's hypothesis, the speed of light after its passing through a fixed window should decrease by a factor of 2. The measurements of the speed of light pulse in a vacuum yielded a value differing from its table value by less than 0.5%. The results of the measurements can be considered as the most straightforward evidence of the validity of the STR second postulate.

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Sergei Ivanovich Vavilov as a historian of science

V P Vizgin, A V Kessenikh, K A Tomilin

1. Introduction

"One can hope that the history of science will sometime itself become science. A warrant of this is the obvious growth of natural science and technology and hundreds of thousands of people creating the history of science on the globe in our sight. It is impossible to ignore this powerful natural phenomenon

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