The Sherwin-Rawcliffe Experiment – Evidence for Instant Action-at-a-distance

Thomas E. Phipps, Jr.
908 S. Busey Avenue
Urbana, Illinois USA
tephipps@sbcglobal.net

Since the nineteenth century physical theorists have considered that electromagnetic mass must exhibit tensor properties if causal delays characterize the interactions of electric charges. In 1960 Chalmers W. Sherwin and Robert D. Rawcliffe enlisted the help of mentors of the A. O. Nier high-resolution mass spectrograph to test this hypothesis, using the predicted mass line-splitting of a football-shaped Lu^{175} nucleus of spin 7/2 (a highly asymmetrical charge distribution). No line-splitting was observed. This null result showed that mass behaves in just the way Newton thought, as a scalar, never as a tensor. What, then went wrong with the theory? We argue that the basic assumption of retardation of distant action was at fault, and that the null result in fact provides strong inferential evidence of instant action-at-a-distance of a Coulomb field.

1. Introduction

The question as to whether action-at-a-distance can occur instantaneously has remained moot throughout the evolution of modern physics. Newton raised a “philosophical” objection to the concept, but incorporated it integrally in his mechanics, specifically, in his laws of motion. Without it, for example, the third law of balance of action-reaction would degenerate into an hypothesis about infinite regressions of actions and reactions – an outcome devoid alike of theoretical elegance, mathematical substance, and empirical support. It can be stated categorically that classical physics critically depends upon all distant force actions (as distinguished from radiative actions) occurring instantaneously, not retardedly.

Einstein changed the climate of opinion among physicists on this topic. He maintained that *all distant force actions*, as well as radiative ones, were retarded at speed *c*. In consequence he discarded Newton’s third law, replacing it with nothing. The mathematics required to support such a sweeping generalization was permanently lacking, in that mechanics makes no provision for it and electromagnetism describes force neither as “propagating” nor as subject to a wave equation. Only radiation meets that criterion. Nevertheless, Einstein’s opinion carried so much weight with physicists that most of them, even to this day, almost unthinkingly subscribe to his view.

Because of the difficulty (indeed, the near impossibility) of conducting laboratory experiments to measure directly the speed of distant force action, theorists have tended to treat this as a playground in which they can disport themselves without empirical constraints. It happens, however, that one experiment [1], conducted by C. W. Sherwin and R. D. Rawcliffe in 1960, but never reported in the open literature, possesses a direct bearing on our topic. So, in fact there are empirical constraints of which most physicists remain presently unaware. The purpose of this paper is to correct this by describing the Sherwin-Rawcliffe experiment and discussing its physical implications for instant action-at-a-distance.

In brief, what the Sherwin-Rawcliffe experiment proved directly was that mass is a scalar quantity – even the mass of an asymmetrical nucleus for which retarded-action theory explicitly predicts a *tensor character* of electromagnetic mass. It was a null experiment, like that of Michelson-Morley. Had the supposition of tensor character of mass been valid, line splittings in a mass spectrometer would have been observed that were not observed. Such a qualitative failure of causal retardation to fit with empirical fact provides strong inferential evidence favoring instantaneousness of distant force action-reaction. Wherever an electric "potential hill" may be pictured as surrounding an arbitrarily-moving charge, that hill, according to the evidence of Sherwin-Rawcliffe, must be considered to move "rigidly"(in the classical sense) and instantly with its source charge, without the slightest time lag. Contrary to intuition based on the above-mentioned Einsteinian prejudice, such a hill is never "left behind," even momentarily, when the charge accelerates. This in turn suggests a physical model of such a Coulombic potential hill in terms of a cloud of virtual photons (quanta of the electric field) surrounding its source charge and subject to *no restraints of causality*.

This, as it happens, has a direct bearing on the famous "4/3 problem" of classical electromagnetic theory [2,3]. The latter, building on the doctrine of universal retardation of all distant force action, deduces a consequent tensor nature of electromagnetic mass, and from this further deduces that an electric charge having total electrostatic energy W will behave (resist acceleration) as if it possessed an added electromagnetic contribution to its inertial mass of $\left(4/3\right)W/c^2$. This claimed extra "electromagnetic mass" is the result of averaging over all angles the consequences of attributing to any pair of equal sub-charges in a spherical charge distribution the electromagnetic mass $m_{EM}\left(1+\cos^2\theta\right)$, where θ is the angle between the vector of charge acceleration and the inter-pair axis. It is this *angular dependence* that unavoidably imparts tensor properties to the electromagnetic mass of asymmetrical charge distributions. Since the (4/3) factor here is obviously wrong, and should be replaced by unity, some basic error has crept into the classical electromagnetic analysis. The error, as one may readily infer, is the starting assumption of retardation of the action between charges. When that is corrected by assuming instant action-at-a-distance, the scalar nature of mass in all charge configurations is rigorously restored and the electromagnetic contribution to total inertial mass becomes W / c^2, as it should be.

The remainder of this paper will seek to impart substance to this introductory summary.

2. Theory: The Left-Behind Potential Hill

My aim in this Section will be to provide a qualitative understanding of the physics, free of all formulas and quantifications. (Those desiring the latter can find them lucidly presented in Refs. [1,2].) Consider two equal point charges held rigidly apart by a thin insulating rod. This assembly moves always as a unit of unchanging dimensions. Let it be accelerated from rest in the laboratory to some velocity so low that no right-minded person would think of invoking relativistic considerations. Initially, while the assembly is still at rest, each charge is (in imagination) surrounded by an electric "potential hill" that peaks at the charge location and slopes symmetrically away, falling off as the inverse of the radial distance. The gradient (radial derivative) measures the slope of the hill and also the inverse-square-law electric *force* experienced by a unit charge placed at a given distance. This hill of course is just a descriptive device employed to reify the concept of electric "potential." The hill may be considered to have topographical properties, quantified by circles of intersection of “equipotential” planes spaced at equal heights. That is, the “equipotentials,” seen from above, are concentric circles – contours increasingly dense as they get smaller – on the surface of the potential hill marking equal vertical increments of potential.

Very well. Let the acceleration occur parallel to the inter-charge axis; that is, along the direction of the connecting rod. At the moment the acceleration occurs the front charge moves down the slope of the potential hill centered on the rear charge. Similarly, the rear charge has to climb the slope of the hill centered on the front charge. Because of causality, which we are assuming, the charges and their connecting rod move together instantaneously, but the potential hills, being not rigidly connected, momentarily continue to sit right where they are. That is our model, engendered by the belief (firmly held by all card-carrying physicists) that no response from the remote parts of these hills is possible until *information* (about change of state of source motion) arrives retardedly at speed *c* from the source-charge location. The boost given to the front charge in descending the (lesser) front slope of the rear-charge-produced hill is less than the extra opposition to motion experienced by the rear charge in climbing the (greater) rear slope of the front-charge-produced hill. This follows because the energy gained in crossing equipotentials at the front is less that the energy expended at the rear, inasmuch as the front (down-slope) equipotentials are more widely spaced than the rear (up-slope) ones. There is thus no cancellation. So, the net effect on the assembly is that some extra positive resistance to acceleration is felt. Such resistance at zero velocity is by definition a manifestation of “mass,” in this case termed electromagnetic mass because of its purely electric origin. In any case, the point to keep in mind is that, since the potential hills (at least in their outer portions) are momentarily “left behind” by their accelerated source charges, *equipotentials are crossed* by the rigidlymoving charges. This means that work has to be done, and this extra work (a net positive amount, because more equipotentials are crossed upwardly by the rear charge than downwardly by the front charge) is what gives rise to an added electromagnetic contribution to the inertial mass of the assembly.

Next, let the acceleration be oriented normal (perpendicular) to the inter-charge axis. In this case the same model leads to quite a different result. This time, the charges, when accelerated, move not across equipotential lines but along them (tangentially). As a result, no equipotentials are crossed by either charge, no work is done, and no extra resistance to acceleration is experienced by the assembly. Hence, for this orientation of the acceleration there is no electromagnetic enhancement of inertial mass. From this we see that electromagnetic mass has tensor properties. It depends on the angle θ between the acceleration vector and the inter-charge axis. Suppose we assign to electromagnetic inertial mass some value m_{EM} for the case of charges at rest. If $\theta = 0$, the case of acceleration parallel to the axis, a doubling of electromagnetic mass m_{EM} is predicted [1,2]; whereas if $\theta = 90°$, the case of acceleration normal to the axis, zero enhancement of electromagnetic mass is predicted. It can be shown [1] that for a general angle θ the predicted mass increase is $m_{EM}\left(1+\cos^2\theta\right)$. This expresses quantitatively the allegedly tensor nature of electromagnetic mass predicted on the basis of classical (Maxwellian) electromagnetic theory, in conjunction with the causal retardation model of the "left-behind potential hill." Although the model is not relativistic (apart from the assumption of retarded action), it is applied in a physical regime where non-relativistic analysis is appropriate because all speeds are arbitrarily low. Any mass effect manifests itself first at zero velocity, in the heart of strictly

Newtonian territory.

3. The Sherwin-Rawcliffe Experiment

In seeking to test the proposition of tensor nature of electromagnetic mass, Sherwin first consulted nuclear data tables to find a nucleus that was strongly asymmetrical (football-shaped). The clue to this was a large electric quadrupole moment. You can see at once why this is important, since our model discussed above, involving two charges held rigidly apart, exemplifies the same thing as a football-shaped nucleus – namely, an asymmetrical charge configuration. Any such configuration should exhibit tensor electromagnetic mass. The nucleus sought turned out to be Lu^{175}, the isotope of lutetium of mass number 175. Just why this particular nucleus chooses in nature to seek an ellipsoidal configuration about 30% longer on its major axis than on its minor one (obviously an extreme distortion) is probably unknown, but luckily it does.

Next, Sherwin and Rawcliffe made a computer model of the Lu^{175} nucleus as an idealized assemblage of point charges having all observable features, such as quadrupole moment, identical to those of the observed nucleus. The electromagnetic mass of this assemblage was then computed (remember, this was in 1960, so the computation was not the trivial task it would be today), using the tensor mass formula $m_{EM}\left(1+\cos^2\theta\right)$ mentioned above, averaging over various values of θ. Then, exploiting the large spin value of 7/2 of this nucleus, they calculated, using quantum mechanics, the effect of accelerating such a nucleus in the magnetic field of a mass spectrometer – a machine designed to measure very accurately the masses of charged particles. Owing to the slightly different spatial orientations of the asymmetrical charge distribution in the magnetic field, the associated different mass states were predicted to produce a four-fold splitting of the mass line. That is, any group of Lu^{175} nuclei would be statistically divided by action of the magnetic field into four closely-spaced (but readily resolvable) component mass sub-assemblages, exhibiting by this magnetically-induced splitting the tensor property of mass.

This qualitatively new effect of Lu^{175} mass line-splitting was looked for by the stratagem of approaching the mentors of the A. O. Nier high-resolution mass spectrometer at the University of Minnesota and persuading two of Nier's associates to make the necessary observations of Lu^{175}. This was done, with a clear null result. No line splitting was found. Nuclear mass was a dull, normal, Newtonian *scalar* quantity, regardless of charge configuration. Such was the unambiguous experimental finding.

4. Implications

Let us go back to our two-separated-charge model. We saw that if the charge assemblage accelerated from rest and the associated potential hills were left behind, the net result was that for certain orientations of the acceleration vector the charges would necessarily have to cross equipotentials, with the result that electromagnetic mass would be enhanced for such orientations, but not for others. The unavoidable conclusion was that "mass" of this kind is a tensor quantity. But experiment shows that it isn't. So, what must give? Which of the fundamental assumptions that got us thus into loggerheads with nature is at fault and needs to be abandoned? Although relativists can be counted on to contrive ways to squirm aside, I think most people will be forced to admit that the one vulnerable assumption on which the whole pyramid of inference rests is the notion of the "left-behind potential hill." Eliminate that and all difficulties magically vanish. If the potential hills associated with each of the charges move always rigidly right along with their source charges (by instant action-at-a-distance), then there is never any crossing of equipotentials, regardless of orientation of the acceleration vector. As a result, no enhancement of electromagnetic mass occurs, no angular dependence of mass, no tensor nature of mass, nor any conflict with observation. A clearer empirical demonstration of instant action-at-a-distance is not within the grasp of nature to offer mankind. Whether or not the offer is accepted never rests with nature. Where it does rest is best deduced from the eternally valid adage, "A man convinced against his will is of the same opinion still."

5. Discussion: 50 Years Later

Was this fundamental null result – a true step forward in physical understanding, comparable in implications to the Michelson-Morley null – greeted with fireworks and dancing in the streets? Was it noticed by physicists at all? No, to all such questions. Why not? For one thing, unlike Michelson-Morley, it was not publicized nor even reported in the literature. But that is not the real reason. (Here permit me to editorialize.) You may be sure, if physicists had wanted to hear such a message, Sherwin (as physics professor at the University of Illinois and later Chief Scientist of the Air Force) had enough clout to ensure their hearing it. No, the truth is that people hear only what they want to hear, and physicists have never wanted to hear that Einstein was wrong. Best to hush it up. That Einstein predicted all distant actions to be retarded, that this inevitably led to predictions of a tensor nature of electromagnetic mass, and that experiment failed to show mass to be anything but a scalar, were facts too hot for them to handle. When scalar mass is observed, scalar mass is what Einstein predicts. And that remains true to this day. What has changed? Are physicists more open to facts than they were? No, if there has been any change at all, it is in the other direction. Physics is now so deeply and ineradicably committed to Einsteinian ways that any reversal would be all too likely to lead to mass suicides. Careers are built on nothing else. Government funds are dispensed on no other basis. Need more be said? How can one even dream of the facts getting a fair hearing? Even in Sherwin's day, the best thing to do with facts that didn't fit was to bury or disguise them. Today, one sees the same social forces at work most dramatically and instructively in the arena of climate science. Do physicists belong to some race of superior scientists, not subject to the same defining rules of behavior as climate scientists? All are tarred with the same brush.

The upshot is that when you build your fundamental understanding of nature on an untruth your science is at an end. And that is the case for today's science of physics.

6. Summary

In 1960 an experiment was done by Sherwin-Rawcliffe, in collaboration with unnamed personnel of the A. O. Nier mass spectrometer, that showed the mass of an asymmetrical nucleus to be a scalar quantity. This was contrary to classical electromagnetic theory going back to the nineteenth century. The latter had expected tensor electromagnetic mass associated with acceleration directed off-axis at angle θ according to $m_{EM}\left(1+\cos^2\theta\right)$. This expectation was based on a model that presumed all distant actions to be causally delayed at speed *c*. It is clear from the empirical evidence of the mass spectrometer that such a model does not apply to nuclei. In the quantum world, it is evident that a much better model is that of the instantly-responding potential hill, possibly representing a swarm of virtual particles and *not subject to causality*. Such an instant-action model fully accords with the observed fact of scalar mass. This attribute has long been ascribed to the quantum world – that it is ruled by acausality – but physicists are perennially slow to absorb the message and adjust to its consequences. The effect is known as "cultural lag." It is not just a lack of education. Because of the universal trumpeting of Einstein's counter-message, that all distant actions are causally delayed, amounting to a dedicated form of counter-education, the facts about the quantum world tend to get drowned out. And it continues to be underestimated, how extensive is the penetration of the quantum world into the macro world. Thus, the possibility that all force actions, not merely all Coulomb actions, exemplify instant action, and only radiation obeys causal retardation, continues to be rejected as an unthinkable aberration – although it fits perfectly with all known facts. Since the advent of Einstein, the rejecting of the obvious has become a survival necessity of political physicists.

A central mystery about the Sherwin-Rawcliffe experiment is why it was never reported in the literature and incorporated in the history books. I may have left a false impression above that Sherwin had base motives in hiding a result he knew would be unpopular with his peers. I know nothing of the kind. Although I had opportunities to ask him, I never did so, and thus can only speculate. I presume that the null result disappointed him. But that in itself would not have inhibited him from publishing, as was shown 27 years later when an experiment he did to test the Lorentz contraction yielded a null result that I know was a deep disappointment (since he was a Lorentz relativist, who insisted on physical content of models – the Lorentz contraction being a factual shortening of atomic bonds – and did not subscribe to the artful-dodging ontological ambiguity of Einsteinians toward the "reality" of their constructs, which permanently protects them from falsification). Sherwin's later experiment was published in a prominent place [4]. So, it is unlikely that disappointment in a null result alone explains his earlier reticence. Sherwin was never a game player or a politician of physics. If I have suggested otherwise, I have done his memory a great injustice. I think his motives will remain always unknown. I consider him a great man, a man of integrity, and a model physicist whose like we shall not see again.

The abstract [5] of the written final report issued by the Coordinated Sciences Laboratory at the University of Illinois on the Sherwin-Rawcliffe experiment [1] opens with the sentence, "According to the theory of relativity the inertial mass of any physical system should be a scalar quantity (no matter how distorted its electromagnetic structure) and the 'excess' inertial mass of electromagnetic origin should not be observable." This may provide the necessary clue. Presented in this light, the only message of the work is, "Physicists, go back to sleep, all is well with your relativity." But of course it wasn't. Einstein's relativity has in fact nothing to say about the zero-velocity regime, nothing to say about mass, which is not its business. It can survive the observation of non-tensor nature of the mass of a distorted charge distribution only through exploiting its inherent ambiguities, alluded to above, and through ignoring altogether its own oft-repeated dictum of universal retardation of distant action. The fact is that relativity, as now constituted and reduced to practice, is not a falsifiable theory. It is thus an inhabitant of the realm of religion, not of science. Perhaps Sherwin reasoned fatalistically to the effect that his null observations were not suitable for dissemination because (unless presented in terms of an essentially *unpublishable* confrontation) they would only confirm what physicists already "knew." Naturally, nothing is worth publishing in the physics literature that merely confirms what is known "according to the theory of relativity." Its supporters have informed us, indeed, that the latter is not a theory but a fact. Empirical confirmation of facts is supererogatory. So, why publish? It all makes a dreadful kind of sense – which only goes to confirm my thesis, asserted above, that the science of physics is at an end.

References

[1] C. W. Sherwin and R. D. Rawcliffe, "Electromagnetic Mass, & the Inertial Properties of Nuclei," Report I-92, 14 March, 1960, Coordinated Science Laboratory, University of Illinois, formerly available from U. S. Department of Commerce, Clearinghouse for Federal Scientific and Technical Information, document acquisition number AD0625706. This organization no longer exists under that name and the document is apparently no longer available at any price to the taxpayers who paid for the work.

[2] C. W. Sherwin, *Basic Concepts in Physics* (Holt, Rinehart and Winston, NY, 1961), App. II.

[3] T. E. Phipps, Jr., *Heretical Verities: Mathematical Themes in Physical Description* (Classic Non-fiction, Urbana, 1986), p. 273.

[4] C. W. Sherwin, *Phys. Rev. A* **35** (1987), 3650-3654 .

[5] The abstract of the original Sherwin-Rawcliffe report [1] may currently be found on the Internet at http://www.dtic.mil/srch/doc?collection=t3&id=AD0625706.