New Light On An Old Problem

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Like many other people I find myself not having the time to do all the things that I would like to do in a day. I have always wished I could emulate the young lady in Prof. Arthur Bullers (1874-1944) limerick which was published in the December 19, 1933 issue of that reputed journal, *Punch*:

"There was a young lady named Bright
Whose speed was faster than light.
She set out one day,
In a relative way,
And returned home the previous night."

Well, up to now I have not succeeded in my attempts to gain time in this way, but there is hope, there is hope as I will try to make clear in a minute.

First of course, as we all know, the speed of light is finite. This was first demonstrated by Roemer in 1676. He measured the interval between successive eclipses of the intermost satellite of Jupiter (that would be Io, with its sulfur spewing volcanoes), at a time when Jupiter was close to Earth. From his data he calculated when the 100th eclipse should occur, and (I surmise) invited his friends to come and observe. Well the eclipse did not materialize when he had expected it! Here they all were, waiting for the little moon to cooperate and it did not! And it was not by seconds that the event was amiss but by a whopping 15 minutes. With all his friends gone home shaking their heads, with doubts about his ability to predict anything, Roemer started thinking about this and realized that, because of where they were in their orbits, the distance between Earth and Jupiter was increasing and that his embarrassment could be explained by the fact that light from the satellite would therefore take longer to arrive to his telescope. He calculated that his observations could be accounted for if the speed of light was 48,303 leagues/second. As we know, this number, which corresponds in the units we prefer today to 214,000 km/sec, was in fact of the correct order of magnitude. With improved methods for measuring the speed of light we now use the figure of 299,792.75 km/sec. Since the speed of light is finite there is always a possibility that one could better it, and thereby regain time?

Now what gave me hope that this might in fact already have been achieved, is a paper by A.M Steinberg, P.G. Kwiat and R.Y. Chiao of the Department of Physics at the University of California at Berkeley, on "Measurement of the Single-Photon Tunneling Time", published in Physical Review Letters 1993, 71 pp. 708-711. They say "Using a two-photon interferometer, we have measured the time delay for a photon to tunnel across a barrier consisting of a 1.1 mμ thick ID photonic band-gap material. The peak of the photon wave packet appears on the far side of the barrier 1.47 +/- 0.21 fs *earlier* (their italics!) than it would if it were to travel at the vacuum speed of light *c*..." Now all I have to do, thinks I, is to somehow take advantage of these photons and I'll be in the company of Ms. Bright whenever I need time to finish all the things I want to do. Too bad that the next sentence of the abstract quoted above, goes on to say "Although the apparent tunneling velocity (1.7 +/- 0.2) c is superluminal", imagine! almost twice the speed of light! "this is not a genuine signal velocity and Einstein causality is not violated..." What a let down! As explained by Rolf Landauer[1] there are other instances in which there appears to be superluminal velocity, which does not really mean that the "accepted light velocity barrier" has "crumbled". Imagine for example watching the light from a lighthouse beacon impinging on a distant wall. The spot it forms may "move faster that the velocity of the light, but this is not a violation of relativity; one spot is not the source of the next". It is easy to understand this image, but the rest of the story leaves me somewhat puzzled. I feel a bit like Chaim Weizmann, the President of Israel, who said after a transatlantic crossing in the company of Albert Einstein: "he explained his theory to me every day, and on arrival I was fully convinced that he understood it." The neat thing about this is that I can keep on dreaming with even higher hopes that I had before about catching up, someday, somehow. ■

Reference:

1 Landauer, R. 1993. Light Faster than Light? *Nature*, 365, pp 692-3

Front Cover Image

A large variety of shapes of fullerenes have been reported in the literature. Regardless of their shape, all these particles have a hollow core surrounded by graphite layers of 0.34 nm spacing. Particles in the form of squares, polygons and tubes up to several microns in length have been observed. The hollow core is a sphere, or a cylindrical cavity in the case of tubes, of about 2 nm diameter. The heart shaped example shown here is quite different in the size and shape of the core, but it is still surrounded by graphite 0.34 nm layers. Notably, it was observed on February 14, indicating date rather than time dependence in the growth process of fullerenes. **Happy belated Valentine!**

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