There Is No Speed Barrier for a Wave Phase Nor for Entangled Particles

Florentin Smarandache
Dept. of Mathematics, University of New Mexico, 200 College Road, Gallup, NM 87301, USA
E-mail: fsmarandache@yahoo.com; smarand@unm.edu

In this short paper, as an extension and consequence of Einstein-Podolski-Rosen paradox and Bell's inequality, one promotes the hypothesis (it has been called the Smarandache Hypothesis [1, 2, 3]) that: There is no speed barrier in the Universe and one can construct arbitrary speeds, and also one asks if it is possible to have an infinite speed (instantaneous transmission)? Future research: to study the composition of faster-than-light velocities and what happens with the laws of physics at faster-than-light velocities?

This is the new version of an early article. That early version, based on a 1972 paper [4], was presented at the Universidad de Blumenau, Brazil, May–June 1993, in the Conference on "Paradoxism in Literature and Science"; and at the University of Kishinev, in December 1994. See that early version in [5].

1 Introduction

What is new in science (physics)?

According to researchers from the common group of the University of Innsbruck in Austria and US National Institute of Standards and Technology (starting from December 1997, Rainer Blatt, David Wineland et al.):

- Photon is a bit of light, the quantum of electromagnetic radiation (quantum is the smallest amount of energy that a system can gain or lose);
- Polarization refers to the direction and characteristics of the light wave vibration;
- If one uses the entanglement phenomenon, in order to transfer the polarization between two photons, then: whatever happens to one is the opposite of what happens to the other; hence, their polarizations are opposite of each other;
- In quantum mechanics, objects such as subatomic particles do not have specific, fixed characteristic at any given instant in time until they are measured;
- Suppose a certain physical process produces a pair of entangled particles A and B (having opposite or complementary characteristics), which fly off into space in the opposite direction and, when they are billions of miles apart, one measures particle A; because B is the opposite, the act of measuring A instantaneously tells B what to be; therefore those instructions would somehow have to travel between A and B faster than the speed of light; hence, one can extend the Einstein-Podolsky-Rosen paradox and Bell's inequality and assert that the light speed is not a speed barrier in the Universe.

Such results were also obtained by: Nicolas Gisin at the University of Geneva, Switzerland, who successfully teleported quantum bits, or qubits, between two labs over 2 km of coiled cable. But the actual distance between the two labs was about 55 m; researchers from the University of Vienna and the Austrian Academy of Science (Rupert Ursin et al. have carried out successful teleportation with particles of light over a distance of 600 m across the River Danube in Austria); researchers from Australia National University and many others [6, 7, 8].

2 Scientific hypothesis

We even promote the hypothesis that:

> There is no speed barrier in the Universe, which would theoretically be proved by increasing, in the previous example, the distance between particles A and B as much as the Universe allows it, and then measuring particle A.

It has been called the *Smarandache Hypotesis* [1, 2, 3].

3 An open question now

If the space is infinite, is the maximum speed infinite?

"This Smarandache hypothesis is controversially interpreted by scientists. Some say that it violates the theory of relativity and the principle of causality, others support the ideas that this hypothesis works for particles with no mass or imaginary mass, in non-locality, through tunneling effect, or in other (extra-) dimension(s)." Kamla John, [9].

Scott Owens' answer [10] to Hans Gunter in an e-mail from January 22, 2001 (the last one forwarded it to the author): "It appears that the only things the Smarandache hypothesis can be applied to are entities that do not have real mass or energy or information. The best example I can come up with is the difference between the wavefront velocity of

a photon and the phase velocity. It is common for the phase velocity to exceed the wavefront velocity c, but that does not mean that any real energy is traveling faster than c. So, while it is possible to construct arbitrary speeds from zero in infinite, the superluminal speeds can only apply to purely imaginary entities or components."

Would be possible to accelerate a photon (or another particle traveling at, say, $0.99c$ and thus to get speed greater than c (where c is the speed of light)?

4 Future possible research

It would be interesting to study the composition of two velocities v and u in the cases when:

$v < c$ and $u = c$;

$v = c$ and $u = c$;

$v > c$ and $u = c$;

$v > c$ and $u > c$;

$v < c$ and $u = \infty$;

$v = c$ and $u = \infty$;

$v > c$ and $u = \infty$;

$v = \infty$ and $u = \infty$.

What happens with the laws of physics in each of these cases?

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