Peter Naur
The aberration of light: chronic scientific confusion

This is a summary of the article titled *Aberration in Special Relativity: A Case of Chronic Scientific Confusion* by Peter Naur, published in *Physics Essays*, vol. 12, no. 2, 1999, 358-67. This is the story of a flaw in Einstein's original work on special relativity and how this flaw has given rise to controversy and confusion and has contaminated a large part of the relevant scientific literature in astronomy and physics with error.

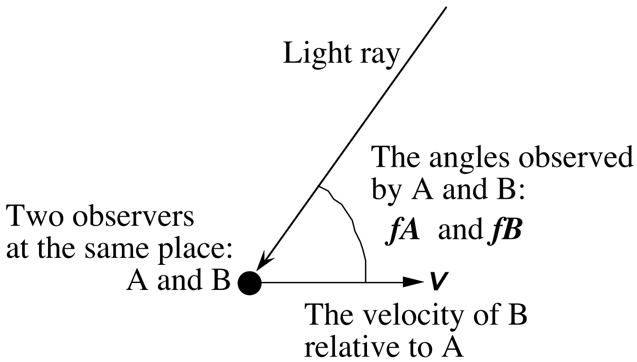
The phenomenon of aberration, as observed by astronomers, manifests itself primarily as a change in the position of every star of the night sky such that each star is observed to move around in a closed curve, with a period of a year. It was discovered by James Bradley in 1729. About this observable effect there is common agreement in all the relevant scientific literature.

However, when it comes to the principles of physics that will account for the observed phenomenon of aberration, the scientific literature displays confusion, presented in the article by quotations from 60 publications from the years 1905 to 1993. The confusion is seen in the textbooks of astronomy and of the theory of relativity, in that in such textbooks aberration is explained in three different, incompatible ways.

By the first way of explanation the aberration effect arises from the velocity of movement of the observer, without any clarity about what that movement is relative to. Such an explanation is found in textbooks of astronomy by R. H. Baker and L. W. Fredrick (1971), H. Karttunen et al. (1997), K. R. Lang (1980), L. Motz and A. Duveen (1966), A. E. Roy and D. Clarke (1988), W. M. Smart (1942), O. Struve, B. Lynds, and H. Pillans (1959), and S. P. Wyatt (1964). C. A. Murray (1983) treats aberration explicitly as an issue of Newtonian mechanics, without any attention to the theory of relativity.

By the second way of explanation the aberration effect arises from the velocity of movement of the observer relative to the light source. This explanation was given by A. Einstein in his first paper on relativity (1905) and was taken over into textbooks of astronomy by A. Danjon (1952-53) and by J. A. Mitton (1991) and books on the theory of relativity by, M. Laue (1919, 5. ed. 1952), W. Pauli (1921 and 1958), C. Møller (1952), H. Arzeliès (1966), and A. I. Miller (1981). This explanation is defect. This is evident from observations of double stars and from an experiment performed by J. Stark (1925).

By the third way of explanation the aberration effect is a matter of the directions from which a light beam is seen to arrive by two observers at the same place who move relative to each other, shown in the figure.



By the Lorentz transformation of the theory of special relativity the angles *fA* and *fB* are related as follows:

$$\cos fB = (\cos fA - (v/c)) / (1 - (v/c) \cos fA)$$

where c denotes the velocity of light, 300,000 km/sec. Aberration is the difference between *fA* and *fB*. This explanation of aberration was first presented by B. Herassimovitch (1914). Without mention of its source it was taken over into books on the theory of relativity by H. Dingle (1940), P. G. Bergmann (1947), V. Fock (1959), H. Zatzkis (1960), R. K. Pathria (1963), and W. L. Burke (1980). The two observers theory accords with all known evidence.

Planetary aberration denotes a computational rule for determining the direction of the light signal observed by observer B, which applies when the motion of B relative to A has been uniform and rectilinear during the time the light has taken to reach from the source to the observer. The rule says that the direction observed by B may be determined as the direction in the system of A of the line connecting the position of the light source at the moment of the light emission with the position of B at the same time. The mathematical analysis shows that this rule is only approximately valid. However, the approximation is close enough to make the rule of planetary aberration useful in most astronomical practice.

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