From astronomical to terrestrial light

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Abstract- One of the claims that the Special Theory of Relativity is a valid theory is that experiments seem to prove that the velocity of astronomical light reaching the surface of our earth is always \( c \). That inherently means ‘relative to our earth’. This article shows why this conclusion must be wrong and what is really happening when astronomical light reaches earth.

Introduction
In Ref [1] the theorem is proven that the propagation velocity of light in vacuum is only \( c \) with respect to its source, rejecting the hypothesis on which the STR is based. Ref [2] emphasizes the incorrectness of the STR from an historical point of view. The content of this article is based on the mentioned theorem.

Astronomical light
Astronomical light is defined as light that has been emitted by astronomical bodies. Such light reaches our earth normally after a very long time. So, given the theorem mentioned in the Introduction, astronomical light cannot reach the earth with velocity \( c \) w.r.t. to the earth. In order to be strictly correct and because it is essential in this consideration, the theorem has to be presented as: the propagation velocity of light is \( c \) w.r.t. its source at the moment of emission.
So at the moment light is emitted by an astronomical body and the relative velocity between that body and our earth would be \( v \), this light at that moment has the propagation velocity \( c-v \) w.r.t. the earth, assuming that \( v \) is in the same direction as the propagation of the light, transmitted in the direction of the earth. Due to the rotation of the earth around the sun, this \( v \) has been changed to a completely undefined velocity at the moment that this astronomical light reaches earth. But I will keep on using this symbol.
As soon as the astronomical light enters our atmosphere I will call it terrestrial light.

The drag coefficient of Fresnel
In 1818 Fresnel deduced the mathematical expression for the velocity of light in a moving tangible medium. This expression shows the drag coefficient of Fresnel. He deduced this expression, assuming that the ‘medium’ ether was necessary for the propagation of light and at the same time being an absolute reference for whatever velocity. Fizeau experimentally proved the correctness of this expression in 1851:
\[
c_m' = c_m + v(n^2 - 1)/n^2
\]
If, instead of what Fresnel assumed, not the ether is taken as the reference for all mentioned velocities, but the source of the light, then this equation has to be interpreted with the following definitions:

- \( v \) = the velocity of the medium w.r.t. the source of the light
- \( n \) = the refractive index of the medium
- \( c_m = c/n \) the velocity of light w.r.t. its source for \( v=0 \)
- \( c \) = the velocity of the light w.r.t. its source in vacuum
- \( c_m' \) = the velocity of light w.r.t. its source for \( v \) not equal zero
Most likely the expression of Fresnel never has been subject of discussion after the medium ether had been abandoned. So be it. By defining the source as the reference for the velocity of light and for the velocity of the medium, Fresnel’s expression can, without any restriction, be maintained.

**Terrestrial light**

As soon as the astronomical light enters our atmosphere, exactly the situation as described in the previous paragraph shows up. The refraction coefficient ‘n’ however is not uniquely defined, because it starts with a value very close to 1 and it is about 1.0003 near the surface of the earth. But the final velocity of the light is of course determined by the ‘n’ in the neighbourhood of the earth. This atmosphere behaves like a moving tangible transparent medium as described in the previous paragraph, with velocity \( v \) w.r.t. the astronomical body at the moment of emission of that light. As mentioned already \( v \) is completely undefined, not only because of the fact that normally the relative velocity between that body and the earth is unknown at the moment of emission, but also due to the fact that normally such light will reach our earth after such a long period of time that it is at a completely different position in its orbit around the sun.

Writing the expression of Fresnel \( c_m' = c_m + v(n^2 - 1)/n^2 \) as:

\[
c_m' = c_m + v - \frac{v}{n^2}
\]

with : \( c_m' \) = the velocity of the light w.r.t. its source,

leads to \( c_m'' = c_m' - v = c_m - \frac{v}{n^2} \),

with \( c_m'' \) = the velocity of the light w.r.t. earth,

because \( v \) now is the difference in velocity between the astronomical body at the moment of emission and the earth at the moment this light enters the atmosphere.

A very good approximation of \( c_m'' \) is: \( c_m'' = c_m - v \).

**Conclusion**

The velocity of astronomical light, transformed to terrestrial light when it enters the atmosphere of our earth, has a propagation velocity w.r.t. the earth that equals the velocity of light in, so w.r.t., the atmosphere, minus the difference in velocity between the astronomical body at the moment of emission and the earth at the moment this light enters the atmosphere.

**References**
