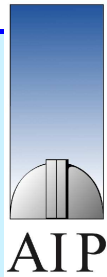


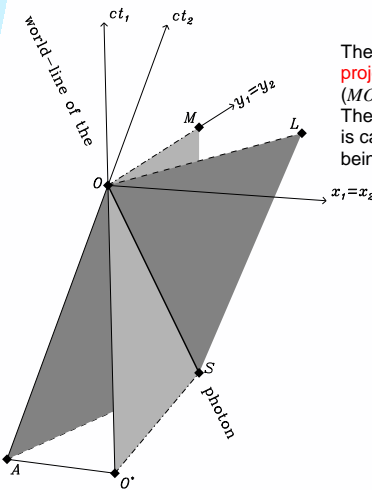
Fresnel's Paradox and Relativity Theory

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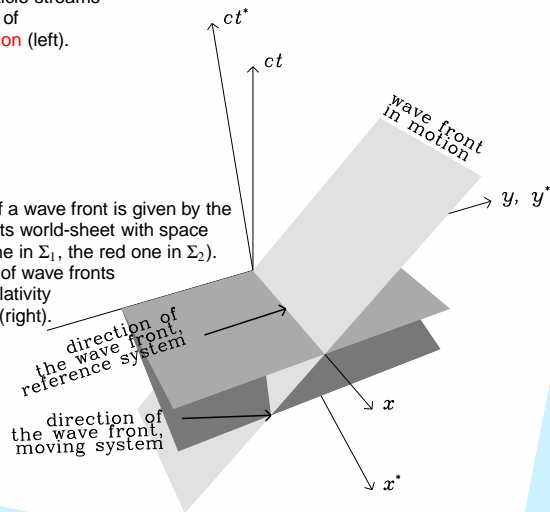


The first observation to abandon absolute simultaneity was that of the **aberration of light waves**. The postulate that both the particle streams and the wavefronts show the same aberration implies the relativity of simultaneity – and with the group argument, all the kinematics of SRT.

1. The null result of the ether drift experiments was interpreted primarily as a fact that shows **complete drag** in contrast to Fresnel's assumption of **no drag** at all. More than 20 years elapsed before Einstein draw the positivistic conclusion that eliminated the ether concept. Since then it is mainly forgotten why Fresnel was forced to assume a freely flowing ether. It is equally forgotten and rarely acknowledged that – with present technics – that Fresnel's hypothesis would not have solved the paradox, and that his paradox alone implies the relativity of simultaneity.



The direction of a particle is the **projection** of its world-line onto space (MO in Σ_1 , LO in Σ_2). The aberration of particle streams is caused by relativity of being at a given **position** (left).



The direction of a wave front is given by the **intersection** of its world-sheet with space (the yellow plane in Σ_1 , the red one in Σ_2). The aberration of wave fronts is caused by relativity of **simultaneity** (right).

2. Fresnel's paradox consists in his observation that – in the Galilean frame-work that was accessible only – wave fronts show **no aberration**, and this is independent of whether an ether is moving or not. This fact is rarely found in textbooks, and sometimes even wrongly described. Fresnel writes his brother that it forms the most vexing and paradox problem of his wave representation of light in particular.

Normally, for the Galilean position a particle picture is used to explain aberration, but for SRT the wave picture and the simple transformation of the phase is chosen. The particle picture is repeated in SRT in the arguments about composition of velocities, but the phase-front argument is never exhibited to the Galilean environment. It is rarely mentioned, that for the Galilean position, the phase transformation argument just does not yield **any aberration at all**, while the particle picture works well for both positions.

3. Requiring the ether to move freely through the telescope did not solve the paradox until Fresnel found that the telescopes at hand did not measure any wave front, but the interference point of the bundle cut out by the objective lens or mirror, that is, Fresnel tacitly used the particle aspect – and found aberration also in the wave picture. The paradox was **not solved** but was shown **not to apply**. Aberration was observed now because wave fronts did not show aberration. Since VLBI, we are able to measure wave fronts, and we are in conflict with a Galilean theory in any case, even with Fresnel's hypothesis.

The often cited impression that first-order effects in relativity should have a counterpart in non-relativistic physics is wrong. The relativity of simultaneity is a first-order effect without non-relativistic counterpart, so is the aberration of wave fronts. The change of the speed of light in Galilean compositions is a first-order effect, and it has no counterpart in SRT.