Photographing using relativistic camera - obscura.

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Abstract:
The article discusses the results of photographing using a stationary or moving at relativistic speed camera - obscura.

Keyword: special relativity, clock synchronization, length contraction, Lorentz transformations

Imagine that observers *A* and *B* with synchronous clocks (in the Einsteinian sense) are located at points *a* and*b* on the *X* -axis of the coordinate system *K*, symmetrically about the point of origin *O*. The coordinates of points *a* and *b* are, respectively, equal to *–x* and *x*. On the *Y*-axis at point*d* with the coordinate *y* there is a camera obscura with its opening directed to the point of origin *O*. Observers *A* and *B*, who are in range of vision the camera obscura, wish to take their simultaneous photoes. To do so, each of them at a point of time *t*=0 activates the flash. The distance from each observer to point *d* is equal to $\sqrt{x^2 + y^2}$. Therefore, after a time equal to $\sqrt{x^2 + y^2}\,/c$, the light pulses reflected from the observers simultaneously fall into the opening of the camera obscura, and this pair of observers *A* and *B* is captured on the film. The photo is not distorted. The height of the observers, their cross-sectional dimensions and the distance between them on the photo are proportional to their actual size.

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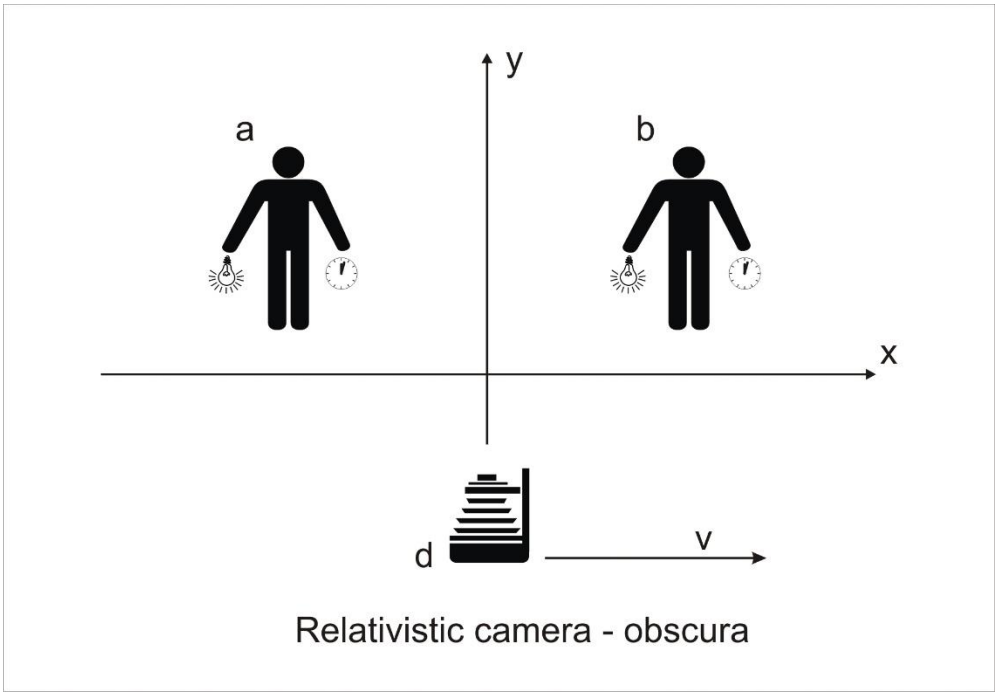

Fig.1. Relativistic camera - obscura.

Now imagine that the camera obscura is not at rest at point *d*, but moving parallel to the *X*-axis with velocity *v*, getting to point *d* at the moment of time $\sqrt{x^2+y^2}/c$. The light reflected from the observers, which at this time has simultaneously come to point *d*, falls into the aperture of the moving camera obscura, and instantly falls on the film, thus producing an image. We believe that the dimensions of the camera obscura in the direction transverse to its motion are small enough and in the direction of its motion are large enough for the film not to go beyond the incident image falling on the film during the light travel period from the aperture to the film.

What do you think, what kind of distortion will distortion appear in the picture and why?

Because of the reduction of the film moving in the coordinate system *K* the image obtained after visualisation will be stretched in the transverse direction (in the direction of motion) $1/\sqrt{1-v^2/c^2}$ times. The figures of the observers will thicken, and the distance between them will increase. If on the photo one could see the clocks on the observers' hands or close to them, these clocks will show the same time, i.e. that the observers' wish to be photographed at the same moment in time would be fulfilled. Yet the observers within the reference frame *K'* where

the camera obscura is at rest and where the observers A and B are moving, will think that the photo is"wrong".

They will assume that the flashes were activated asynchronously and asymmetrically to the place of exposure from the points located at different distances from the place of exposure. From their point of view, the light pulses, having simultaneously passed the aperture of the camera obscura at different angles to the plane of the film, did not simultaneously fall on the film and formed the image not at the moment in time t', but during period of time $\Delta t'$.

Let's assume now that in order to obtain a "correct" picture though not satisfying the customers, the observers *A* and *B*, the observers within the reference frame *K'* will activate the flashes simultaneously at the moment in time *t'*, such that the pulses reflected from the observers *A* and *B* moving within the reference frame *K'* will simultaneously arrive at the aperture of the camera obscura. As the distance between the observers and their transverse dimensions are $1/\sqrt{1-v^2/c^2}$ times less than their proper distance and dimensions, the image on the film becomes contracted, so the observers *A* and *B* on the photo become "thinner" and the distance between them becomes less. The clocks located close to the observers will show different time, i.e. the observers' wish to be photographed at the same moment in time would not be fulfilled.

The observers within the reference frame *K*, wherein the camera obscura is moving, will assume that the light coming from the flash was emitted asynchronously and asymmetrically in relation to the place of exposure from points located at different distances from the place of exposure. They will assume that the light pulses, having simultaneously passed the aperture of the camera obscura, fell on the film asynchronously and formed the image not at the moment in time *t*, but during period of time Δ*t*.

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