

A relativistic variant of Mach's principle

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Abstract

We take an idea of Mach and postulate an absolute frame of reference, i.e. there is a state of absolute rest and motions of inertial frames of reference relative to the absolute frame can be measured.

Postulate: The total angular and linear momentum of the universe are zero - this is one version of Mach's principle.[?] There is an absolute frame of reference, where an absolute point of reference is given by the origin of an inertial frame with zero total momentums. Motions relative to the absolute frame can be measured - there is a state of absolute rest.

This can be seen as a variant of Mach's principle that local inertial frames are affected by the cosmic motion and distribution of matter.

The absolute frame of reference defines a standard time. It is calculated from the temporal trajectory of absolute points of reference in the absence of gravitational effects and allows the determination of absolute simultaneity independent from inertial frames of reference. The standard time is the maximum elapsed time.

Rotations and motions relative to the absolute frame can be measured. Motions can be measured, since time dilatation[?] is not relative, but always in relation to the absolute frame of reference:

$$T' = T\sqrt{1 - \frac{v^2}{c^2}}, \quad (1)$$

i.e. v is the velocity compared to the absolute frame and T is the standard time.

If an inertial frame is moving in the positive x -direction in the absolute reference frame, then the time of two systems moving with velocity v (measured in the inertial frame) in the positive and negative x -direction to point $\pm x_0$ (in the inertial frame) is different. This can be used to determine the velocity v of the inertial frame.

References

- [1] E. Mach, "Die Mechanik in ihrer Entwicklung: historisch-kritisch dargestellt", 1883, Brockhaus, Leipzig.

- [2] A. Einstein, "Über das Relativitätsprinzip und die aus demselben gezogenen Folgerungen", Jahrbuch der Radioaktivität 4 (1907) 411.