



# Observer-Emergent Time, Space, and Inertial Laws

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## Abstract

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The role of the observer in physics is reconsidered in connection with our evolving assumptions about the nature of time. Unlike the observer's optional movement through space, evolution in time is compulsory and strictly governed by causal order. Thus, it is argued that time is intrinsically more fundamental than space. The geometry of space is appreciated as emergent degrees of freedom allowing observers to develop invariant transformation equations between them. Inertial laws are shown to emerge from the observer's assumptions about the nature of time and its transformations. In the light of the recent resurgence of interest in higher-derivative theories, particularly in the quest to quantize and/or adapt gravity or the law of inertia to the issues of missing mass and accelerated expansion of the universe, it is illuminating to rediscover the roots of these theories from the observer's appreciation of time. We demonstrate how the observer's operational assumptions about time promulgate dynamical laws.

## Keywords

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observer, emergent manifold, causality, time dilation, general theory of relativity, higher-derivative theories, modified inertia, alternative gravity theory