The Planck Length and the Constancy of the Speed of Light in Five Dimensional Spacetime Parametrized with Two Time Coordinates

In relativity and quantum field theory, the vacuum speed of light is assumed to be constant; the range of validity of general relativity is determined by the Planck length. However, there has been no convincing theory explaining the constancy of the light speed. In this paper, we assume a five dimensional spacetime with three spatial dimensions and two local time coordinates giving us a hint about the constancy of the speed of light. By decomposing the five dimensional spacetime vector into four-dimensional vectors for each time dimension and by minimizing the resulting action, for a certain class of additional time dimensions, we observe the existence of a minimal length scale, which we identify as the Planck scale. We derive an expression for the speed of light as a function of space and time and observe the constancy of the vacuum speed of light in the observable universe.

**General information**
Publication status: Published
Organisations: National Space Institute, Astrophysics and Atmospheric Physics
Contributors: Köhn, C.
Pages: 635-650
Publication date: 2017
Peer-reviewed: Yes

**Publication information**
Journal: Journal of High Energy Physics, Gravitation and Cosmology
Volume: 2017
Issue number: 3
ISSN (Print): 2380-4335
Original language: English
Keywords: Two Time Dimensions, Planck Length, Constancy of the Speed of Light
Electronic versions:
JHEPGC_2017101110460320.pdf
DOIs:
10.4236/jhepgc.2017.34048

**Bibliographical note**
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Research output: Contribution to journal › Journal article – Annual report year: 2017 › Research › peer-review