

Part I Objectives

The main objective of this part is to show that there exists a logical link between Galileo's principle of relativity and Minkowski's four-dimensional formulation of special relativity.

Chapter 2 revisits Galileo's arguments used in his refutation of Aristotle's view on motion that led him to his principle of relativity according to which absolute uniform motion cannot be detected with mechanical experiments.

Chapter 3 carries out an analysis to reveal the physical meaning of this principle. The results of this analysis are quite unexpected – absolute uniform motion cannot be detected since it does not exist. What lies behind the non-existence of absolute uniform motion is even more unexpected – there exists not just one three-dimensional space, but many such spaces. This in turn is possible only in a world of at least four-dimensions. The analysis in this chapter implies that Minkowski's four-dimensional formulation of special relativity is *logically* contained in Galileo's principle of relativity and could have been discovered earlier.

Chapter 4 develops a simple idea – if the world is four-dimensional with time entirely given as the fourth dimension, it should be a monolithic entity given at once and should resemble the ordinary three-dimensional Euclidean space since it is also given at once. In such a case the relations between worldlines (containing the whole histories of physical objects) in this four-dimensional world should be similar to the corresponding relations between lines in the Euclidean space. That is why a translation of Euclidean relations between lines into the corresponding relations between worldlines in the four-dimensional world should be regarded as a manifestation of the four-dimensionality of the world that can be tested experimentally. When those translations are obtained in Chap. 4, it turns out that they coincide with the kinematic consequences of special relativity. This shows, as Minkowski argued, that it is a theory of a four-dimensional world.