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DEFECTS IN FOUR-DIMENSIONAL CONTINUA: A PARADIGM FOR THE EXPANSION OF THE UNIVERSE?

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Abstract. The presence of defects in material continua is known to produce internal permanent strained states. Extending the theory of defects to four dimensions and allowing for the appropriate signature, it is possible to apply these concepts to space-time. In this case a defect would induce a non-trivial metric tensor, which can be interpreted as a gravitational field. The image of a defect in space-time can be applied to the description of the Big Bang. A review of the four-dimensional generalisation of defects and an application to the expansion of the universe will be presented.

1. Introduction

The correspondence between the space-time description typical of the general relativity theory (GR) and the geometrical properties of continua has remote roots in the ether theories of the XIXth century (see some interesting references to 1839 Mac Cullagh theory in a review by A. Unzicker [23]). More specifically a formal link between moving dislocations and special relativity was pointed out by Frank [4] in 1949, then variously discussed by a number of other authors (cited in Section 2.1 of [23]). It is the very geometrization of space-time which immediately suggests a correspondence with material continua, their metric properties, and the theory of elasticity. This long known analogy has been, and is now and then, revived, but has never been taken too seriously and/or used as a constitutive theory of space-time. There are of course philosophical reasons for this mistrust, in a description of our universe basically dualistic (space-time on one side, matter/energy on the other), where the attribute of "reality", whatever it is, is easily assigned to matter/energy and rather ambiguously recognized for space-time. Even within the framework of relativity it is in practice hardly accepted the idea that time (apart from signature) is really like the other dimensions of space and that space-time