

Seminarium Zakładu Fizyki Teoretycznej

Departament Badań Podstawowych
Narodowego Centrum Badań Jądrowych

January 17, 2024 (Wednesday), h. 11:15

The seminar will be held in room 207 @Pasteura 7

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Exploring General Relativistic Approaches to Modeling Large-Scale Structure Formation in the Universe

ABSTRACT: The present era of precision cosmology has provided us with high-quality observational data across astrophysical and cosmological scales. Interpreting these data requires robust modeling of self-gravitating systems. However, the use of exact solutions of Einstein's equations and non-linear approaches has been less favored in examining the observations.

In this talk, we explore various relativistic approaches to modeling the formation of large-scale structures in the universe. We begin by discussing an illustrative model for the collapse of a homogeneous and isotropic overdense region (the top-hat spherical collapse model). We then show how to extend this model to exact inhomogeneous solutions with spherical symmetry (LTB) and beyond spherical symmetry (Szekeres models). The geometrical flexibility of these solutions can be exploited to develop more general models (such as Swiss cheese and onion models) that provide a more realistic description of the networks of cold dark matter structures. We examine the "silent property" exhibited by LTB and Szekeres models and its application in developing alternative approaches. Specifically, we establish the relationship between the LTB/Szekeres models and the (relativistic) Zel'dovich approach, leading to the development of a new general relativistic method. Through these various methods, our goal is to deepen our understanding of the role of curvature and relativistic corrections in the formation of large-scale structures and how inhomogeneities can backreact on the large-scale (background) geometry.

*Best regards,
T. Altinoluk, M. Kowal, P. Małkiewicz, E. Sessolo, P. Zin*