

Seminarium Zakładu Fizyki Teoretycznej

Departament Badań Podstawowych
Narodowego Centrum Badań Jądrowych

Dec 15, 2021 (Wednesday), h. 11:15

The seminar is held online:

https://www.gotomeet.me/NCBJmeetings/bp2_seminar

Ismael Delgado Gaspar

(NCBJ)

"Exact solutions of Einstein's equations and Relativistic

Zel'dovich Approximation"

ABSTRACT:

The current era of precision cosmology has produced a large amount of high-quality observational data at all astrophysical and cosmological scales, whose theoretical interpretation requires a robust modeling of self-gravitating systems. However, a non-perturbative approach by means of exact solutions of Einstein's equations has been less favored to analyze the cosmological observations. In this talk, we will show that the full dynamical freedom of the Szekeres models (the most general exact solution applicable to cosmology) allows for the description of realistic 3-dimensional networks of cold dark matter (CDM) structures. We will also discuss how these solutions can be generalized to a new non-linear perturbative approach.

In the first part, we will examine the sufficient conditions for the existence of multiple spatial extrema of the Szekeres covariant scalars. These results allow us to set up networks of pancake-shaped CDM overdensities and density voids, providing a coarse-grained but fully relativistic non-linear description of large-scale cosmic structures before their virialization.

The second part will examine the relationship between the Szekeres models and the Relativistic Zel'dovich Approximation (RZA). We show that the second class of the Szekeres solutions is exactly contained within RZA when the solution is governed by the first principal invariant of the deformation field. Although the connection with the first class of Szekeres models is not straightforward, this class can be interpreted as a spatial superposition of non-intersecting fluid lines, where each world line evolves independently and under the RZA model equations on different associated "local backgrounds." Such an interpretation paves the way for generalizing the Lagrangian perturbation scheme to structure formation models containing the whole family of Szekeres models as a limit, i.e., a Generalized Relativistic Zel'dovich Approximation.

Best regards,

T. Altinoluk, M. Kowal, P. Małkiewicz, E. Sessolo, P. Zin