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# NON-RELATIVISTIC GRAVITY AND ITS COUPLING TO MATTER

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## Abstract

We will discuss the non-relativistic expansion of general relativity coupled to matter. We study the expansion of the Einstein–Hilbert action up to next-to-next-to-leading order. We couple this to different forms of matter: point particles, perfect fluids, scalar fields (including an off-shell derivation of the Schrödinger–Newton equation) and electrodynamics (both its electric and magnetic limits). We find that the role of matter is crucial in order to understand the properties of the Newton–Cartan geometry that emerges from the expansion of the metric. We end by discussing a variety of solutions of non-relativistic gravity coupled to perfect fluids. This includes the Schwarzschild geometry, the Tolman–Oppenheimer–Volkoff solution for a fluid star, the FLRW cosmological solutions and anti-de Sitter spacetimes.

**Date :** Friday, March 13, 2020

**Time:** 13:30

**Place:** IMBM Seminar Room, Boğaziçi University South Campus