Non-Relativistic Geometry in String Theory, Holography and Gravity

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Newton-Cartan geometry was introduced more than 90 years ago in order to find a geometric formulation of Newtonian gravity. This geometry (including a novel generalisation that includes torsion) has in recent years gained renewed interest as it appears in a variety of settings in modern theory involving gravity, string theory and holography.

In particular, torsional Newton-Cartan geometry has been shown to appear as the boundary geometry for Lifshitz spacetimes. which is a holographic setup for systems with non-relativistic symmetry. The reason is that non-relativistic field theories naturally couple to such geometries, in the same way that relativistic field theories couple to Riemannian geometry. Furthermore, non-relativistic geometry appears in limits of string theory and the AdS/CFT correspondence. This includes novel Chern-Simons theories of gravity in three dimensions which follow from a well-defined limit of the AdS3/CFT2 correspondence, which I will discuss.

I will also comment on how non-relativistic strings move in a Newton-Cartan target space, and a further worldsheet limit which is related to limits of AdS5/CFT4.

Finally, I will talk about recent work on understanding non-relativistic gravity (including its Newtonian limit) from a new perspective,