

# Seeing Through Space Time

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Abstract: We consider inverse problems for the Einstein equation with a time-dependent metric on a 4-dimensional globally hyperbolic Lorentzian manifold. We formulate the concept of active measurements for relativistic models. We do this by coupling Einstein equations with equations for scalar fields.

The inverse problem we study is the question of whether the observations of the solutions of the coupled system in an open subset of the space-time with the sources supported in this set determines the metric in a larger domain. To study this problem we define the concept of light observation sets and show that knowledge of these sets determine the conformal class of the metric. This corresponds to passive observations from a distant area of space which is filled by light sources.

We will start by considering inverse problems for scalar non-linear hyperbolic equations to explain our method. No previous knowledge of Lorentzian geometry or general relativity will be assumed.

This is based on joint work with P. Hinz, Y. Kurylev, M. Lassas, Y. Wang and J. Zhai