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Asymptotic analysis of isolated gravitational systems

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A central result within mathematical relativity is the well-posedness of the initial value formulation of GR for initial data satisfying Einstein constraint equations, where uniqueness of maximal globally hyperbolic developments of initial data is consistent with the type of determinism expected from classical physical theories. In this context, isolated gravitational systems are modelled by asymptotically Euclidean initial data sets, and there are physically reasonable expectations about the asymptotic behaviour of these systems. It turns out that a rigorous mathematical understanding of the conditions that guarantee these expectations is still an open problem. This is crucial to make canonically conserved quantities carrying physical information well-defined. In the case of the ADM energy and linear momentum, precise geometric criteria making them well-defined are well-known, but for the finer ADM center of mass and angular momentum this is not the case, and ad-hoc asymptotic conditions, expected to hold for reasonable physical systems, tend to be demanded. In this talk, we will comment on recent advances related to regularity theory and asymptotic analysis of geometric partial differential equations which allow one to partially characterise in pure geometric terms those initial data sets which indeed obey these expected asymptotic properties.

Primary author: AVALOS, Rodrigo (University of Tübingen)

Presenter: AVALOS, Rodrigo (University of Tübingen)

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