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The two-body problem at Asymptopia

Solutions to Einstein's 4-dimensional vacuum field equations of general relativity are parametrized, roughly speaking, by solutions to the 3-dimensional *constraint equations*, which represent "initial data" on a spacelike hypersurface. Using the conformal method introduced by James York and others, the problem of finding solutions to the constraint equations can be reduced to solving a formally determined system of elliptic PDEs on a 3-manifold.

An *asymptotically hyperbolic initial data sets* is a solution to the constraint equations on the interior of a smooth manifold with boundary, whose intrinsic and extrinsic curvatures approach those of the standard spacelike hyperboloid in Minkowski space near infinity. The key feature of such initial data sets is that they admit conformal compactifications obtained by adding a boundary at infinity and conformally rescaling the metric and second fundamental form so that they have smooth (or at least C^2) extensions to the boundary. The asymptotic region near conformal infinity ("Asymptopia") reflects the future asymptotic behavior of the resulting spacetime more closely than an asymptotically flat initial hypersurface does.

Gluing techniques have proved to be a fruitful way of constructing new solutions to the constraint equations from old ones. However, when typical gluing techniques are applied to two asymptotically hyperbolic initial data sets, the glued data set will have two disconnected asymptotic regions, which is problematic for physical modeling.

In this talk, based on joint work with Jim Isenberg and Iva Stavrov-Allen, I will describe a new gluing construction for asymptotically hyperbolic initial data sets, in which the gluing all takes place near the conformal infinity; it can be interpreted physically as starting with two asymptotically hyperbolic initial surfaces in asymptotically flat spacetimes (perhaps representing two isolated gravitational systems), and gluing them together to produce a new system that contains (slightly perturbed) copies of both of the original ones. The main advantage of our construction is that if we start with two spacetimes whose asymptotic regions are connected, then the new glued spacetime also has a connected asymptotic region.