Spacetime Geometry and Gravitational Radiation

Spacetimes allowing gravitational radiation have been of particular interest in the mathematical theory of General Relativity as well as in astrophysics. Several experiments aim at detecting gravitational waves in the near future. Geometric analysis lays open the structures of the relevant manifolds. In this talk, I discuss spacetime geometries arising from the Einstein equations coupled to various fields in General Relativity. Null hypersurfaces play a crucial role in the discussion. Results on their structure and asymptotic behavior yields insight into gravitational waves. I explain the geometric picture of gravitational radiation and discuss new results on their nonlinear phenomena in the presence of neutrino radiation. The latter is joint work with David Garfinkle.