Some properties of pp-and plane waves in general relativity theory

Graham Hall

(Institute of Mathematics, University of Aberdeen)

This talk involves the so called pp- and plane waves which arise in general relativity theory. Some attention will be paid to the physics involved but the main idea is to highlight their geometrical properties, to show how many general, geometrical "conjectures" based on standard, positive definite manifolds fail in Lorentz signature and to lay the blame (usually) on the pp- or plane wave. The talk comes in the following (hopefully digestible) pieces. First, I will give a discussion of the definitions of pp- and plane waves and which includes their algebraic, geometrical and physical properties. This involves a brief discussion of "wave surfaces" in Lorentz spaces. Second, some remarks will be made on the Killing, homothetic and curvature symmetries that such metrics possess and also the symmetries possessed by their wave surfaces. The final part of the talk will involve posing some conjectures for space-times based on results known for (4-dimensional) positive definite metrics. They will all be shown to be false and that the cause of this failure is (almost) always due to the existence of pp-and plane waves.