

Solutions with a geodesic, single Weyl PND: from vacuum to aligned Einstein-Maxwell

Lode Wylleman (University of Stavanger)

Abstract

By the Goldberg-Sachs theorem a geodesic, single Weyl principal null direction (PND) in a vacuum or an aligned non-null Einstein-Maxwell (EM) gravitational field, possibly with cosmological constant, is shearing. I will first highlight a seemingly unnoticed result by Debever and Leroy, viz. a geodesic, single Weyl PND in vacuum is also non-twisting, and show that it can be extended to the EM case. The vacuum solutions thus constitute the Newman-Tamburino class and have a zero cosmological constant. De Groote and Van den Bergh have proved that the EM generalizations are cylindrical and integrated this class of solutions. The analysis will be revised in an EM gauge within the Geroch-Held-Penrose formalism. This shows that *both* Maxwell PNDs are geodesic, non-twisting, shearing, single Weyl PNDs, and that the Petrov type is I; moreover the equations become drastically more compact and allow for an invariant integration.