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Theory: On the nature of Bondi-Metzner-Sachs transformations

Monday, September 4, 2023 3:00 PM (15 minutes)

This work investigates, as a first step, the four branches of BMS transformations, motivated by the classification into elliptic, parabolic, hyperbolic and loxodromic proposed a few years ago in the literature. We first prove that to each normal elliptic transformation of the complex variable z used in the metric for cuts of null infinity, there is a corresponding BMS supertranslation. We then study the conformal factor in the BMS transformation of the u variable as a function of the squared modulus of z. In the loxodromic and hyperbolic cases, this conformal factor is either monotonically increasing or monotonically decreasing as a function of the real variable given by the modulus of z. The Killing vector field of the Bondi metric is also studied in correspondence with the four admissible families of BMS transformations. Eventually, all BMS transformations are re-expressed in the homogeneous coordinates suggested by projective geometry. It is then found that BMS transformations are the restriction to a pair of unit circles of a more general set of transformations. Within this broader framework, the geometry of such transformations is studied by means of its Segre manifold.

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