Service de Physique de l'Univers, Champs et Gravitation

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Sujet de mémoire

Higher-spin soft theorems from the celestial conformal field theory

In a spectacular failure of any naive expectation, in 1962 Bondi, van der Burg, Metzner and Sachs showed that the asymptotic symmetries of asymptotically-flat gravity are given by an infinite-dimensional group, called BMS group, rather than by the familiar Poincaré group. Recently, it has also been pointed out that the scattering amplitudes of four-dimensional asymptotically flat gravity transform covariantly under BMS symmetries [1]. This observation has been used to interpret Weinberg's factorisation theorems for soft amplitudes [2] — that is for scattering amplitudes involving a graviton whose momentum tends to zero — as the Ward identities of these symmetries. The relation between asymptotic symmetries and soft theorems has been later generalised to amplitudes involving massless particles of any spin [3].

The BMS group, in its extended version, includes the infinite-dimensional symmetry group of a two-dimensional conformal field theory [4] and this lends scattering amplitudes a natural reinterpretation as correlations functions of a holographically dual conformal field theory defined on the celestial sphere at null infinity [5]. The goal of this project is to, (i) learn the basics tools of conformal field theory and (ii) use them to rederive Weinberg's soft theorems for amplitudes involving massless particles of spin $s > 2$.

Prerequisites: courses of General Relativity and Quantum Field Theory I and II

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References

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[3] A. Campoleoni, D. Francia and C. Heissenberg, "On higher-spin supertranslations and superrotations," JHEP **05** (2017), 120 [arXiv:1703.01351 [hep-th]].

[4] G. Barnich and C. Troessaert, "Aspects of the BMS/CFT correspondence," JHEP **05** (2010), 062 [arXiv:1001.1541 [hep-th]].

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