

Service de Physique de l'Univers, Champs et Gravitation

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Sujet de mémoire

## Newman-Penrose charges in Yang-Mills and higher dimensions

Conserved charges are an important tool to study the dynamics of a non-linear system. In theories displaying a gauge symmetry, like the invariance under diffeomorphisms of general relativity, conserved charges are deeply related to the notion of asymptotic symmetries. In general relativity, these are the symmetries of the spacetime far away from any source of energy. The natural expectation is that they coincide with the symmetries of Minkowski space, i.e. with the Poincaré group. In 1962 Bondi, van der Burg, Metzner and Sachs showed, however, that the asymptotic symmetries of asymptotically-flat gravity are given by an infinite-dimensional group, called BMS group [1, 2]. As a result, infinitely many conserved charges are actually present in addition to energy and angular momentum. These have been studied intensively in the last few years thanks to their recently discovered relations with memory effects and soft theorems [3].

An apparently independent set of conserved charges in asymptotically flat gravity has also been identified in 1965 by Newman and Penrose [4]. In a spacetime of dimensions four, the latter have been recently identified with some subleading contributions to the BMS charges [5]. The goal of the project is twofold: first we will check whether an analogue of Newman-Penrose charges can also be defined for Yang-Mills theories, starting from the subleading terms in their asymptotic conserved charges. Then we will study how to generalise the relation between Newman-Penrose and BMS charges to spacetimes of dimension greater than four, where the very definition of BMS symmetries is already much subtler [6].

**Prerequisites:** course of General Relativity

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## References

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- [6] A. Campoleoni, D. Francia and C. Heissenberg, “Asymptotic Charges at Null Infinity in Any Dimension,” Universe **4** (2018) no.3, 47 [[arXiv:1712.09591 \[hep-th\]](#)].