

Double copy and massless free fields in curved spacetime

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Assuming any massless free-fields with spin higher than $1/2$ are constructed by scalar fields (spin-0) and Dirac-Weyl fields (spin- $1/2$), we introduce a map between spin-2 massless free-fields (gravity fields) and Dirac-Weyl fields in spinor formalism, then associated Dirac-Weyl spinors that can live in certain spacetime are identified. Regarding them as basic units, other higher spin massless free-fields are built. In this way, some hidden fundamental features related to massless-free fields are revealed. In particular, we systematically rebuild the double copy for type N and type D spacetime. We further extend the study to vacuum non-twisting type III solutions, we find there is a special Dirac-Weyl scalar whose square is just proportional to Weyl scalar, then a degenerate Maxwell field is constructed with the aid of an auxiliary scalar field, both fields not only satisfy their field equation in the curved background spacetime, but also in flat spacetime. The result further confirms that there must exist a deep connection between gravity theory and Yang-Mills gauge theory.

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Track Classification: Student Talks