In this article, generating functionals for tree-level (or classical) scattering amplitudes of maximally supersymmetric theories, *i.e.*, those of $\mathcal{N} = 4$ super Yang-Mills theory and $\mathcal{N} = 8$ supergravity, are obtained. Derivations are based on recent developments on the understanding of $\mathcal{N} = 4$ Yang-Mills theory in a framework that utilizes spinor momenta (of scattering massless gauge particles) in supertwistor space $\mathbf{CP}^{3|4}$. This framework is sometimes called the spinor-helicity formalism because the information on the number of spinor momenta involved in a scattering of interest determines the helicity configuration of the scattering particles. The simplest configuration is called maximally helicity violating (MHV) one, which consists of two negative helicity particles and $(n-2)$ positive helicity particles (or the other way around, depending on the definition of spinor momenta), with n being the total number of scattering particles. Recent developments show that general non-MHV tree amplitudes of gluons (or gauge particles in Yang-Mills theory) can be expressed by recursive use of MHV tree amplitudes [1]; the resultant expressions are called the Cachazo-Svrcek-Witten (CSW) rules. One of the main results in this article is that, by use of these CSW rules, the authors manage to write down a field-theoretic expression of generating functionals for tree amplitudes of gluons in general. Further, the authors show that the expression can be extended to the case of $\mathcal{N} = 8$ supergravity. Along the way, topics including supersymmetric (SUSY) Ward identities on MHV amplitudes, applications of MHV generating functionals to loop amplitude, and relation between MHV amplitudes and holomorphic correlators in conformal field theory, are also discussed.

References

[1] F. Cachazo, P. Svrcek and E. Witten, "MHV vertices and tree amplitudes in gauge theory," JHEP **0409**, 006 (2004) [arXiv:hep-th/0403047].