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Abelian color cycles: a new approach to strong coupling expansion and dual representation for non-abelian lattice gauge theory.

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We present a dual approach for SU(2) lattice gauge theory, i.e., an exact mapping of the partition sum to new, so-called dual variables. The dual representation is constructed by decomposing the Wilson gauge action into "abelian color cycles" (ACC), which are loops in color space around plaquettes. The ACCs are complex numbers and as such commute, such that a dual representation can be obtained as in the abelian case. The original SU(2) degrees of freedom are integrated out and the dual degrees of freedom are occupation numbers of the ACCs, subject to constraints reflecting the original SU(2) symmetry. The approach is then extended to the case of SU(2) gauge fields with fermions. Analyzing the strong coupling region we show that the system is free of sign problems up to $O(\beta^3)$. The ACC concept can be generalized to other non-abelian gauge groups such as SU(3).

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