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Field theory of symmetry protected valence bond solid states in (2+1) dimensions AKIHIRO TANAKA, National Institute for Materials Science, Jpn, SHINTARO TAKAYOSHI, Department of Quantum Matter Physics, University of Geneva — With the scope of identifying possible symmetry-protected topological (SPT) states, we revisit the effective field theory description of 2d antiferromagnets in terms of nonlinear sigma models with topological Berry phase terms. We focus on ground states that can be characterized as spatially-uniform valence-bond-solid states residing on a square lattice, which implies that the spin quantum number S be an even integer. A path integral representation of wave functionals allows us to study the topological properties of the ground state in terms of a field theory defined in a space whose dimensionality is reduced by one, which leads us to an interesting incarnation of the well-known Haldane-gap argument for 1d antiferromagnets. From this, we conclude that the ground state can be an SPT state when S =2× odd integer, while for S =2 × even integer it is topologically trivial. We also discuss how our method generalizes to 1d and 3d antiferromagnets.

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