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Symmetry Protected Topological Phases in Polar Molecule Spin Ladder Systems S.R. MANMANA, Institute f. Theoretical Physics, University of Göttingen, D-37077 Göttingen, Germany, E.M. STOUDENMIRE, Department of Physics and Astronomy, UC Irvine, CA 92697, USA, K.R.A. HAZZARD, A.M. REY, JILA, NIST and Department of Physics, CU Boulder, CO 80309, USA, A.V. GORSHKOV, IQI, Caltech, Pasadena, CA 91125, USA — We show how to use polar molecules in an optical lattice to engineer quantum spin models with arbitrary spin $S \geq 1/2$ and with interactions featuring a direction-dependent spin anisotropy. This is achieved by encoding the effective spin degrees of freedom in microwave-dressed rotational states of the molecules and by coupling the spins through dipolar interactions. We demonstrate how one of the experimentally most accessible anisotropies stabilizes symmetry protected topological phases in spin ladders. Using the numerically exact density matrix renormalization group method, we find that these phases – previously studied only in the nearest-neighbor case – survive in the presence of long-range dipolar interactions. We also show how to use our approach to realize the bilinear-biquadratic spin-1 and the Kitaev honeycomb models. Experimental detection schemes and imperfections are discussed.

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