Title: Energy-decaying extrapolated RK–SAV methods for the Allen–Cahn

and Cahn–Hilliard equations

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Abstract: We construct and analyze a class of extrapolated and linearized Runge–Kutta (RK) methods, which can be of arbitrarily high order, for the time discretization of the Allen–Cahn and Cahn–Hilliard phase field equations, based on the scalar auxiliary variable (SAV) formulation. We prove that the proposed q-stage RK–SAV methods have qth-order convergence in time and satisfy a discrete version of the energy decay property. Numerical examples are provided to illustrate the discrete energy decay property and accuracy of the proposed methods.