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Complex Scalar Field Dark Matter and Cosmological B-Modes from Inflation BOHUA LI, Univ of Texas, Austin, TANJA RINDLER-DALLER, University of Michigan, PAUL SHAPIRO, Univ of Texas, Austin — As an alternative to the WIMP CDM model, we consider dark matter comprised of ultralight bosons, described by a classical complex scalar field, for which particle number per unit comoving volume is conserved. When the homogeneous background universe evolves in the presence of this type of scalar field dark matter (SFDM), the equation of state of SFDM is relativistic at early times, evolving from stiff ($\bar{p} = \bar{\rho}$) to radiationlike ($\bar{p} = \bar{\rho}/3$), before it becomes nonrelativistic and CDM-like at late times ($\bar{p} = 0$). Thus, before the familiar radiation-dominated phase, there is an earlier phase of stiff-matter-domination. The timing of the transition between these phases determined by SFDM model parameters, particle mass m and self-interaction coupling strength λ, is constrained by cosmological observables, particularly $N_{\rm eff}$, the effective number of neutrino species during BBN, and cosmological tensor fluctuations from inflation, which leave an imprint on CMB B-modes. Primordial tensor modes that reenter the horizon during the stiff phase contribute significantly to the total energy density of the universe as gravitational waves, increasing the expansion rate of the early universe. This effect yields constraints on SFDM model parameters.

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