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Stripe phase and double-roton excitations in interacting spin-orbit-coupled spin-1 Bose-Einstein condensates KUEI SUN, The University of Texas at Dallas, Richardson, Texas, USA, CHUNLEI QU, The University of Texas at Dallas, Richardson, Texas, USA and Università di Trento, Povo, Italy, YONG XU, The University of Texas at Dallas, Richardson, Texas, USA, YONG-PING ZHANG, OIST Graduate University, Onna, Okinawa, Japan, CHUANWEI ZHANG, The University of Texas at Dallas, Richardson, Texas, USA — Spin-orbit (SO) coupling plays a major role in many important phenomena in condensed matter physics. However, the SO coupling physics in high-spin systems, especially with superfluids, has not been well explored because of the spin half of electrons in solids. In this context, the recent experimental realization of spin-orbit coupling in spin-1 Bose-Einstein condensates (BECs) has opened a completely new avenue for exploring SO-coupled high-spin superfluids. Nevertheless, the experiment has only revealed the single-particle physics of the system. Here, we study the effects of interactions between atoms on the ground states and collective excitations of SO-coupled spin-1 BECs in the presence of a spin-tensor potential. We find that ferromagnetic interaction between atoms can induce a stripe phase exhibiting two modulating patterns. We characterize the phase transitions between different phases using the spin-tensor density as well as the collective dipole motion of the BEC. We show that there exists a new type of double maxon-roton structure in the Bogoliubov-excitation spectrum, attributing to the three band minima of the SO-coupled spin-1 BEC. Our work could motivate further theoretical and experimental study along this direction.

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