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Damping of spin-dipole mode and generation of quadrupole mode excitations in a spin-orbit coupled Bose-Einstein condensate CHUAN-HSUN LI, DAVID BLASING, YONG CHEN, Purdue University — In cold atom systems, spin excitations have been shown to be a sensitive probe of interactions and quantum statistical effects, and can be used to study spin transport in both Fermi and Bose gases. In particular, spin-dipole mode (SDM) is a type of excitation that can generate a spin current without a net mass current. We present recent measurements and analysis of SDM in a disorder-free, interacting three-dimensional (3D) ^{87}Rb Bose-Einstein condensate (BEC) by applying spin-dependent synthetic electric fields to actuate head-on collisions between two BECs of different spin states. We experimentally study and compare the behaviors of the system following SDM excitations in the presence as well as absence of synthetic 1D spin-orbit coupling (SOC). We find that in the absence of SOC, SDM is relatively weakly damped, accompanied with collision-induced thermalization which heats up the atomic cloud. However, in the presence of SOC, we find that SDM is more strongly damped with reduced thermalization, and observe excitation of a quadrupole mode that exhibits BEC shape oscillation even after SDM is damped out. Such a mode conversion bears analogies with the Beliaev coupling process or the parametric frequency down conversion of light in nonlinear optics.

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