Contributed Talk

Exact solvability of Spin-orbit and Rabi Coupled Bose-Einstein Condensates and Attributes of Localized Solutions

P. S. Vinayagam[1] and **R. Radha**[2]

[1]*Physics Department, PSG College of Arts and Science (Autonomous), Coimbatore, Tamil Nadu, India*

[2]*Centre for Nonlinear Science (CeNSc), PG and Research Department of Physics, Government College for Women (Autonomous), Kumbakonam, Tamil Nadu, India*

In this paper, based on an integrable model governed by four system parameters, namely, spin-orbit coupling and Rabi coupling which are constants while the other two parameters, namely the harmonic trap and scattering lengths which are time dependent, we investigate the spin orbit-Rabi coupled condensates governed by the two coupled Gross-Pitaevskii (GP) equation. Employing Darboux transformation approach with nontrivial seed solution, we generate rogue waves, breathers, mixed rogue-dark-bright and classical dark-bright solitons. While the addition of spin orbit coupling contributes to rapid oscillations in the amplitude of the rogue waves, Rabi coupling results in the appearance of stripes in the temporal direction. When the transient trap is switched on, these stripes which remain stable within the confining region, begin to overlap exponentially in the expulsive domain and eventually shrink leading to instability. We have shown that the instability arising in the rogue waves in a transient trap can be completely overcome by manipulating the scattering length through Feshbach resonance. In the case of breathers, the Rabi coupling introduces temporal stripes with single and double mode peaks around the origin while under the influence of the transient trap, the breathers get compressed and tilted. On the other hand, the amplitude of breathers which stays constant between a maxima and minima despite oscillating with time undergoes rapid fluctuations in a given spatial domain under the influence of SOC. In the case of classical dark-bright solitons, we see the flipping of dark solitons to attain positive density much similar to bright solitons under the impact of Rabi coupling. One also witnesses a 45° shift in the trajectory of dark and bright solitons when the transient trap is switched on. The width of the solitons widen in the confining trap while they shrink in the expulsive domain.