Structure and Dynamics of Noncommutative Solitons: Spectral Theory and Dispersive Estimates

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Abstract. Consider the Nonlinear Schrödinger equation (NLS) with two spatial dimensions. By enhancing the spatial plane with Moyal-Weyl noncommutivity and restricting to radial solutions, or alternately restricting to radial solutions and discretizing the radial direction, one finds a novel lattice NLS. We prove the existence and properties of a family of ground state solitons as well as their asymptotic stability for sufficiently large soliton mass. The spectra and local time decay estimates are similar to those of the associated continuum NLS although the methods we employ are quite different. Closely related equations have previously appeared in the physics literature as models for D-brane dynamics in string theory and optical soliton formation in nonlinear waveguide arrays.