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On the topological characteristic of the spectra of some composite quantum systems

I will discuss the spectral characteristic of a class of composite quantum systems that obey nonlinear and nonlocal type dynamics. The specific models of dynamics I consider depend on a triplet of constituents—two subsystem Hamiltonians $(H, \hat{H})$, both with pure point spectrum, and an analytic function (f)—as well as a real parameter s. The composite system state vector (canonically identified with a Hilbert–Schmidt class operator, here denoted K) evolves according to the nonlinear equation:

$$-i\hbar\dot{K} = KH + \hat{H}K + \frac{1}{s}Kf(K^*K).$$

In spite of the complex patterns of the resulting dynamics, the *stationary states* of such systems can be described fairly explicitly (see A. Sowa, *Stationary states in nonlocal type dynamics of composite systems*, J. Geom. Phys., to appear, doi:10.1016/j.geomphys.2009.07.015). Here, I will present recent results characterizing the topological type of the spectra of such composite systems.

It turns out that the spectrum of the composite system is often very distinct from the spectra of its two subsystems. I will illustrate this with examples which show that while subsystems have discrete spectra, the energy levels of the composite system may fill the Cantor set, or, in another case, a union of a finite number of intervals. Some of the examples involve the series $\sum n^{-s}$.