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Over the past several decades astronomers have become aware of the growing role of chaos in galactic and solar system dynamics. At the same time mathematicians working in nonlinear dynamics have developed a number of powerful tools to use in the analysis of dynamical systems. Unfortunately not all of these tools are directly applicable to astronomical systems. The fellow proposes to develop and apply spectral techniques to the analysis of time series data of chaotic orbits in galactic potentials on short, astronomically realistic, timescales. This will be done by exploiting the fact that, in a well defined sense, a chaotic orbit is constructed as a superposition of pieces of several different regular orbits. The astronomical motivation is to use spectral techniques as a tool to investigate the structural stability of conventional galactic modeling towards various sorts of low amplitude irregularities (graininess, weak dissipation, spatial symmetry breaking, presence of a supermassive black hole, and gravitational interactions with galaxies and other extragalactic objects) which are typically ignored.