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Chaos in barred galaxies: A study of several scenarios

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Galaxies can be classified according to the scheme proposed by Edwin Powell Hubble. This scheme separates the spiral galaxies into two types: regular spiral galaxies (S) and barred spiral galaxies (SB). This bar substructure can be understood as a disturbance to the axisymmetric potential of the galactic disk. The present work was focused on the study of gravitational potentials generated by a barred galaxy structure. The classic way to study these barred galactic potentials is observing the structure of orbits that are supported by them. Stellar orbits supported by a galactic potential are the backbones of any galactic structure. So the study of the characteristics of stellar orbits is of vital importance to understanding the formation and evolution of these galactic structures. Therefore, we studied the nature of the orbits immersed in analytical potentials with two degrees of freedom representing barred galaxies. In order to do this, we applied the Smaller Alignment Index (SALI), which is a tool for distinguishing regular and chaotic motions in the phase space of Hamiltonian Dynamical Systems. It was possible because the motion of a test particle in a model of a barred galaxy in the rotation is given by a Hamiltonian function. We studied six-time independent models, each representing a different bar situation. Also studied six-time dependent models, where the bar evolves over time. Some of the main conclusions are: retrograde orbits are more conducive to chaos, "more axisymmetric" barred galaxies have more regular orbits, very massive bars generate more chaotic motions and the bars with rapid growth also leaves the environment more conducive to chaos.

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