A GALAXY MODEL WITH LONG-LIVED TWO-ARMED SPIRAL STRUCTURE

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We present an N-body simulation of a galaxy with a long-lived two-armed spiral pattern. The model consists of a static bulge and halo and an active disk of 60,000 particles. The disk contains 41 % of the total mass of the system. The resulting rotation curve has a steeply rising central part and is falling at larger radii. Half of the disk particles represents an old stellar population, half of them gas clouds that can collide inelastically with each other.

A spiral pattern develops in the initially featureless disk. The arms are found both in the stellar and the gaseous components, although the gas arms are narrower than the stellar ones. The spiral lasts for about three pattern revolutions without severe distortion, and persists for at least two more revolutions with distortions and bifurcations resulting from an increasingly clumpy interstellar medium. However, the model does not contain any processes like supernova explosions that could broaden the gas arms. The result of the simulation implies that two-armed grand design spirals in non-barred, non-interacting galaxies can be long-lived if star formation and other heat sources not present in the simulation maintain a quasi-steady interstellar medium.

The key factors contributing to the generation of this long-lived pattern are:
(1) a Q-barrier (large velocity dispersion) in the inner region,
(2) a mass distribution and rotation curve that allows swing amplification of m=2 waves with an inner Lindblad resonance inside the Q-barrier,
(3) a star-cooling routine that keeps the stellar velocity dispersion constant with adiabatic variations allowed, and
(4) a substantial amount of cold, dissipating gas in the disk.

The stellar pattern extends from the Q-barrier to the outer Lindblad resonance and the gaseous pattern extends from the region of the inner Lindblad resonance to the outer Lindblad resonance.

More details can be found in *Astrophys. J. Lett.*, **356**, L9.

F. Combes and F. Casoli (eds.), Dynamics of Galaxies and Their Molecular Cloud Distributions, 132.