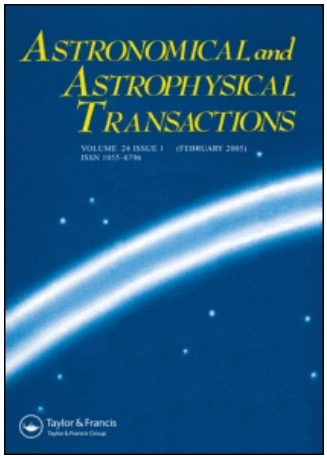

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ON A POSSIBLE ORIGIN OF COMPLICATED GALACTIC SPIRAL PATTERNS

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Some of the observational features of complicated galactic spiral patterns (e.g. branching arms, etc.) may be well explained assuming the possibility of the quasi-stationary modes superposing in the galactic disc. These modes may be excited by the same mechanism-gravitational or hydrodynamic- or by different ones, and possess same or different aximuthal index.

KEY WORDS galaxies, spiral patterns, instabilities.

It seems difficult to explain the observed complicated galactic spiral patterns (with branching arms, etc.) from the viewpoint of excitation and self-support of gravitational or hydrodynamic modes without additional assumptions, such as non-stationary rotation in central parts of the galactic disk (cf. Nezlin and Snezhkin, 1990).

This problem can be avoided allowing for coexistence (superposition) of two or more oscillatory modes in the galactic disk. The azimuthal mode indices (that determine the number of spiral arms) can be the same or different for these modes, as well as the excitation mechanisms (hydrodynamic or gravitational). In general, such situation is not excluded, and a number of systems can be pointed out with different oscillatory modes coexisting at the stage of finite amplitudes (or even shock waves, as in supersonic jets—e.g., Norman and Hardee, 1988). Note that we mean quasi-stationary modes, each of them being a result of constructive interference of waves propagating from the dynamic resonances.

Fridman (1978) proposed a similar idea explaining the multi-layered spiral structure (different numbers of arms in different radius ranges within the disk) with specific conditions within a given range determining specific instability arising in these regions. Each instability has its specific relation of the maximum growth rate on the azimuthal mode index m, leading to differences in spiral patterns throughout the disk. Nevertheless, we propose to analyze the possibility that different ustable modes simultaneously develop in the same disk region.

With the framework of the stationary model, with the above assumptions, such observed features of galactic spiral patterns can be explained as the spiral arm branching (e.g., NGC 151, 1288, 2997, 4725, 4736, 5033, 6946, 7412, etc.), a dense gas ring overlapping the spiral pattern (NGC 1024, 2223, 3124, 3344, 7329, etc.), the coexistence of the arms with different pitch angles in the same spiral pattern, and the spiral pattern in the central region of the bar (NGC 1512), etc.

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