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## Formation and Evolution of Galaxies

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GENERAL TRENDS

At the beginning of this review period a number of arguments were put forward against the neutrino model which became popular in 1980-1983[1]: too high a rate of the structure evolution at the non-linear stage and the same difficulty in the galaxy formation. As a consequence, many other schemes of the structure origin have been elaborated: models with "cold" particles, with unstable missing mass, etc. In these models the missing mass is in the form of weakly interacting particles (axion, photino, gravitino, etc.), or of usual particles (e.g., neutrino) but with properties that are out of the ordinary (e.g. instability). However, the standard neutrino model cannot yet be regarded as rejected[2], the more so in view of the recent data on the large-scale peculiar velocities[3].

The "cold"-particle hypothesis has been actively developed. In its simplest version this hypothesis contradicts many observational data and demands biasing, a process of galaxy formation where the distribution of visible matter does not

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reproduce the distribution of missing mass. Attempts to modify the old neutrino model have brought about a large family of models with unstable missing mass. Some of these models rapidly develop and look quite vital. A tendency towards composite (hybrid) schemes of the formation of galaxies is becoming rather obvious. These are for instance, neutrino models with a "cold" component[4] or with cosmological strings and explosions, a "cold" model with Λ-term[5], models with unstable particles and Λ-term[6], etc.

The problems we have mentioned here were treated in several review papers[7] and in recent IAU simposia (see the Introduction by G. Setti).

COLD DARK MATTER MODELS (CDM) AND BIASED GALAXY FORMATION

Davies et al.[8] found that N-body simulations of CDM with $\Omega = 1$ adequately represent the observational picture of superclusters and voids if galaxies were located at the high (2.5 standard deviations) mass density peaks. Different schemes for biased galaxy formation were suggested by other authors[9]. The three-point correlation function was estimated by Melott and Fry[10], while the N-point correlation function was discussed by Jensen and Szalay[11].

Statistical properties of high mass density maxima were studied by Peacock and Heavens[12], and Bardeen et al.[13]. This approach is doubtlessly one of the most promising on the way to disclosing the mystery of the galactic creation.

UNSTABLE DARK MATTER MODELS (UDM)

First variants of UDM with decaying neutrinos were proposed by several authors[14]. It was found[15] that the structural parameters would contradict the observations if galaxies were formed before the particle decayed. UDM with formation of the non-linear structures at the epoch of decays ($Z_d \simeq 3 - 10$) and later were discussed by Doroshkevich et al.[16]. Virgocentric infall velocities in UDM were estimated by Hoffman[17]. CDM and UDM meet difficulties in the explanation of bulk velocities on scales ~ 100 Mpc.

HIERARCHICAL EXPLOSIONS (EM) AND STRING (SM) MODELS

The physical aspects of EM were discussed by Carr and Ikeuchi[18], and Ikeuchi and Ostriker[19], while numerical simulations for galaxy distribution were presented by Saarinen et al.[20]

The development of SM has been much pursued[21] and applications to formation of structures were made by many authors[22]. It was found[23] that the results of non-linear simulation of SM with cold particles does not agree with observations.

NEW APPROACHES

The problem of the difference of the correlation functions for galaxies and for rich clusters is still puzzling. New approaches to the problem have been suggested[24].

New methods for studying and modelling the large-scale galaxy distribution were proposed, such as the sponge-like structure and the Euler characteristics[25]. A new approach to the percolation method[26] provides sensitive tests and enables the application of the method to catalogues with non-cubical boundaries. A new method for large-scale simulations based on Burger's equation was suggested[27].

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