GALAXY FORMATION: THE ROLE OF GRAVITATIONAL COLLISIONS

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Some aspect of a semi-empirical model of galaxy formation is presented. In this model, galaxy formation proceeds through a series of rapid non-merging collisions with surrounding objects. For a given galaxy, a collision at an epoch z is characterized in terms of the fractional rate of change of binding energy induced by the tidal field [1]. The total rate of change of binding energy during the lifetime of the galaxy is computed in an Einstein-de Sitter universe, assuming that collisions continuously occur from birth up to the present day against a set of background galaxies with various masses. Rules for the formation of morphological types are then derived along the following (phenomenological) line: substantial or efficient collisions – characterized by a high rate of energy exchange – drive the formation of elliptical galaxies, whereas little or inefficient collisions lead to the formation of disks. These rules are coupled to the Press & Schechter mass function for a Cold Dark Matter spectrum normalized to the present distribution of X-ray clusters, allowing one to predict the evolution, for each morphological type, of number densities as a function of redshift. The model reproduces the observed present-day morphology-density relation [2] and predicts the formation redshift of field ellipticals to be $z \geq 2$, while spirals form at $z \leq 1.5$. Predictions are made for the redshift evolution of morphological populations in the field as well as in clusters (see [3] for more details).

References

[1] L. A. Aguilar, S. D. M. White, *ApJ* **295**, 374 (1985)
[2]M. Postman, M. J. Geller, *ApJ* **281**, 95 (1984)
[3] C. Balland, J. Silk, R. Schaeffer, *ApJ*, *submitted*, (1997)

K. Sato (ed.), Cosmological Parameters and the Evolution of the Universe, 151.