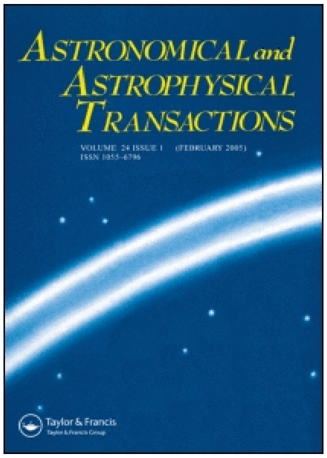

Astronomical & Astrophysical Transactions
The Journal of the Eurasian Astronomical Society
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713453505

A "cloudy" scenafuo of the formation of elliptical galaxies

V. Missoulis [a]
[a] Sternberg Astronomical Institute, Moscow, Greece

Online Publication Date: 01 November 1995
To cite this Article: Missoulis, V. (1995) 'A "cloudy" scenafuo of the formation of elliptical galaxies', Astronomical & Astrophysical Transactions, 8:4, 317 - 318
To link to this article: DOI: 10.1080/10556799508226949
URL: http://dx.doi.org/10.1080/10556799508226949

Astronomical and Astrophysical Transactions, 1995,
Vol. 8, pp. 317–318
Reprints available directly from the publisher
Photocopying permitted by license only

A "CLOUDY" SCENARIO OF THE FORMATION OF ELLIPTICAL GALAXIES

V. MISSOULIS

Sternberg Astronomical Institute, 119899 Moscow, Russia
On life: Greece

(Received May 18, 1993)

1*D* numerical solutions for giant, dwarf and medium mass protogalaxies show that the idea of the interaction of the galactic wind with cloudy surroundings can explain very well the observational data about elliptical galaxies. Specifically it can explain the correlations $L_X \propto L_B^2$, $M_S \propto M_V$, $Z_S \propto M_S^{0.4}$ and also a plausible assumption that the initial mixture of the luminous and dark matter in the Universe was uniform.

KEY WORDS Stellar generations, galactic wind

The simple model of galaxy formation leads to the correlation $M_S/M_0 = Z_S/y$ [1, 2]. Although the shortage of gas in elliptical galaxies [3] leads us to suggest that the remnant gas leaves the system when the star formation stops, mathematical simulations of the simple model [1] prove that the above correlation only shows how the mean stellar metalicity (Z_S), the total stellar mass (M_S) and the initial baryonic mass (M_0) were connected when the star formation had stopped. This assumption is supported by the example of our Galaxy. The metalicity distribution of the halo stars shows that the halo has been formed by the simple model [4]. On the other hand, if we assume that M_0 is equal to the disk mass ($10^{11}M_\odot$), M_S (the halo mass) is close to $10^{10}M_\odot$, $y = 0.02$, then for the halo we have $Z_S \simeq 0.1Z_\odot$ as it is observed.

The basic idea in this paper is that galactic wind starts blowing from the center when the most of the galaxy mass is in clouds which extend far beyond the boundary of the stellar galaxy. At that time the gas becomes hot, star formation stops and the clouds start to be evaporated by their hot surroundings. The galactic wind is extremely rich in heavy elements, but its mass is much less than the mass of metal-deficient clouds. The evaporation of the clouds occurs little by little so the matter becomes a nearly uniform mixture. The reason for the empirical correlation $Z_S \simeq M_S^{0.4}$ [5, 6] is not the fact that the less massive galaxies have lost a certain fraction of their mass, but the fact that when the formation of the first generation stars had stopped, a smaller fraction of their mass was in stars and thus the fraction of the galactic wind in them was smaller, and so the metalicity of the mixture.

Models of dwarf ($M_0 \simeq 10^{10} M_\odot$),medium ($M_0 \simeq 10^{11} M_\odot$) and giant ($M_0 \simeq 10^{12} M_\odot$) protogalaxies are solved numerically. The correlation $Z_S \propto M_S^{0.4}$ leads us to suggest that $M_W \propto M_0^{1.4}$ (M_W is the mass of the galactic wind). The numerical solutions show that, in the dwarf models, a large fraction of the mass of the second stellar generation is in the form of stars, formed by unevaporated clouds. For the four reliable models, this fraction is 10%, 22%, 36% and 50%. The metalicity of these stars will be as low as the metalicity of the first stellar generation. So it can be explained why dwarf galaxies have a greater fraction of metal-deficient stars than the giant ones [5].

In the giant and medium models, the ratio of the initial baryonic mass to the mass of the dark halo is close to 0.06. In the dwarf models, it is 0.06 or 0.09. The models with a massive halo form a stellar population with the mean metalicity equal to that expected from the correlation $Z_S \propto M_S^{0.4}$ and the final metalicities of the medium and giant galaxies. On the other hand, the models with a less massive halo form a stellar population much poorer than expected. The situation will be even worse if we adopt the result of [7] that, in the correlation $Z_S \propto M_S^k$, the parameter k is smaller than 0.4. So it is concluded that the initial mixture of the dark and luminous matter in the Universe was uniform, as it is reliable to suggest. On the other hand, every model loses nearly the half of its initial baryonic mass and thus the observational evidence that the ratio of the stellar to the dark mass in a galaxy does not depend on its mass can be explained.

Except of the metalicity, this model succeeds to explain the existence of the hot corona. Specifically, for the dwarf models we have $L_X \simeq 10^{39}$ erg/s, for the medium models $L_X \simeq 10^{41}$ erg/s and for the giant ones $L_X \simeq 10^{43}$ erg/s. Their stellar masses are proportional to their initial mass, so if we assume that the blue luminosity is proportional to the stellar mass, we will take $L_X \propto L_B^2$ as it is observed [2, 3, 8].

So the cloudy model can explain the main properties of the elliptical galaxies. It can also explain the existence of the hot intergalactic gas with the solar metalicity in clusters of galaxies [9, 10]. On the other hand, there is no obvious observational evidence which contradicts this model.

References

1. Marochnik, L. S. and Suchkov, A. A. (1984) *The Galaxy*, Moscow, Nauka.
2. Suchkov, A. A. (1988) *Galaxies Well-known and Puzzling Ones*, Moscow, Nauka.
3. Volkov, E. V. (1990) *Astrophysics* **32**, No. 1.
4. Pagel, B. E. J. and Edmunds, M. G. (1981) *Ann. Rev. Astron. Astroph.* **19**, 77.
5. Pickles, A. J. (1985) *Ap. J.* **296**, 340.
6. Mould, J. R. (1984) *Publ. Astron. Soc. Pacific* **96**, 773.
7. Aaronson, M., Cohen, J. G., Mould, J., and Malkan, M. (1978) *Ap. J.* **223**, 824.
8. Forman, W., Jones, C., and Tucker, W. (1985) *Ap. J.* **293**, 102.
9. Mushotzky, R. F., Holt, S. S., Smith, B. W., Boldt, E. A., and Serlemitsos, P. J. (1981) *Ap. J.* **244**, L44.
10. Ulmer, M. P., Cruddage, R. G., Fenimore, E. E., Fritz, G. G., and Snyder, W. A. (1987) *Ap. J.* **319**, 118.