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A chemical evolution of Local dwarf galaxies: LeoI

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Abstract. A chemical evolution of the Local Group dwarf galaxy LeoI is considered in a framework of merger scenario. The stellar metallicity distribution function of LeoI was calculated in the framework of the merger scenario. The observed metallicity distribution is not reproduced quite well by monolithic collaps for this galaxy. The use of a merger of several fragments allows to obtain a better resemblance between modeled and observed stellar metallicity distributions.

Key words. Galaxies: chemical evolution – merger scenario: metallicity distribution function – dwarf galaxies: LeoI

1. Introduction

The theory of hierarchical clustering is wide spreading now; according to this theory, the formation of massive galaxies is considered by merger of smaller stellar systems. The traces of past mergers are observed now in the haloes of Milky Way and M31 galaxies (Ibata et al. 1994, 2001). Dry (gas poor, collisionless) mergers and stellar accretion events are the prime candidates for the strong mass and size evolution of stellar spheroids at $z < 2$ (Hopkins et al. 2009). There is observational evidence that massive early-type galaxies may undergo no more than one major merger since z=0.7 with significant contribution from the minor merger for the mass buildup (Bundy et al. 2009). Massive spiral galaxies in Local Group could be formed by merger of individual fragments; two of them (M31 and M33) were formed by merger of 2 high-metallicity fragments only (Nykytyuk 2004; Nykytyuk 2008). But the question arises as what objects could be building blocks for formation of massive galaxies in Local Group? It is natural to suppose that systems like Local dwarf galaxies are the building blocks of massive ones. We set ourselves two objectives i) to check whether the merging process plays a role in the formation of dwarf galaxies ii) whether systems like dwarf galaxies can be building blocks of massive ones. We used the observed metallicity distribution function of LeoI dwarf galaxy to check out these assumptions.

2. The merger scenario - the main idea

The merger scenario for chemical evolution of galaxies was described in details in Nykytyuk (2008). Shortly, we suppose that the stellar population is composed of a mixture of stars that were formed in fragments originally evolving independently from the main protogalactic cloud and/or from each other. Hence, there should be a set of fragments whose to-

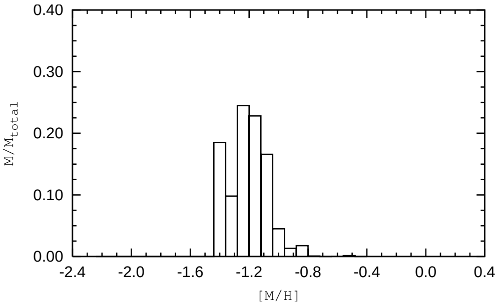

Fig. 1. The masses and metallicities of merging fragments.

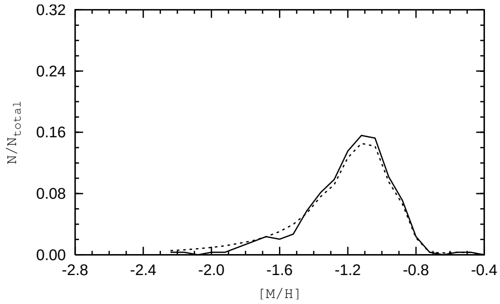

Fig. 2. Comparison of the metallicity distribution function observed for LeoI dwarf galaxy by Held et al. (2010) (solid line) with the predictions of our model(dashed line).

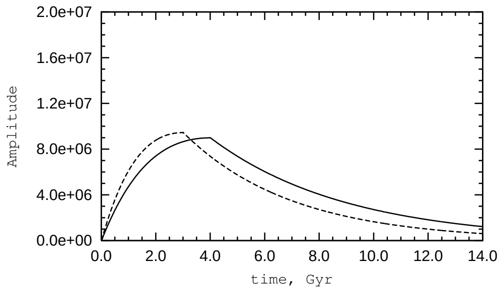

Fig. 3. The star formation rate (solid line) and accretion rate (dashed line) during fragment's life.

tal stellar populations reproduce the observed stellar metallicity distribution function.

We assume the mass of fragments from which a galaxy is formed, to equal the sum of the masses of their stellar population and the gas fallen onto a galaxy up to the present epoch. The star formation process in different fragments can begin at different times. A fragment can evolve up to a given astration level s before falling onto a protogalaxy. Fragments can be captured by a protogalaxy before a stellar population is formed, i.e. fragments composed completely by gas can be captured.

In order to calculate the resulting metallicity distribution function we have i) to calculate the metallicity distribution function of an individual fragments. ii) to find the set of fragments, whose sum of stellar populations would reproduce the observed its quite well.

If dwarf galaxies were building blocks of more massive galaxies, it could be enough to have only one fragment in order to reproduce the observed metallicity distribution function. If not, we will calculate a set of fragments.

3. Results and discussions

In the framework of merger scenario we have obtained the set of fragments of different masses and metallicities for the case of Leo I galaxy, see Fig.1. It is supposed that accretion of pristine gas occurred during the evolution of the individual fragment; the star formation and accretion histories are shown in Fig.3. The metallicity distribution function as result of merger of fragments, displayed in Fig. 1, is demonstrated in Fig.2. One can see that by using such a set of fragments allows us to reproduce the observed metallicity distribution function quite well. The Kholmogorov-Smirnov convergence criterion for the observed and calculated functions of metallicity in this case is ~ 0.93. Studies of the stellar populations in simulated galaxies by Tissera et al. (2012) have shown that if the masses of the accreted objects are small, they are destroyed during an accretion. If these masses are significant, a small gradient can be formed, and the stars with larger values of metallicity can concentrate to the center of a galaxy. I.e. no gradient in the case of LeoI may indicate a minor merger process, which could be consistent with the result obtained by us. Thus, mergers could play a prominent role in the formation of the dwarf galaxy Leo I. The fact that we have received more than one fragment, as expected, shows that dwarf galaxies like LeoI, could not serve as building blocks for formation of more massive galaxies and the question about galactic building blocks is still open.

4. Conclusions

A chemical evolution of dwarf galaxy LeoI is considered in the framework of merger scenario. The resulted metallicity distribution function was calculated quite well for this galaxy. To reproduce the observed metallicity distribution function of the LeoI, we need to have at least ten fragments, evolved with accretion of pristine gase during the life of a fragment. The calculations show that observed metallicity distribution function of the dwarf galaxy LeoI can be reproduced by merger of more than one fragment. This implies that systems like this dwarf galaxy could not be building blocks of massive galaxies.

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References

Bundy, K., Fukugita, M., Ellis, R. S., et al. 2009, AJ, 697,1369
Held, E. V., Gullieuszik, M., Rizzi, L., et al. 2010, MNRAS, 404, 1475
Hopkins, P. F., Bundy, K., Murray, N., et al. 2009, MNRAS, 398, 898
Ibata, R. A., Gilmore, G., Irwin, M. J. 1994, Nature, 370, 194
Ibata, R. A., et al. 2001, Nature, 412, 49
Nykytyuk, T. 2004, Kinematika i Fizika Nebesnykh Tel, 20, 489
Nykytyuk, T. 2008, New Ast., 13, 340
Tissera, P. B., White, S. D., Scannapieco, C. 2012, MNRAS, 420, 255