SEARCH FOR COMPANIONS OF NEARBY ISOLATED GALAXIES

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The radial velocities are measured for 45 galaxies located in the neighborhoods of 29 likely isolated galaxies in a new catalog. We find that about 85% of these galaxies actually are well isolated objects. 4% of nearby galaxies with $V_{LG} < 3500$ km/s are this kind of cosmic "orphan"
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1. Introduction

Isolated galaxies (IG) are objects which have not been subject to substantial interactions with their nearby surroundings (another galaxy or groups of galaxies) during their lifetimes. Thus, their observed physical characteristics are mainly determined by the initial conditions at their formation and by internal evolutionary processes. A representative sample of isolated galaxies is needed to verify the theory of the origin and evolution of galaxies, and also as a reference for studies of the properties of galaxies in pairs, groups, and clusters-- that is, in order to understand the influence of the surroundings on such properties of galaxies as their morphology, chemical composition, and rate of star formation.

1.1. Isolated galaxies brighter than 15m.7. One successful attempt to create this kind of sample is Karachentseva's Catalog of Isolated Galaxies (CIG) [1]. In compiling it, the following empirically selected criteria for isolation were used:

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where the subscripts 1 and \( i \) refer to a fixed galaxy and to its neighbors, respectively. In other words, a galaxy with angular diameter \( a_1 \) is considered to be isolated if all "significant" neighbors with angular diameters \( a_i \) in the range (2) lie a distance \( r_{ii} \) from it of at least \( 20a_i \).

A visual survey of the neighborhoods of all the galaxies from the Zwicky CGCG catalog [2] in the O and E charts of the POSS-1 sky survey showed that the criterion of isolation was satisfied by 1051 galaxies (\( m < 15^\circ.7, \delta > -3^\circ, |b| > 20^\circ \)), or about 4% of the total number of galaxies in the CGCG.

The fundamental difference between the CIG and the other lists of "individual" galaxies is that neighboring galaxies are taken into account within a substantial interval of angular diameters (or stellar magnitudes). Therein lies its major advantage, since ignoring even very slightly fainter neighboring galaxies and a fixed, independent of the visible magnitude, limit on the angular distance of neighboring galaxies leads to considerable contamination of the samples of so-called "field galaxies" by members of groups. (See, for example, the work of Stocke [3] and Huchra and Thuan [4], who examined "field" galaxies from the list of Turner and Gott [5].)

An analysis of the criterion for isolation (Karachentseva [6], Adams et al. [7]) shows that the conditions (1) and (2) are sufficiently stringent. For galaxies with typical sizes on the order of 20 kpc, with a peculiar velocity for the field galaxies on the order of 100 km/s, the time to cover a distance equal to 20 diameters is roughly 4 billion years. This means that the CIG galaxies are isolated for a substantial part of the lifetimes and have not been subjected to the influence of the surroundings as they evolved. It should be noted that some isolated galaxies could have experienced a dynamic merger with neighbors in the past. Sometimes cases of this sort can be recognized from a peculiar shape of a galaxy or an excess of infrared emission.

Over the 35 years since the publication of the CIG, the observational spectral and photometric data base for isolated galaxies has increased substantially. It suffices to say that the fraction of galaxies in the CIG with measured radial velocities has increased from 5% to roughly 95%.

Since the beginning of the century a group of astronomers from Spain, the USA, France, and Italy have been engaged in the extensive AMIGA project [8]. This project is aimed at studying the physical properties of a reference sample of the most isolated galaxies selected from the CIG after the initial characteristics have been refined and supplements on the basis of modern observational data. The results of the papers [9,10] by Verley et al. are of special interest for this problem.

Verley et al. [9] have conducted an automatic search on the DSS digital sky survey for neighbors with stellar magnitudes \( B < 17^\circ.5 \) within a circle of radius 0.5 Mpc for each of 950 galaxies in the CIG. After some additional checks, a catalog of approximately 54000 neighbors was compiled, for 30% of which the radial velocities are available in data bases. Without dwelling on the details, here we give the overall statistical result: the neighbors which were found constitute a population in which objects of the far background preponderate. Verley et al. [9,10] found that the conditions (1) and (2) of the CIG, which eliminate the "significant" neighbors, correspond to an average difference in radial velocities of the isolated galaxies and the other neighbors of \( \sim 18000 \) km/s. The isolation of the