Dark Galaxies and Lost Baryons
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Morphology and Environment of Dwarf Galaxies in the Local Universe

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Abstract. Analysis of dwarf galaxies in the local universe shows that dwarf irregular galaxies are its dominant populations and the majority of dwarf elliptical galaxies are likely to be located in the overdense regions, However, a significant fraction of blue dwarf ellipticals (dE$_{blue}$) and peculiar dwarf ellipticals (dE$_{pec}$ are found to be located in the under-dense regions.

Keywords. dwarf galaxies, morphology, environment

1. Introduction

Understanding the formation mechanism of dwarf galaxies is central to the modern observational cosmology since they are the most abundant populations. Owing to their intrinsic faintness, there is no statistics on their distribution as well as their physical properties beyond the local group. However, thanks to the advent of SDSS it is now possible to analyze the statistics of dwarf galaxies in various environments. The purpose of the present study is to analyze the environment dependence of galaxy morphology using SDSS DR5 complemented by nearby galaxy catalogs for brighter galaxies.

2. Morphology of dwarf galaxies

The dwarf elliptical galaxies were classified into dE, 'dE,N', dE_{pec}, dE/Im, and dS0, based on Sandage & Binggeli (1984) scheme. We added blue dwarf ellipticals dE$_{blue}$, which are known by blue colors owing to the global presence of young stellar populations, are known to be abundant in the nearby universe. The dE and 'dE,N' galaxies are non-nucleated and nucleated dE, respectively and dE$_{pec}$ is characterized by young stellar populations around the nuclei. The dE/Im is a transition type from irregulars to ellipticals or vice versa. The dS0 is dwarf counter part of an S0 galaxy. The dwarf irregular galaxies are classified into three types, Im, Im/BCD, and BCD, following Sandage & Binggeli (1984). They are most dominant populations in the local universe including spirals and ellipticals.

3. Environment dependence

We derive the local density (ρ) by calculating the mass of galaxies with a projected distance of 1Mpc and a line of sight velocity difference less than 500km/s assuming constant M/L. The distances of galaxies were derived from velocities corrected for the Virgo-centric flow with H_0=75km/s/Mpc.

As shown in Figure 1, the majority of dwarf elliptical galaxies are located in the over-dense regions regardless of their morphologies. However, there are some differences. The 'dE,N', Im/dE, and dS0 galaxies show narrow distributions peaked at $log\ \rho \approx 1.8$. The distribution of dE galaxies is not much different from those of 'dE,N', dE/Im, and dS0

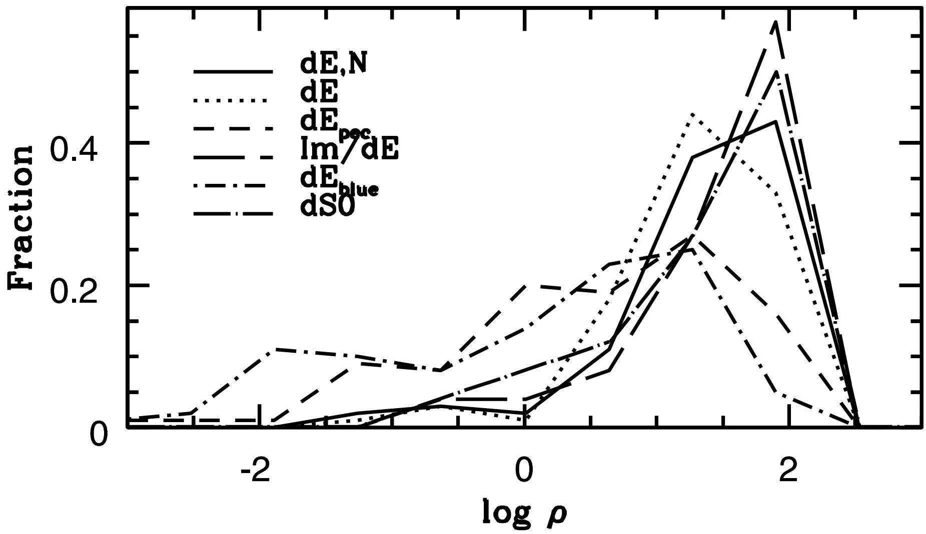

Figure 1. Fraction of dwarf elliptical galaxies as a function of local density

galaxies except for a slight shift toward the lower density. But, the distribution of dE_{pec} and dE_{blue} show high peaks in their distributions and have extended tails at $log\ \rho < -1$.

The dE/Im and dS0 galaxies show the most narrow distributions in Figure 1 with peaks at $log\rho \approx 1.8$. It means that both of the types are located in the highest density regions like the central parts of a rich cluster of galaxies. The high density environment of Im/dE and dS0 galaxies suggests that they are likely to be exposed to strong tidal interactions with neighboring galaxies.

4. Discussion and conclusions

The majority of dwarf elliptical galaxies, especially for 'dE,N', dE, dE/Im, and dS0 galaxies, are preferentially located in the high density regions with a narrow distribution. But, dE_{pec} and dE_{blue} galaxies, show a broad distribution with an extended low density tails. The young stellar populations of these galaxies seem to be made of the recently accreted gas in the under-dense regions.

The high density environment of Im/dE galaxies implies that they are dwarf elliptical galaxies whose outer parts are torn off by strong tidal forces from their neighbors. By the same line of reasoning, a plausible mechanism for the origin of dS0 galaixes is the harassment scenario in which impulsive collision deprive them of their gas. If so, their progenitors may be late type spirals since their length scales are similar (Kim *et al.*(2006)).

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References

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