The intriguing life of massive galaxies
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A star cluster view of the life of massive galaxies

Myung Gyoon Lee[1] **and Hong Soo Park**[1]
[1]Seoul National University, Seoul, Korea
email: mglee@astro.snu.ac.kr

Abstract. We present an overview of recent findings on the kinematics, age, and metallicity of globular cluster systems in nearby giant elliptical galaxies and their implications for understanding how giant elliptical galaxies formed and evolved.

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We derived the kinematics, metallicity, age, and [α/Fe] of globular clusters in several giant elliptical galaxies (gEs) (NGC 4636, M87, M49, M60, NGC 5128, NGC 1399, and NGC 1407) from the spectroscopic line indices in the literature (Park *et al.* 2012). We made a combined sample of gE globular clusters by combining all the globular cluster data in gEs. The globular clusters in the combined sample of gEs show a bimodal metallicity distribution with peaks at [Fe/H] $= -1.25(\sigma = 0.32)$ and $-0.42(\sigma = 0.25)$, consistent with color distributions. The metal-poor globular clusters are on average ~ 3 Gyr older than the metal-rich ones. They show a large range in age from 2 to 15 Gyr, including a significant number of young globular clusters, in contrast to the Milky Way (MW) globular clusters, which are all older than 7 Gyr. The metal-rich globular clusters show a broader age distribution than the metal-poor ones, showing that young ones are mostly metal-rich. The mean [α/Fe] value of the combined gE globular clusters is smaller than that of the MW globular clusters. In the case of the old group, the mean ages for the metal-rich and metal-poor globular clusters are about 13 Gyr, and there is little difference in the mean ages between the two populations. ones. In the case of the young group, the mean age for the metal-rich globular clusters is about 5 Gyr, which is about 2 Gyr younger than that for the metal-poor ones. Considering observational clues on photometry, metallicity, age, kinematics and spatial distribution of globular clusters in gEs lead to the mixture (Bibimbap) model for formation of globular clusters in gEs (Lee *et al.* 2010a, Lee *et al.* 2010b). (1) Metal-poor globular clusters are formed mostly in low-mass dwarf galaxies very early, and preferentially in dwarf galaxies located in a high density environment like a galaxy cluster. (2) Metal-rich globular clusters are formed together with stars in massive galaxies or dissipational merging galaxies later than metal-poor globular clusters, but not much later than metal-poor globular clusters. (3) New metal-rich globular clusters are formed during dissipational merging. A significant fraction of metal-poor globular clusters in gEs we see today are from dissipationless merging or accretion. In summary, galaxies grow via dissipationless and dissipational merging of galaxies of various types and via accretion of dwarf galaxies.

References

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