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1-3. Galaxies and Their Clusters

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EVOLUTION OF MULTIPHASE HOT INTERSTELLAR MEDIUM IN ELLIPTICAL GALAXIES

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1. Introduction

Theoretical arguments indicate that the ISM is inhomogeneous; Mathews estimated that the $\sim 1M_{\odot}$ of metal ejected by each supernova event into the ISM is trapped locally within the hot bubbles [1]. Since in elliptical galaxies, there is no overlapping of expanding supernova remnants after galactic wind period [2], it is expected that this inhomogeneity persists for a long time. The observations also suggests that the ISM of elliptical galaxies is inhomogeneous [3][4]. Based on these arguments, we studied the evolution of the multiphase (inhomogeneous) ISM.

2. Conclusions

The main results and conclusions can be summarized as follows [5]:

1. The model predicts that the supernovae are *not* effective as heating sources of the ISM in the *inner* region of galaxies after the galactic wind stops. In the inner region, supernova remnant can cool rapidly

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because of their high density and/or metal abundance. Since the remnants initially have large thermal energy, the energy ejected by supernova explosions is radiated and supernovae do not heat up the ISM. Thus, cooling flow is established even if supernova rate is large. In the *outer* region of the galaxies, the cooling time of the remnants is long. Thus, most of energy ejected by supernova explosions is not radiated and it is transfered into the circumferential ISM. This results shows that *heating efficiency of supernovae depends on their environment.* Mixing of SNRs with ambient ISM makes this transfer more effective.

2. In a inner region of a galaxy, the present iron abundance of the hot ISM can be less than that of the mass-loss gas or stars if the supernova rate is small, because the phases with higher metal abundance generally cool faster and gas inflows from outer region where the metal abundance of the mass-loss gas is small. However, the spectral simulations show that predicted metal abundances are still larger than the ones observed by *ASCA* in the central region, if the present supernova rate is < 0.01 SNu. In the outer region where the selective cooling is ineffective, metal abundance of the ISM directly reflects that of the gas ejected from stars. Our model predicts that iron line emission by SNRs is prominent in the central region ; [Si/Fe] and [Mg/Fe] decrease towards the galactic center, when SNRs mix with ambient ISM of only their volumes.

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