DYNAMIC S0 GALAXIES: A CASE STUDY OF NGC 5866

J-T Li
QD Wang, *University of Massachusetts - Amherst*
Z Li
Y Chen

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Abstract

S0 galaxies are often thought to be passively evolved from spirals after star formation is quenched. To explore what is actually occurring in such galaxies, we present a multi-wavelength case study of NGC 5866—a nearby edge-on S0 galaxy in a relatively isolated environment. This study shows strong evidence for dynamic activities in the interstellar medium, which are most likely driven by supernova explosions in the galactic disk and bulge. Understanding these activities can have strong implications for studying the evolution of such galaxies. We utilize *Chandra*, *Hubble Space Telescope*, and *Spitzer* data as well as ground-based observations to characterize the content, structure, and physical state of the medium and its interplay with the stellar component in NGC 5866. A cold gas disk is detected with an exponential scale height of $\sim 10^2$ pc. Numerous distinct off-disk dusty spurs are also clearly present: prominent ones can extend as far as $\sim 3 \times 10^2$ pc from the galactic plane and are probably produced by *individual* SNe, whereas faint filaments can have ~kpc scale and are likely produced by SNe collectively in the disk/bulge. We also detect substantial amounts of diffuse Hα- and Pα-emitting gas with a comparable scale height as the cold gas. We find that the heating of the dust and warm ionized gas cannot be explained by the radiation from evolved stars alone, strongly indicating the presence of young stars in the galactic disk, though at a slow formation rate of ~0.05 *M* yr^{-1}. We further reveal the presence of diffuse X-ray-emitting hot gas, which extends as far as 3.5 kpc away from the galactic plane and can be heated easily by Type Ia SNe in the bulge. However, the mean temperature of this gas is ~0.2 keV, substantially lower than what might be expected from the mass loss of evolved stars and Type Ia SNe heating alone in the galaxy, indicating that the mass loading from the cool gas is important. The total masses of the cold, warm ionized, and hot gases are ~5×10^8 *M* , 4×10^4 *M* , and 3×10^7 *M* , respectively. The relative richness of the gases, apparently undergoing circulations between the disk and halo of the galaxy, is perhaps a result of its relative isolation.

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