X24a Rapid Growth of Galactic Supermassive Black Holes through Accreting Giant Molecular Clouds during Major Mergers of their Host Galaxies

Chi-Hong Lin (University of Tokyo), Ke-Jung Chen (ASIAA), Chorng-Yuan Hwang (NCU, ASIAA)

Observations have revealed the existence of supermassive black holes (SMBHs) with masses of $10^9\,M_\odot$ in high-redshift galaxies at z∼7. Consequently, understanding the formation of SMBHs located at the centers of galaxies has become a crucial topic in modern astrophysics. In order to address this intriguing issue, we have employed a merger scenario coupled with our molecular-cloud model and ran hydrodynamics simulations using the GIZMO code. This code is well-suited for modeling complex galaxy interactions and the growth processes of SMBHs. In our simulations, we have applied physical parameters to construct the halo, disk and bulge, based on observational results (e.g., Gaia) and Fujii's Milky-Way model. We have taken into account gas dynamics, star formation, and the physics associated with SMBHs. By examining the growth of SMBHs, the activity of star formation, and the size of the galactic bulge, we investigate the co-evolution between SMBHs and their host galaxies. Our findings indicate that during major mergers, molecular clouds drive rapid SMBH growth from $10^7\,M_\odot$ to $10^9\,M_\odot$ and trigger starbursts. To further validate this discovery, we also discuss the migration timescale of molecular clouds and explore the empirical relation between stellar mass and SMBH mass, which contributes to our understanding of the formation of these "heavy monsters."