[구GC-01] Secular Evolution of Nuclear Bulges through Sustained Star Formation

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Gas materials in the inner Galactic disk continuously migrate toward the Galactic center (GC) due to interactions with the bar potential, magnetic fields, stars, and other gaseous materials. In case of the Milky Way, those in forms of molecules appear to accumulate around 200 pc from the center (the central molecular zone, CMZ) to form stars there and further inside. The bar potential in the GC is thought to be responsible for such acculmulation of molecules and subsequent star formation, which is believed to have been continous throughout the lifetime of the Galaxy. We present 3-D hydrodynamic simulations of the CMZ that consider self-gravity, radiative cooling, and supernova feedback, and discuss the efficiency and role of the star formation in that region. We find that the gas accumulated in the CMZ by a bar potential of the inner bulge effectively turns into stars, supporting the idea that the stellar cusp inside the central 200 pc is a result of the sustained star formation in the CMZ. The obtained star formation rate in the CMZ, 0.03-0.1 Msun, is consistent with the recent estimate based on the mid-infrared observations by Yusef-Zadeh et al. We discuss the secular evolution of nuclear bulges in general, based on our results.

[구GC-02] Nonlinear Dynamical Friction of a Circular-orbit Perturber in a Uniform Gaseous Medium

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We use three-dimensional hydrodynamic simulations to investigate nonlinear gravitational responses of gas to, and the resulting drag force on, a massive perturber moving on a circular orbit through a uniform gaseous medium. We assume that the background medium is non-rotating and adiabatic with index 5/3, and represent the perturber using a Plummer potential with softening radius a. This work extends our previous study where we showed that the drag force on a straight-line trajectory is proportional to a0.45 if the perturber is massive enough. This indicates that the orbital decay of supermassive black holes (SMBHs) near galaxy centers may take much longer than the prediction of the linear force formula applicable for low-mass perturbers. For the circular orbits are considered, however, we find that the nonlinear drag force becomes independent of a, but dependent instead on the orbital radius R as ∝ R0.5. This suggests not only that the choices of large values of a, for resolution issues, in recent numerical experiments for mergers of SMBH, are marginally acceptable, but also that the gaseous drag indeed provides an efficient mean for the orbtial decay of SMBHs. This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (MEST), No. 2009-0063616.