A Numerical Study of Star Formation in Nuclear Rings of Barred-Spiral Galaxies

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We use grid-based hydrodynamic simulations to study star formation history in nuclear rings of barred-spiral galaxies. The gaseous medium is assumed to be infinitesimally thin, isothermal, and unmagnetized. To investigate the effects of a spiral arm potential on star formation in nuclear rings, we consider both with and without spiral arms. We find that star formation rate (SFR) in a nuclear ring is determined by the mass inflow rate to the ring rather than the total gas mass in the ring. In the case of without spiral arms, the SFR shows a strong primary burst and weak secondary bursts at early time, and declines to small values at late time. The primary burst is caused by the rapid gas infall to the ring due to the bar growth, with its duration and peak depending on the bar growth time. On the other hand, models with spiral arms show multiple star bursts at later time caused by additional mass inflows from spiral-arm to bar regions. When the SFR is low, ages of young star clusters exhibit an azimuthal gradient along the ring since star formation takes place preferentially near the contact points between the dust lanes and the nuclear ring. When the SFR is large, on the other hand, star formation is widely distributed throughout the whole length of the ring, with no apparent age gradient of star clusters.