[구GC-05] Reliability of the Tremaine-Weinberg Method for Measuring Multiple Pattern Speeds in Barred-Spiral Galaxies

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Barred-spiral galaxies possess double patterns: a bar and spiral arms. While their angular speeds play an important role in governing gas dynamical evolution of barred spiral galaxies, there is no direct way to observe them. The Tremaine-Weinberg (TW) method has been one of the most reliable indirect methods to estimate pattern speeds, although it requires a few strict assumptions, notably one that the gas tracer is in a quasi-steady state. In barred-spiral galaxies, however, non-steady gas flows are significant especially when the double patterns have different angular speeds. Using numerical models, we explore the effect of non-steady gas motions on the determination of double pattern speeds based on the TW method. We find that the TW method is accurate within 15% when there is only a single pattern or when double patterns have the same angular speed. When double patterns have different speeds, on the other hand, neglecting the non-steady flows leads to quite large errors (> 30%) in the derived pattern speeds, and severely underestimate the real values for the viewing angle parallel to the bar minor axis. This suggests that one should be cautious when applying the TW method to galaxies with double patterns with different speeds.

[구GC-06] What Controls Star Formation In Nuclear Rings of Barred Galaxies?

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We use grid-based hydrodynamic simulations to study star formation in nuclear rings in barred galaxies. The gaseous medium is assumed to be infinitesimally thin, isothermal, and unmagnetized. To investigate various situations, we vary the total gas content in the bar regions and the bar growth time. 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. 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. The secondary bursts result from re-infall of the ejected gas by star formation feedback of the primary burst. When the SFR is low, ages of young star clusters exhibit an azimuthal gradient along the ring since star formation takes place mostly 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. Regardless of SFR, star clusters have a positive radial age gradient, with younger clusters located closer to the ring, since the ring shrinks in size over time.