THE DETECTION OF A GAS-RICH BAR IN THE INTERACTING GALAXY UGC 2855

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Bars fuel the prolific star formation rate in many Starburst galaxies. They provide a mechanism for feeding gas into the nuclei as well as a laboratory for the study of molecular gas that is unbound and diffuse due to tidal strain and cloud collisions. A large percentage of galaxies show a stellar bar which is, however, in most cases almost devoid of (molecular) gas, except in the central region. Thus, long gaseous bars are rare and transient phenomena.

Our recent high resolution map of the galaxy UGC 2855 shows that it has a gaseous bar that is second in length only to the bar in NGC 7479 (10 kpc). The observations were done in the ^{12}CO J=1→0 transition, at the Caltech six-element Owens Valley Radio Observatory (OVRO) array. UGC 2855 is an IR-bright ($L_{\rm FIR} = 4.6 \cdot 10^{10}\,L_\odot$), gas rich (Aalto et al. 1995) SBc galaxy, inclined by ~60°, at a distance of ~20 Mpc. Preliminary H- and K-band spectroscopy, showing Brγ, vibrationally excited H_2 and [Fe II] lines, indicates nuclear or starburst activity. The possible interaction of UGC 2855 with UGC 2866, about 60 kpc distant, may have triggered the development of its pronounced bar. Our map (Fig. 1 a) shows the continuous CO emission throughout the bar, which has a projected length of ~8 kpc.

If we assume a 'standard' I(CO)-to-N(H_2) conversion factor of $X = 2.5 \cdot 10^{20}\,{\rm cm^{-2}/K\,kms^{-1}}$, the H_2 mass in the bar is $\sim 2.3 \cdot 10^9\,{\rm M_\odot}$. However, a diffuse gas component which is neither virially bound nor very optically thick in the CO 1 → 0 transition is likely to exist. Thus, the standard X-

Y. Sofue (ed.), The Central Regions of the Galaxy and Galaxies, 219-220.

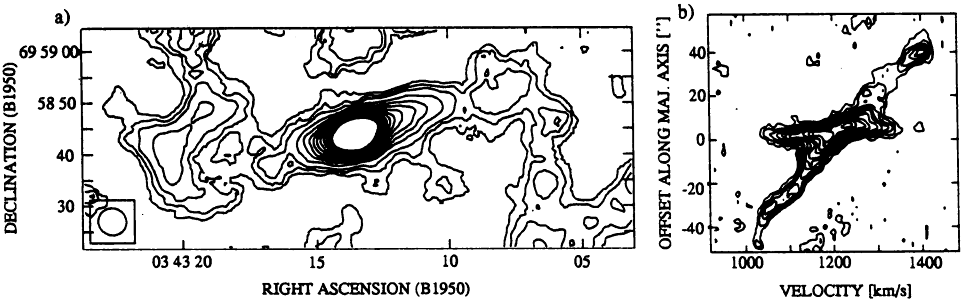

Figure 1. 3-field mosaic of the distribution of CO 1 → 0 in UGC 2855 (synthesized beamsize 5.2″ × 5.4″): a) Total integrated intensity in the naturally weighted map. The contour levels are at 2%, 4%, 8%, 12% ... 50% of the maximum, 137 Jy km s^{-1} $beam^{-1}$. b) Position-velocity diagram for a 10″ wide strip along the major axis. The contour levels range from 0.042 Jy $beam^{-1}$ to 0.420 Jy $beam^{-1}$ in steps of 0.042 Jy $beam^{-1}$ (2σ).

factor may overestimate the H_2-mass. On the other hand, the interferometer map will miss extended flux.

In Fig. 1 b), we display a position-velocity diagram along the major axis of the bar. Out to a distance of ~4 kpc from the center, the velocity along the bar rises linearly, indicating solid-body rotation of the bar. In the inner ~1 kpc, there is an additional high velocity component. No strong intensity maximum is associated with the systemic velocity at the center — the strength of the central region in the total integrated intensity map is due to gas at high velocities close to the nucleus. Some gas at velocities forbidden for circular rotation seems indicated.

At least two explanations are possible for the central high-velocity gas :
1) Dynamical simulations of gas in bar potentials reproduce pv-diagrams that closely match our observations if the family of x_2 (antibar) orbits is populated (see e.g. García-Burillo & Guélin 1995). However, UGC 2855 shows no trace of the 'twin peak' gas pile-up regions aligned with the minor bar axis that are interpreted as the intersection region between x_1 and x_2 orbits close to the Inner Lindblad Resonance (ILR) (Kenney et al. 1992). In fact, a long, gaseous bar is expected to be young and might not have ILR and thus, no x_2-orbits.
2) A rotating (accretion) disk (with a radius of close to 500 pc) can also explain the velocity structure. If no ILR exists and gas cannot settle on x_2-orbits, it should be funneled toward the center with high efficiency, which might encourage the formation of a large disk surrounding the nucleus.
Higher resolution data as well as a model of the mass distribution are required to distinguish between the scenarios.

References

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