The Neutral ISM in Starburst Galaxies
ASP Conference Series, Vol. 320, 2004
S. Aalto, S. Hüttemeister, A. Pedlar

Neutral ISM in the Interacting Spiral NGC 4647

Harriet Cullen, Paul Alexander, Dave Green

The Unversity of Cambridge, Cavendish Laboratory, Madingley Road, Cambridge, CB3 0HE, UK

Kartik Sheth

Astronomy Department, Caltech, MS 105-24, Pasadena, CA 91125, USA

Abstract. NGC 4647 is an example of a late-type galaxy believed to be in the early stages of interaction with an early-type system. It appears to be both HI deficient and CO rich. Whilst the HI data indicate the system has a low atomic gas surface density, the ^{12}CO ($J = 2 \rightarrow 1$) flux gives a molecular gas mass of $\sim 6 \times 10^9$ M$_\odot$ corresponding to a surface density ~ 20 M$_\odot$ pc^{-2}, significantly larger than average for a galaxy of this type. The large CO to HI surface density ratio could be explained by enhanced HI to H_2 conversion in this system.

1. Introduction

We are investigating how the ISM evolves during galaxy interactions by studying a small sample of interacting galaxies consisting of one late and one early-type system. The sample has been selected to represent a range of stages of interaction. Here we present preliminary data for NGC 4647 (SAB(rs)c) which is believed to be in the early stages of interaction. The galaxy is situated towards the edge of the Virgo cluster.

2. The Neutral ISM of NGC 4647

The CO maps of NGC 4647 are shown in Figure 1. The ^{12}CO ($J = 2 \rightarrow 1$) emission was mapped over a region of $110'' \times 90''$. Molecular gas was detected over the full range of RA and Dec mapped. The emission reveals two central peaks, approximately aligned with the semi-minor axis of the galaxy. The CO emission is asymmetric in distribution, the surface density falling twice as rapidly on the western side of the galaxy, towards the center of the Virgo cluster.

The ^{12}CO ($J = 1 \rightarrow 0$) OVRO interferometer map reveals two central peaks, consistent with the peaks in the lower resolution map. From these peaks the CO emission is extended, following the spiral arm structure visible in the Hα image.

The lower resolution ^{12}CO ($J = 2 \rightarrow 1$) data gives a total CO flux of 820 Jy km s^{-1}. Assuming a CO($J = 2 \rightarrow 1$)/CO($J = 1 \rightarrow 0$) intensity ratio of 0.8 as found in the Milky Way (Sanders et al. 1992) we estimate the molecular gas mass of NGC 4647 to be 5.7×10^9 M$_\odot$ at a distance of 21.9 Mpc. This corresponds to a molecular gas surface density of 21.6 M$_\odot$ pc^{-2}, approximately three times larger than that of barred spirals in the BIMA SONG sample.

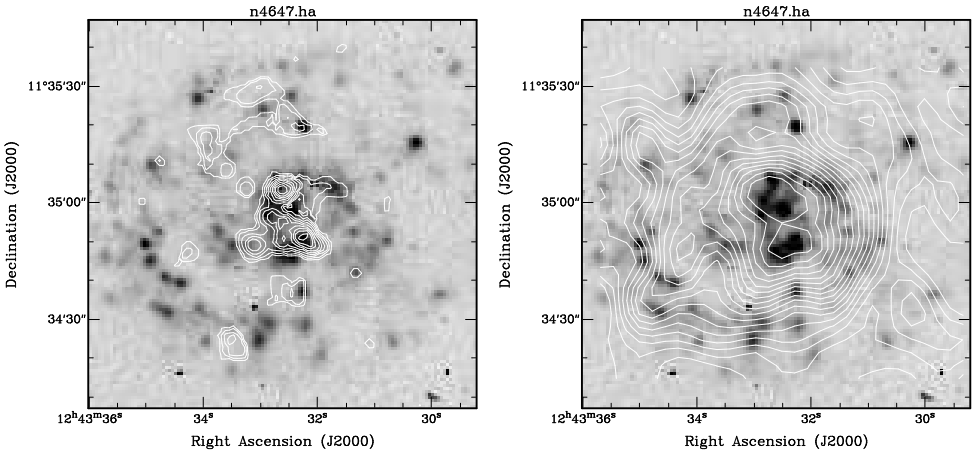

Figure 1. *Left* OVRO ^{12}CO ($J = 1 \rightarrow 0$) map of NGC 4647, ($\theta_{\rm FWHM} = 5''$) *Right* JCMT ^{12}CO ($J = 2 \rightarrow 1$) map of NGC 4647 ($\theta_{\rm FWHM} = 22''$). The CO maps are overlayed on a continuum subtracted Hα image (Young et al. 1996), coordinates are J2000.

Low resolution VLA data (Cayatte et al. 1990) reveal extended HI emission in NGC 4647, with a total HI flux of 10.10 ± 0.44 Jy km s^{-1} corresponding to an HI mass of $1.1{\times}10^9$M$_\odot$ and surface density of 4.26 M$_\odot$ pc^{-2}. Cayatte et al. (1994) compare the HI surface densities of a number of spiral galaxies in the Virgo cluster with field galaxies of the same morphological type. They find NGC 4647 to have a surface density approximately three times lower than a comparable field galaxy.

NGC 4647, situated on the edge of the Virgo cluster has a low HI surface density but reveals no evidence for ram pressure stripping in the HI morphology or dynamics (Cayatte et al. 1994). It has a high CO surface density and a star formation rate of ~ 0.8 M$_\odot$ year^{-1} similar to that of the Milky way. The large amount of CO can not therefore be explained by an unusually low star formation rate. One possible explanation for the large CO to HI surface density ratio is enhanced conversion of HI to H_2. It is possible that we are observing this system just before it enters a starburst phase.

References

Cayatte, V., Kotanyi, C., Balkowski, C., et al. 1994, AJ, 107, 1003

Cayatte, V., van Gorkom, J. H., Balkowski, C., et al. 1990, AJ, 100, 604

Sanders D. B., Scoville N. Z., Tilanus R.P.J., et al. 1992, AIP Conference Proceedings 278, 311

Young, J., Allen, L., Kenney, J., et al. 1996, AJ, 112, 1903