Peculiar Galaxy NGC 2976

N91-14199

L. J. Tacconi (NFRA/Dwingeloo)
J.M. van der Hulst, and P.R. Wesselius (Univ. of Groningen)

NGC 2976, a companion galaxy of M81, is a nearly edge-on system with no obvious spiral structure. In a spectrophotometric study of this system Carozzi-Meysonnier (1980) found that NGC 2976 has a small mass of 2×10^9 $M_\odot$ and low luminosity of 4.2×10^8 $L_\odot$, which places it among the latest types of disk systems. Low resolution (12′) HI observations (Appleton, Davies, and Stephenson 1981) indicate the presence of an HI tail connecting this galaxy with M81.

It has been suggested that interactions which occur among galaxies trigger bursts of star formation (*e.g.* Toomre and Toomre 1972, Larson and Tinsley 1978). Indeed, enhanced star formation has been observed in interacting systems by Hummel (1981) who found a correlation between the presence of tidal interaction and radio continuum flux, by Soifer *et al.* (1984), who found a similar correlation with high far-infrared flux, and by Kennicutt *et al.* (1987) who found enhanced star formation rates in a complete sample of interacting galaxies using Hα and IRAS data. In addition, molecular clouds are the potential sites for future star formation, and many galaxies which exhibit strong CO emission, such as M82, M51, IC342, and NGC 4321, are members of groups or clusters of galaxies.

We are currently studying NGC 2976 at many wavelengths to investigate the extent to which an interaction with M81 may have affected the star formation history of this galaxy. Here, we present observations of NGC 2976 made at 50 μ with the high resolution CPC instrument onboard IRAS, at 21-cm (both HI line and radio continuum) with the WSRT, and in the Hα line (kindly taken for us at the KPNO 36" by J. Young, L. Allen, and S. Kleinmann). The far infrared emission is not centrally peaked as in other spirals (*e.g.* Wainscoat *et al.* 1987), but has obvious intensity peaks near the ends of the disk. The ionized gas as inferred from the Hα observations, is largely confined to two large, symmetrically placed emission regions near the ends of the disk. Finally, the HI and 21-cm radio continuum emission also exhibit this strongly, double peaked structure. At all of the above wavelengths the emission peaks are roughly coincident and lie ~1.2′ to the NW and ~1.1′ to the SE of the optical center of this galaxy.

Figure 1 shows the FIR, HI, radio continuum, and Hα maps of NGC 2976. The bi-modal distribution of the recent massive star formation and of the neutral interstellar medium is in contrast with that seen in blue and red images of NGC 2976 (Carrozzi-Meyssonier 1980, and present investigators) which are not dominated by large concentrations at these positions, but show a smooth distribution, with HII regions scattered throughout the disk. The symmetric location of the peaks with respect to the nucleus of NGC 2976 suggests that they have a dynamical origin. A possible explanation is that these peaks are hot spots located at the ends of a bar. However, a velocity field, derived from the HI data, shows no signature of the presence of such a bar.

In each of the two large emission regions of NGC 2976, peak column densities of 1.6×10^{21} atoms cm^{-1} are observed in HI. Each region contains more than 3.5×10^7 $M_\odot$ of atomic gas over a ~1×1 kpc region. Combined, these two regions contain more than half of the HI which we have observed in this galaxy. More than 20% of the total Hα flux of the galaxy comes from the northwest complex, with an integrated flux of $\sim 1.8 \times 10^{-12}$ erg cm^{-2} s^{-1}. The southeast complex is somewhat fainter, with an integrated flux of 1.0×10^{-12} erg cm^{-2} s^{-1}. Although the large HII complexes dominate the Hα emission from NGC 2976 and are unusual for a low mass galaxy, they are not unlike giant HII regions found in nearby luminous spiral galaxies such as M51 (van der Hulst *et al.* 1988).

REFERENCES

Appleton, P.N., Davies, R.D., and Stephenson, R.J. 1981, *Astron. Astrophys.*, **92**, 189.
Carozzi-Meysonnier, N. 1980, *Astron. Astrophys.*, **92**, 189.

Hummel, E. 1981, *Astron. Astrophys.*, **96**, 111.
Kennicutt, R.C. Jr., Keel, W.C., van der Hulst, J.M., Hummel, E., and Roettiger, K.A. 1987, *A.J.*, **93**, 1011.
Larson, R.B. and Tinsley, B.M. 1978, *Ap.J.*, **219**, 46.
Soifer, B.T., Rowan-Robinson, M., Houck, J.R., de Jong, T., Neugebauer, G., Aumann, H.H., Beichman, C.A., Boggess, N., Clegg, P.E., Emerson, J.P., Gillett, F.C., Habing, H.J., Hauser, M.G., Low, F.J., Miley, G., and Young, E. 1984, *Ap.J. (Lett.)*, **278**, L71.
Toomre, A. and Toomre, J. 1972, *Ap.J.*, **178**, 623.
van der Hulst, J.M., Kennicutt, R.C., Crane, P.C., and Rots, A.H. 1988, *Astron. Astrophys.*, **195**, 38.
Wainscoat, R.J., de Jong, T., and Wesselius, P.R. 1987, *Astron. Astrophys.*, **181**, 225.

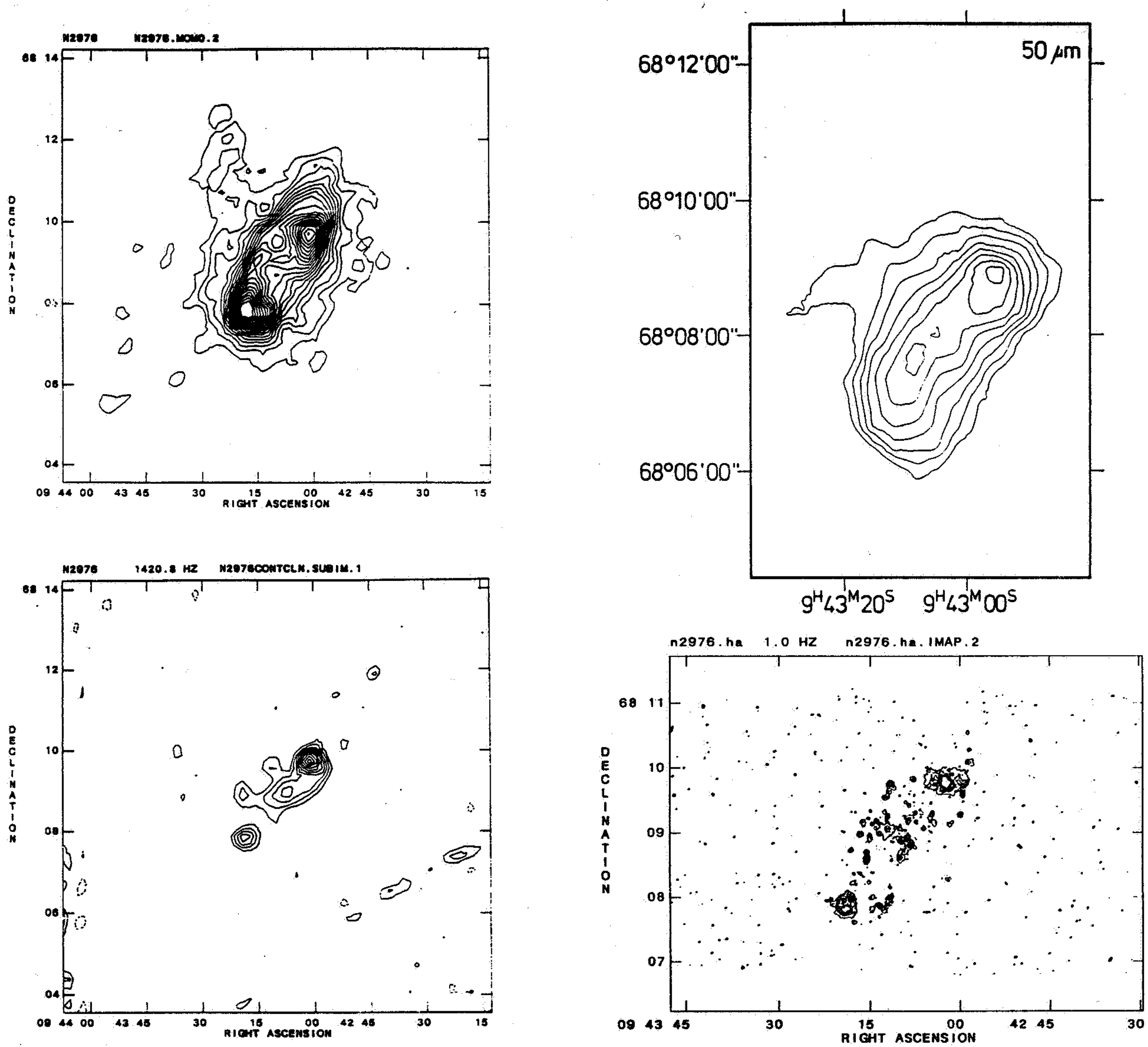

Figure 1: Contour maps of the HI (upper left), 50μ (upper right), 21-cm radio continuum (lower left), and Hα (lower right) images of NGC 2976. In each case, the lowest contour level is 3σ, with levels increasing in 1σ steps. The resolution of the HI and 21-cm continuum data is 22″, and that of the 50μ image is ~80″.