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A Multi-Wavelength Survey of the ISM in NGC 628

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1. Introduction

Is atomic hydrogen a precursor to or byproduct of the star formation process? Recent evidence suggests that a large percentage of the atomic hydrogen in spiral galaxies could be due to photodissociation of molecular gas by UV radiation from hot young stars. Allen, Atherton & Tilanus (1986) proposed the idea to describe the relative placement of the dust lanes, HII regions and HI gas in the spiral arms of M83. More recently, Allen *et al.* (1997) have looked on smaller spatial scales in M81 and seen that the photodissociation process could describe the location of the Hα, FUV, and HI in the spiral arms. To address these questions in the nearby face-on spiral NGC 628, we have obtained a high resolution, high sensitivity VLA HI image (Adler *et al.* 1999) and compare it to Hα and UIT far-UV images (Cornett *et al.* 1994).

2. Summary

The distribution of HI in the disk shows characteristics of modal density waves. One prediction of the modal density wave theory is that waves cross as they move inward and outward between the resonances of the galaxy, causing intensity modulation along the arms as a function of galactocentric distance (Bertin *et al.* 1989). This effect is seen in the integrated HI intensity image. There are numerous HI fragments extending across the interarm regions; these could indicate the presence of leading spiral arms.

Overall, there is very good agreement between the FUV and Hα emission (Figure 1a). This is not surprising, since both trace massive star formation.

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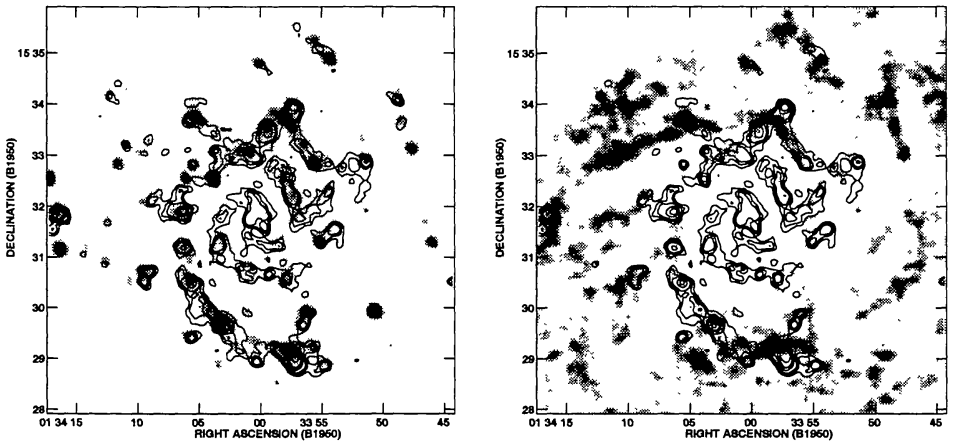

Figure 1. (a) FUV contours on Hα greyscale (left). (b) FUV on HI (right).

All bright Hα peaks have an associated FUV peak, most of which are spatially coincident. Most, but not all, bright FUV peaks have associated Hα peaks. Those that do not are likely associated with B-star associations (rather than OB associations) – hot enough to produce FUV radiation, but not quite hot enough to ionize and create Hα emission.

Most FUV (and hence Hα) peaks have associated HI emission, but the peaks are NOT coincident (Figure 1b). Rather, the HI appears on the edges of the FUV peaks; in some instances, the FUV peak is centered in an HI hole. This morphology is well described as "chimneys," where massive star formation has blown holes out of the galactic disk (Norman & Ikeuchi 1989). As the molecular hydrogen is blown out of the disk, the hot young stars photodissociate it into HI on the inner surface of the holes. These results are consistent with those found in M81 by Allen *et al.* (1997).

However, there are also areas of the disk which may be better described by the standard picture of star formation. The large complex at (RA=$01^h\,33^m\,58^s$, DEC=15°29') shows HI on the inner, upstream side of the arm, with Hα centered on the arm and FUV further downstream. This is consistent with HI flowing into the arm, where it combines into molecular hydrogen, collapses, with OB associations (Hα emission) being formed in the arms. The FUV emission further downstream is indicative of longer-lived B-star associations, which are no longer hot enough to ionize the associated gas.

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