RADIO CONTINUUM OBSERVATIONS OF THE STARBURST GALAXY NGC 2146

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High-sensitivity multi-frequency radio continuum observations (1.5, 5, 8.4 and 15 GHz at a resolution of 4.7 × 4.7 arcsec^2) of the starburst galaxy NGC 2146 were presented (see also Lisenfeld et al. 1996, MNRAS, 281, 301). We have fitted these data with a three-dimensional diffusion model. The data and the model emphasize that active star formation is confined to the centre of the galaxy. From the variation of the spectral index along the minor and the major axis it could be deduced that the distribution of cosmic ray (CR) sources, and hence star formation activity, is in the form of a bar. The diffusion model is a good fit to the radio data for NGC 2146 along the major axis of the galaxy and along the minor axis for distances less than 10 arcsec (2.6 kpc) from the major axis. The value of the diffusion coefficient D_0, and its energy dependence, are strongly constrained by the data perpendicular to the inferred bar within NGC 2146 along the minor axis. We derived $D_0 = 1.0$ to 4.0×10^{28} cm^2 s^{-1}, with $\mu = 0$. Our best estimate for μ is in the range $\mu = 0.0$ to 0.2 with a firm upper limit of $\mu < 0.5$. This suggests that diffusion is the dominant mode of propagation in this region which corresponds to the inner, most actively star forming disc of NGC 2146. At distances greater than 10 arcsec from the centre of the galaxy along the minor axis the model is no longer an adequate fit to the data. Upon examination of the radio emission in the region where the diffusion model begins to fail, we note that the radio images show filamentary structures. The most likely reason for this behaviour is that away from the centre of the galaxy a large fraction of the radio emission is from a halo which is seen in projection. The propagation of CR electrons in the halo might be more complicated than we have considered for the propagation within the disc. Due to the strong star formation activity in NGC 2146, an outflow from the disc triggered by correlated supernova explosions may be present.

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HOW MANY ACTIVE COMPONENTS CAN A GALAXY HAVE?

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Strong emission lines in galaxy spectra can be excited by massive star formation and/or an Active Galactic Nucleus (AGN), and line intensity ratios in the optical are effective diagnostic tools for distinguishing between starburst and AGN spectra (Veilleux & Osterbrock 1987). However, we have identified a sample of 30 galaxies in which the source of excitation is ambiguous based on these optical line diagnostics. In order to overcome the large optical extinctions typical of these galaxies, we have obtained near-infrared (NIR) spectra with IRIS at the Anglo-Australian Telescope and are developing NIR line diagnostics to help trace the powering mechanisms responsible. The spectra extend from 0.9 – 2.5 μm and include the emission lines of H_2 and [Fe II], the recombination lines of hydrogen and helium, and the ^{12}CO and ^{13}CO absorption bands located longwards of 2.3 μm. These features, as well as the shape of the underlying continuum are being evaluated for use as potential NIR traces of starburst and AGN activity. This work is being carried out in parallel with optical, NIR and radio imaging of the sample. To date, NIR images obtained using CASPIR in conjunction with an adaptive optics tip/tilt system operating on the 2.3-m Australian National University telescope show the sample galaxies with ambiguous optical spectra to have redder colours than starburst galaxies and AGN (Seyfert 2). This result is in agreement with Ashby et al. (1995). The colours are typical of Seyfert 1 galaxies and are consistent with galaxies that possess a low-luminosity active nucleus surrounded by a starburst disk. Parkes-Tidbinbilla Interferometry observations at 13 cm with $0''.1$ resolution, reveal that nine out of 19 of the galaxies contain high brightness cores indicative of AGN activity. This sample will be valuable for establishing possible connections between starburst and AGN activity.

Ashby, M., Houck, J., & Matthews, K. 1995, ApJ, 447, 545
Veilleux, S., & Osterbrock, D. E. 1987, ApJS, 63, 295

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