3C293: BEAMS IN A ROTATING GASEOUS DISK

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The radio source 3C293 has a bright, steep spectrum ($\alpha \simeq 0.7$; $S_\nu \propto \nu^{-\alpha}$) radio core with kiloparsec-sized structure (Bridle, Fomalont & Cornwell 1981, (BFC)). The core is misaligned by $\sim 35°$ with respect to the extended radio lobes and both the core and lobes have a Z-shaped morphology. To explain this misalignment and morphology, BFC propose a model in which beams 'refract' (buoyantly deflect) in a static hot gaseous halo. Alternatively, Wilson & Ulvestad (1982) have proposed that the source structure may be caused by ram pressure deflection of beams propagating through a rotating gaseous disk. Our optical imaging and spectroscopic observations reported here support the latter model.

OPTICAL IMAGING AND SPECTROSCOPY

Broadband and narrowband exposures (kindly provided by Marie-Helene Ulrich and Harvey Butcher) have been taken with the video camera on the 4m telescope at Kitt Peak to map the general morphology (i.e. the dust and the optical line emission (H_α & [NII]) of the parent galaxy of 3C293. These images show that this galaxy is highly flattened, has an irregular dustlane and extended optical line emission.

Using a long slit spectrometer, the velocities and velocity-widths were measured along and perpendicular to the galaxy major axis using the [OII] and [OIII] lines. These observations show that the gas is rotating and that the lines are rather wide (~ 570 km s^{-1} near the radio core, ~ 300 km s^{-1} elsewhere).

DISCUSSION

The optical data show that the parent galaxy of 3C293 contains a rotating gaseous disk in which the powerful, kiloparsec-sized radio core is immersed. The wide emission lines suggest that non-circular gas motions are also important, particularly near the radio core.

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From these results, and those of the very similar case of 3C305 (Heckman et al. 1982) as well as the statistical relationship between kiloparsec-sized radio continuum and optical line emission (e.g. Heckman et al. 1981), we conclude that the bright radio and optical emission in 3C293 are related. As in 3C305, we propose that beams emanate from the galaxy nucleus and strongly interact with their dense interstellar environment: the rotating gas presumably dissipates the beams prematurely, causing enhanced radio and optical emission on a kiloparsec-sized scale and turbulence induced line broadening. The observed rotation of the gas is in the correct sense to produce the Z-shaped radio morphology in the 'beamsweep' model of Wilson & Ulvestad. This model then requires that the surrounding gas density is high ($\gtrsim 10$ cm^{-3}) and that the beams are efficient at producing radio emission and are fast ($\gtrsim 10^4$ km s^{-1}).

REFERENCES

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