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The environment of the quasar MR 2251-178*

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Abstract. We present new high-resolution images of the field of the quasar MR 2251–178 obtained in the [O III] λ5007 and [O II] λ3727 lines with the ESA photon counting detector at the CFHT. The data are interpreted as a further evidence of a recent gravitational interaction between the quasar and a nearby galaxy.

Key words : quasars—MR 2251–178

The nearby quasar MR 2251–178 ($z = 0.064$) lies within a small cluster of galaxies (Phillips 1980) and is surrounded by a significant nebulosity and by a giant envelope of ionized gas (Bergeron *et al.* 1983). In a previous paper (di Serego Alighieri, Perryman & Macchetto 1984 ≡ SPM) we have mapped the [O III] emission from the extended envelope and have presented evidence that the inhomogeneities observed in the distribution of the ionized gas have originated from a recent ($2–4 \times 10^8$ yr ago) gravitational interaction with a nearby active galaxy (G1 in the notation used by Phillips 1980). We have also suggested that the tidal encounter might have played a role in channeling the gas toward the nucleus, but the poor resolution of the data and its nonlinearity at high count rates did not allow the inner nebulosity to be resolved.

Narrow band images of the field of MR 2251–178 were obtained in 1984 October with the ESA photon counting detector at the Cassegrain focus of the 3.6m CFH telescope (PCD, di Serego Alighieri, Perryman & Macchetto 1985). We have used

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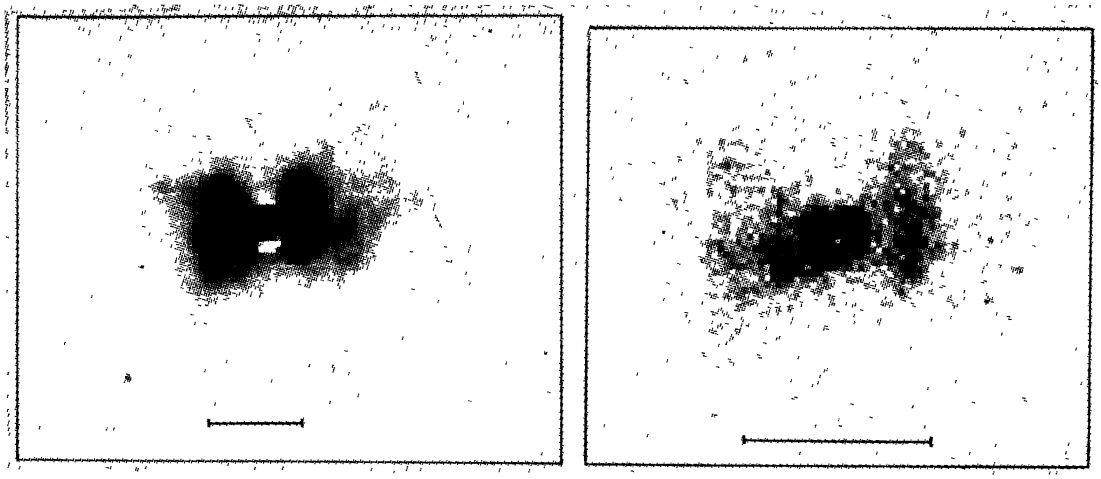

Figure 1. [O III] λ5007 line emission in the environment of MR 2251–178. North is up and east to the left. The scale bars are 5 arcsec (9.4 kpc).

40 Å wide filters centreed on the redshifted [O II] λ3727 and [O III] λ5007 as well as 100 Å wide filters on the nearby continua. The standard PCD format (512 × 512 pixels of 25μm) gave a scale of 0.155 arcsec per pixel and a field of view of about 80 arcsec. Seeing conditions were very good and stable with stellar profiles having a FWHM of 0.5–0.7 arcsec.

Part of the results is shown in figure 1. The chain of condensations at 20–25 arcsec ($\sim$ 40 kpc, $H_0 = 50$ km s^{-1} Mpc^{-1}) to the east of the nucleus, detected by SPM, in the present [O III] data extends further in the direction of galaxy Gl, as is expected for tidally stripped material. Several filaments extend up to a distance of 17 arcsec (32 kpc) from the nucleus. The two main ones point to the west and to the northwest, where emission is seen further out (SPM), and can be followed as close as 3 arcsec from the nucleus, where they merge with the inner nebulosity. The latter is resolved into two main regions : one centreed at 2.0 arcsec (3.8 kpc) to the west of the nucleus, but well separated from it, and elongated in the north-south direction; and a second one to the east, more diffuse and with an enhancement at 1.6 arcsec (2 kpc) from the nucleus in position angle 120°. These regions in the inner nebulosity are seen also in [O II] but not in the continuum images.

In the framework of the gravitational interaction proposed by SPM, we suggest the following tentative interpretation of the data. The recent passage of galaxy Gl near MR 2251–178 produced a number of effects in the gaseous envelope surrounding the quasar : in the outer regions ($R > 35$ kpc) it created density enhancements, which appear largely unaltered since the time of the encounter, because of their long dynamical timescale. In the intermediate region ($5 < R < 35$ kpc) the filamentary structure is evidence of radial motions—possibly inward—of the gas left in unbound orbits after the encounter. In the inner region ($R < 5$ kpc), where a few rotation times have elapsed since the encounter, the gas is settling into a disc or annulus around the quasar, possibly warped by precession.

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