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NGC 1052: A Different Class of H_2O Megamaser?

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Abstract. We present VLBA observations of the H_2O megamasers in the LINER galaxy NGC 1052. The structure we observe suggests a different origin for the masers than those seen in NGC 4258.

Miyoshi et al. (1995) demonstrated that the strong H_2O masers in the galaxy NGC 4258 originated in a rotating disk surrounding a $3 \times 10^7 M_\odot$ black hole. Since that seminal observation several H_2O masers in other galaxies have shown a similar structure. Braatz et al. (1994) discovered a weak (≈ 250 mJy) maser in the galaxy NGC 1052 (Figure 1). It is an elliptical galaxy classified as a LINER at a distance of 13.5 Mpc. It is unusual in that it is also a strong VLBI continuum source. Fig 2 is a 1.3cm image of NGC 1052 showing the linear jet-like structure. The jet components appear to be moving in opposite directions. From 43 GHz data R. Vermeulen (private communication) believes the galactic nucleus lies in the "gap" in the 1.3cm image.

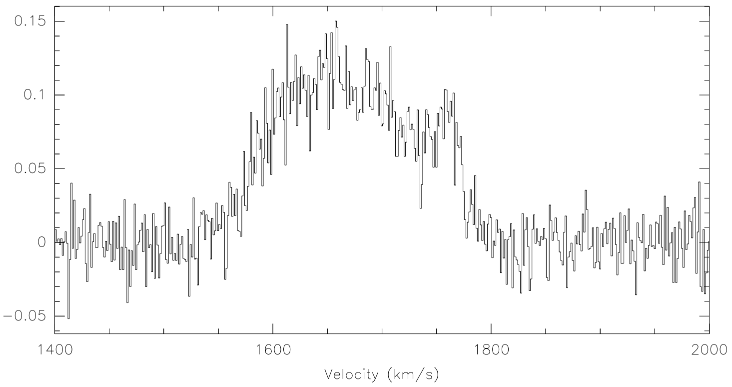

Figure 1. Spectrum of the H_2O megamaser in NGC 1052 taken with the Effelsberg 100m on December 9, 1996.

Figure 1 shows a spectrum of the maser emission. In contrast to most other H_2O megamasers the spectrum is broad (FWHM ≈ 85 km/s), featureless and is redshifted from the galaxy's systemic velocity by ≈ 100 km/s. In these respects it is very similar to the H_2O maser in TXFS2226–184 (Koekemoer et al. 1995). Single dish monitoring data (Braatz et al., in preparation) demonstrate an average acceleration of the maser gas of ≈ 30 km/s/yr until December 1995 after which the acceleration appears to have ceased.

In November 1995 we used the VLBA and phased VLA to observe the H_2O and continuum emission. Figure 2 shows the image from this observation. There are several facts to note: 1) there are 2 maser complexes ($\Delta\Theta \approx 0.35$ mas (4600 AU)); 2) they are physically separated from, but close to, the suggested nucleus; 3) they are *not* perpendicular to the jet; 4) the two complexes have a mean velocity difference of ≈ 30 km/s; 5) the apparent velocity gradient across the two complexes is ≈ 1700 km/s/pc.

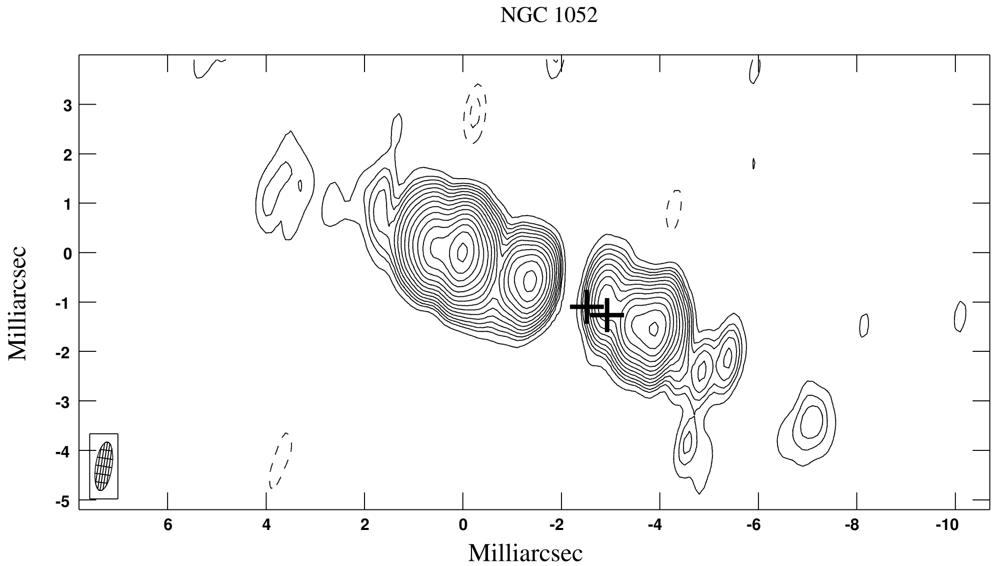

Figure 2. VLBA image of the 22 GHz continuum structure of NGC 1052. The two crosses mark the positions of the two H_2O maser complexes.

What is the nature of the NGC 1052 H_2O megamaser? Off-nuclear masers are not unique. NGC 1068 contains strong nuclear masers, possibly in a rotating disk (Greenhill et al. 1997) and a weak off-nuclear maser 25 pc north of the suggested nucleus (Gallimore et al. 1996). The off-nuclear masers in NGC 1068 share some of the characteristics of those in NGC 1052, namely a broad spectrum offset in velocity from the systemic velocity of the galaxy. If such a picture is true for NGC 1052 then there are two possible explanations: 1) the masers lie in dense molecular gas undisturbed by the powerful jet and the H_2O is amplifying the background continuum; or 2) dense molecular gas is being struck by the jet and excited by low velocity shocks. Further observations are underway in an attempt to determine the true nature of this peculiar megamaser source.

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References

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