THE GALACTIC CENTER RADIO LOBE – A COSMIC JET IN OUR GALAXY?*

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Abstract. The galactic center radio lobe found in the radio continuum is interpreted as due to a channeled exhaust of material perpendicular to the galactic plane driven by an activity in the nuclear region. A common characteristic of the lobe to extragalactic more energetic jets is pointed out.

A radio continuum survey of the galaxy center region of $4^\circ \times 4^\circ$ at 10 GHz has revealed an off-plane, Ω-shaped lobe of diameter 200 pc (Sofue and Handa, 1984). The lobe emerges from the nuclear disk perpendicularly (Figure 1). A cross section of the lobe indicates that it is a result of an explosive or energetic outflow phenomenon (Figure 2). As seen from Figure 2 the radio spectrum of the lobe component is flat, which suggests a thermal gas origin with a total mass of ionized hydrogen of $4 \times 10^5\ M_\odot$. A 2.6 mm CO line survey has shown that high-velocity CO gas with $V_{\rm LSR} = -150$ to 150 km s^{-1} is associated with the lobe ridges and the total mass of molecular hydrogen is about several times $10^5\ M_\odot$ (Figure 3).

We propose the following possible formation mechanisms:

(a) A shock wave produced by an explosion at the nucleus of the Galaxy: a model computation shows an explosion of energy 10^{54} ergs some 10^6 yr ago produces an Ω-shaped shock front with an expansion velocity of about 100 km s^{-1}, at present, which resembles the observed lobe structure (Sofue, 1984).

(b) A channelled exhaust of gas produced by a twisted magnetic field due to an accretion of gas in the nuclear disk (Uchida and Shibata, 1984): the accreting gas twists the field lines and is accelerated along a cylinder perpendicular to the disk. A model calculation by Uchida and Shibata (1984, in this issue) reproduces well the observed feature of the radio lobe.

(c) An inflation of a giant loop of magnetic tube filled with ionized gas, like as a solar prominence: the inflation may be triggered by a Parker-type instability in a magnetized nuclear disk with cosmic rays.

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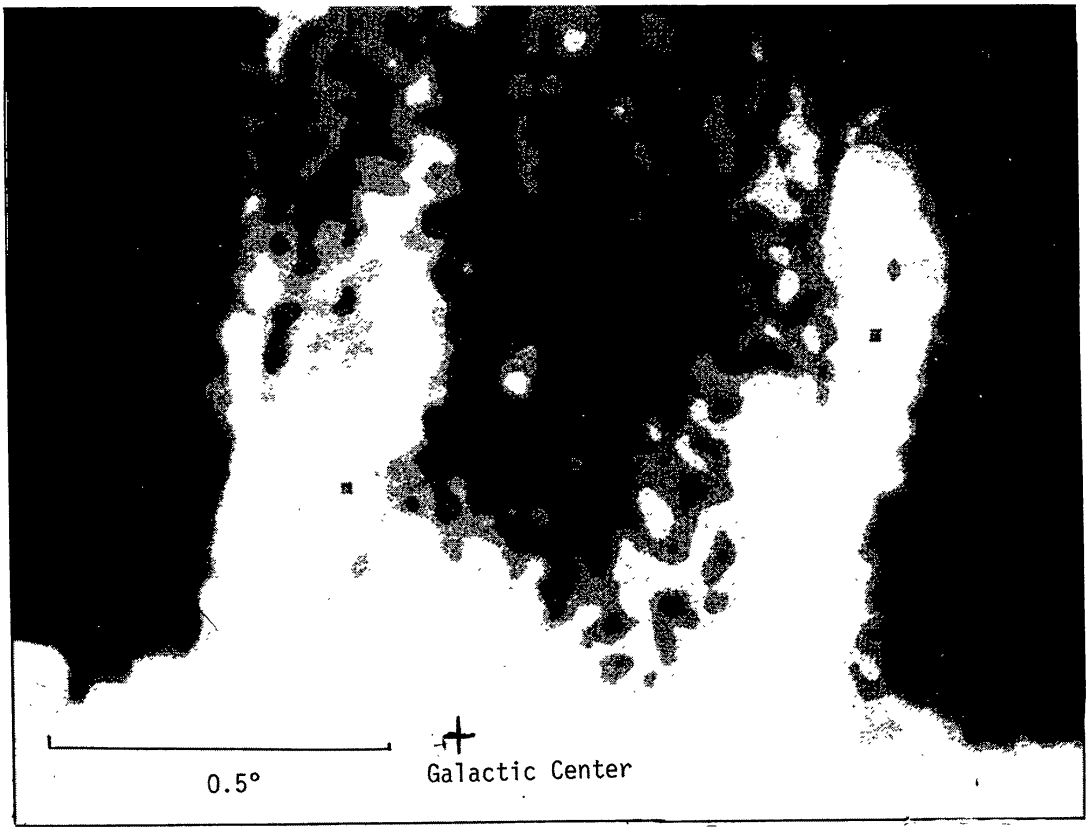

Fig. 1. The galactic center radio lobe at 10 GHz as reproduced from Sofue and Handa (1984).

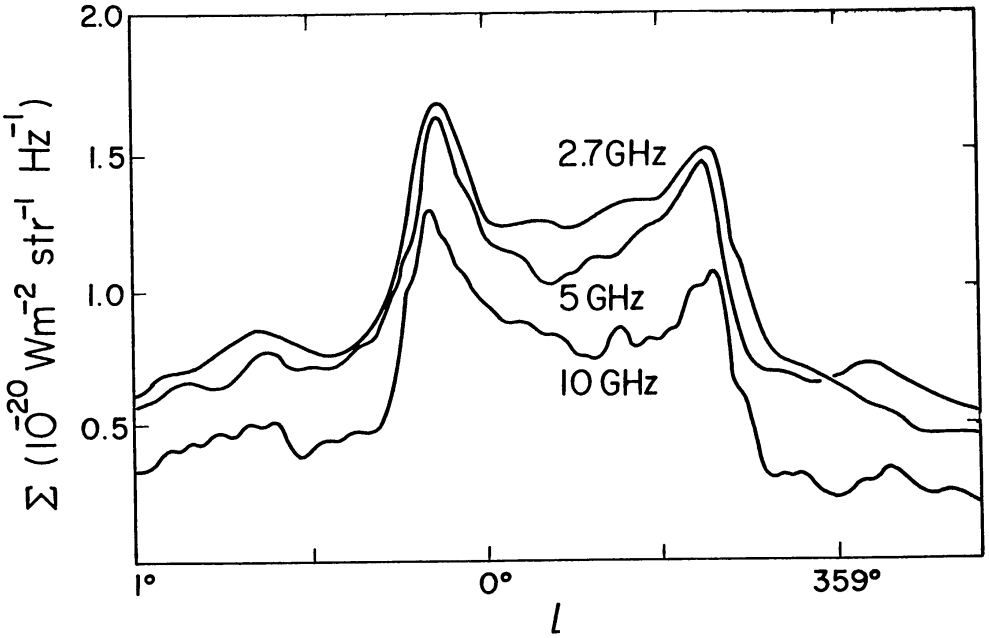

Fig. 2. Cross-sections of the radio lobe at 2.7, 5, and 10 GHz. The absolute zero levels are not correctly calibrated, due to a large-scale galactic background radiation. The data are from the Bonn 2.7 and 5 GHz, and Nobeyama 10 GHz surveys.

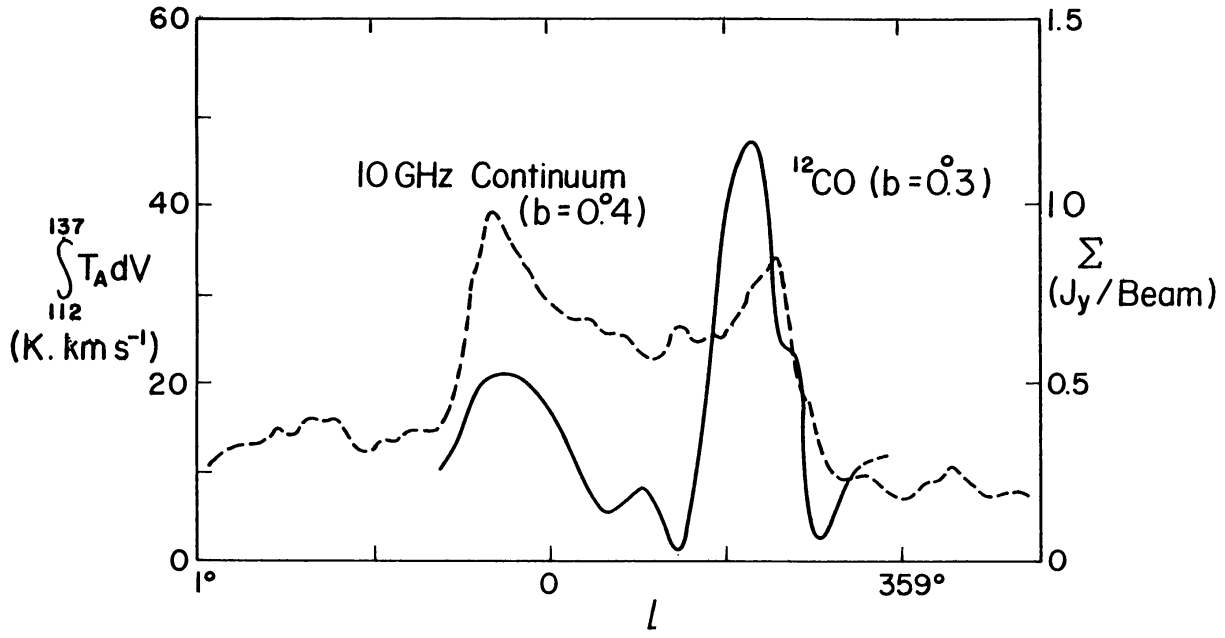

Fig. 3. Distribution of the CO line emission at a velocity range of from 112 to 137 km s^{-1}. The radio lobe ridges are associated with high-velocity CO gas.

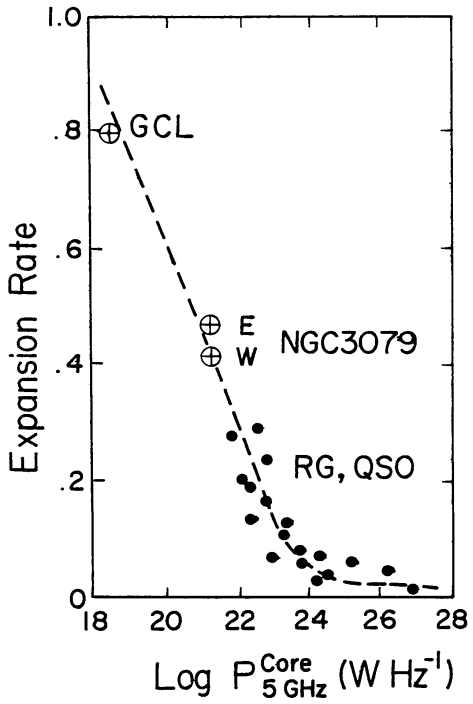

Fig. 4. A plot of lateral expansion rate, as defined by a ratio of the width to length of a jet, versus radio power at 5 GHz of the central radio source. Data for NGC 3079 were taken from Duric *et al.* (1983) and those for radio galaxies and QSOs were taken from Bridle (1984).

According to model B, which seems the most promising among the three, the radio lobe in our Galaxy may be a proto-type or mini-type of the cosmic jet phenomenon, which is frequently observed associated with active nuclei of radio galaxies and QSOs. In Figure 4 we plot the lateral expansion rate of radio jets in QSOs and radio galaxies (Bridle, 1984) versus the radio power of their central sources. In the figure we plot the same quantities determined for the galactic centre radio lobe and for radio lobes in the spiral galaxy NGC 3079. The same relationship obtained for radio jets at higher powers seems to apply for the radio lobes found in the spiral galaxy and in our own Galaxy center. This fact indicates that the radio lobe phenomenon in some spiral galaxies, including our own Galaxy, has common characteristics to the more powerful cosmic jet phenomenon observed in the active nuclei of radio galaxies and QSOs.

A full-description of this contribution will be given in a separate paper (Sofue, 1985).

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