The Source of Maser Emission in W33C (G12.8–0.2)

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Received January 18, 2012; in final form, March 2, 2012

Abstract—The results of observations of the H₂O and OH maser sources toward the region of W33C (G12.8–0.2) are reported. The observations were carried out on the 22-m radio telescope of the Pushchino Radio Astronomy Observatory in the 1.35-cm water-vapor line and on the Large Radio Telescope at Nançay (France), in the main (1665 and 1667 MHz) and satellite (1612 and 1720 MHz) OH lines. Multiple, strongly variable, short-lived H₂O emission features were detected in a broad interval of radial velocities, from −7 to 55 km/s. OH maser emission in the 1667-MHz line was detected at velocities of 35–41 km/s. The Stokes parameters of the maser emission in the main OH lines 1665 and 1667 MHz were measured. Zeeman splitting was detected in the 1665-MHz line at 33.4 and 39.4 km/s, and in the 1667 MHz line only at 39.4 km/s. The magnetic-field intensity was estimated. Appreciable variability of the Zeeman splitting components was observed at 39 and 39.8 km/s in both main lines. The extended spectrum and fast variability of the H₂O maser emission, together with the variability of the Zeeman-splitting components in the main OH lines, may indicate a composite clumpy structure of the molecular cloud and the presence of large-scale rotation, bipolar outflows, and turbulent motions of material in this cloud.

DOI: 10.1134/S1063772912100034

1. INTRODUCTION

The maser radio emission in the OH lines toward the HII region in W33C (G12.8–0.2) was detected by Pashchenko in 1975 [1, 2], and emission in the 1.35-cm water-vapor line by Genzel and Downes in 1976 [3].

The radio continuum source in this region has two emission peaks. Observations at 408 MHz [4] and 5000 MHz [5] showed that the fainter component, G12.7–0.2, is 5′ × 4′ in size, while the size of the intense component, G12.8–0.2, is only 0.8′. The kinematic distance to G12.8–0.2 was estimated from the neutral-hydrogen absorption line profile to be 5 kpc [6].

In January 1975 and October 1978, we carried out observations toward the continuum source W33C on the Large Radio Telescope in Nançay (France) in all four 18-cm OH lines, in both circular polarizations [1, 2]. Strongly polarized maser emission at velocities of 32.5 and 34.5 km/s was detected in the main 1665-MHz OH line against the background of strong absorption. We also determined the coordinates of the OH emission source to be α1950 = 18h11m18.5s, δ1950 = −17°56′ ± 1.5′. The OH maser is embedded in a compact molecular cloud, which is a source of type IIc OH emission in the 1612- and 1720-MHz satellite lines.

Subsequently, we conducted observations of the W33C OH maser in 1991 and 2008–2011. Unfortunately, there is no information about observations of this OH maser by other authors in the literature, either using single dishes or high angular resolution systems. Note that the W33 region hosts two centers of 1665-MHz maser emission arranged symmetrically on either side of W33C.

In November 1976, Genzel and Downes [3] detected intense H₂O maser emission from W33C at 1.35 cm on the 100-m radio telescope in Effelsberg at radial velocities from −4 to 1 km/s (8 Jy), as well as weaker emission (less than 4 Jy) at velocities from 30 to 41 km/s. The coordinates of the detected source coincided with those of the OH maser source to within the errors. The W33C H₂O maser was later observed by Jaffe et al. [7] and Comoretto et al. [8]. In 1981, the emission was notably weaker and occurred at −7 and 34 km/s.
Fig. 1. Spectra of the H$_2$O maser emission toward W33C. The double arrow shows the scale. The radial velocity is given relative to the LSR. The vertical lines at the bottom mark the velocities at which emission features were observed by us (solid) and other authors (dashed).

2. OBSERVATIONS AND DATA

The observations of the 1.35-cm H$_2$O maser emission toward W33C ($\alpha_{1950} = 18^h11^m18.3^s$, $\delta_{1950} = -17^\circ56'21''$) were carried out on the 22-m Pushchino Radio Astronomy Observatory (PRAO) telescope in November 1981, and then from March 2010 to November 2011. The noise temperature of the system with a cooled front-end FET amplifier was 120–270 K, depending on weather conditions.

The signal analysis was carried out using a 2048-channel autocorrelator with a spectral resolution of 6.1 kHz (0.0822 km/s at 22 GHz). For a point-like