Cosmic Masers - from OH to H_0
Proceedings IAU Symposium No. 287, 2012
R.S. Booth, E.M.L. Humphreys & W.H.T. Vlemmings, eds.

doi:10.1017/S1743921312007405

Relative parallaxes in the massive star forming region W33

K. Immer[1,2], M. J. Reid[2] and K. M. Menten[1]

[1]Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany
email: kimmer@mpifr-bonn.mpg.de

[2]Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, 02138 Cambridge, MA, USA

Abstract. The massive star forming complex W33 contains several molecular clouds at different stages of star formation activity, ranging from quiescent to highly active clouds. Our trigonometric parallax observations of water masers in this complex, conducted with the VLBA at 22.2 GHz, show that all water masers have the same distance of 2.4 kpc, locating the W33 complex in the Sagittarius spiral arm.

Keywords. masers, astrometry, stars: distances, stars: formation, Galaxy: structure

1. Background

W33 is a massive star forming complex, containing objects in various stages of evolution, from quiescent infrared-dark clouds (G012.86−0.27, G012.85−0.23) to highly active, infrared-bright regions (G012.81−0.20) (see Fig. 1). The peculiar kinematic structure of W33 (two different velocity groups at ∼36 and ∼60 km/s spread over distinct parts of the region) was discovered via spectral line observations (Bieging *et al.* 1978, Goss *et al.* 1978, Bieging *et al.* 1982). This was explained by either one connected star forming region with large internal motions at a near kinematic distance of 4 kpc, or a superposition of several independent star forming regions arranged along the line of sight.

2. Observations

As part of the BeSSeL project (Brunthaler *et al.* 2011), we performed trigonometric parallax observations of the four water masers G012.68−0.18, G012.81−0.20, G012.90−

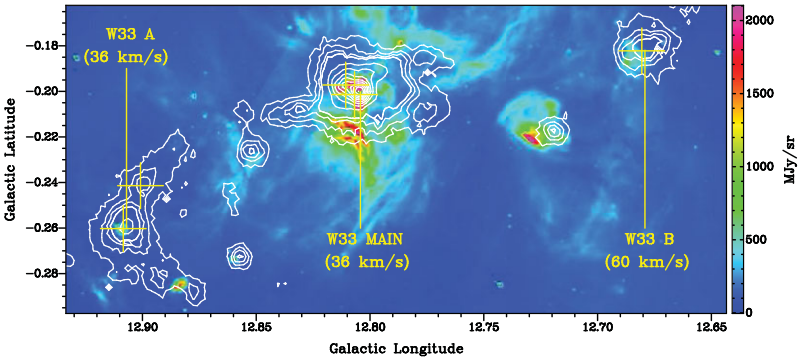

Figure 1: The W33 complex. Background image: 8 μm emission from the GLIMPSE survey. Contours: 870 μm dust emission from the ATLASGAL survey (contour levels: 4% to 10% in steps of 2% and 10% to 100% in steps of 10%). Crosses: Water masers.

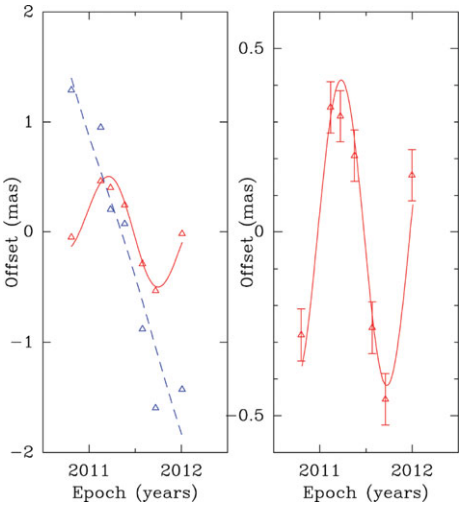

Figure 2: Position measurements of G012.68−0.18 relative to the background quasar J1825−1718. Left panel: East (continuous line) and North (dashed line) position offsets with parallax and proper motion fits versus time. Right Panel: Right ascension parallax fit of 0.416 ± 0.028 mas with the best-fit proper motions removed.

Maser	V_{peak} (km/s)	Relative Parallax (mas)	Distance (kpc)
G012.68−0.18	61	+0.416* ± 0.028	2.4 ± 0.2
G012.81−0.20	35, −3	+0.054 ± 0.031	2.1 ± 0.2
G012.90−0.24	35	−0.055 ± 0.018	2.8 ± 0.2
G012.91−0.26	35	+0.006 ± 0.030	2.4 ± 0.2

* Absolute parallax.

Table 1: Relative parallaxes and distances of the water masers in W33.

0.24, G012.91−0.26 with the Very Large Baseline Array (VLBA) at 22.2 GHz to determine their distances and proper motions. The observations were split in eight epochs from 2010 October to 2012 January to well-sample the right ascension parallax signatures in time. The position measurements of G012.68−0.18 are made relative to the background quasars J1825−1718 and J1808−1822 (see Fig. 2). The other three water masers are too weak to be used as phase reference sources and were phase referenced to G012.68−0.18, yielding relative parallaxes.

3. Results

The relative parallaxes of G012.81−0.20, G012.90−0.24 and G012.91−0.26 are consistent with zero (± 0.06 mas) (see Table 1). Thus, these water masers are located at the same distance as G012.68−0.18 and W33 is one connected star forming complex. Furthermore, we determined the distance to W33 to be 2.4 kpc, almost half the kinematic distance, locating W33 in the Sagittarius spiral arm and not in the Scutum-Crux arm.

References

Bieging, J. H., Pankonin, V., & Smith, L. F. 1978, *A&A*, 64, 341
Bieging, J. H., Wilson, T. L., & Downes, D. 1982, *A&AS*, 49, 607
Brunthaler, A., *et al.* 2011, *Astronomische Nachrichten*, 332, 461
Goss, W. M., Matthews, H. E., & Winnberg, A. 1978, *A&A*, 65, 307

https://doi.org/10.1017/S1743921312007405 Published online by Cambridge University Press