Annual Parallax Distance and Secular Motion of the *Water Fountain* Source IRAS 18286−0959
（「宇宙の噴水」天体 IRAS 18286−0959 の年周視差距離と銀河系内運動 ）

Hiroshi IMAI[1], VERA 中距離円盤プロジェクトチーム[2]

[1]1Department of Physics and Astronomy, Graduate School of Science and Engineering, Kagoshima University

[2]2Mizusawa VLBI Observatory, National Astronomical Observatory of Japan

Abstract

We report on results of astrometric observations of H_2O masers in the "water fountain" source IRAS 18286−0959 with the VERA during 2007 October–2009 September. These observations yielded an annual parallax of IRAS 18286−0959, $\pi = 277 \pm 41$ μas, corresponding to a heliocentric distance of $D = 3.61^{+0.63}_{-0.47}$ kpc. The maser feature, whose annual parallax was measured, showed the absolute proper motion of $(\mu_\alpha, \mu_\delta) = (-3.2 \pm 0.3, -7.2 \pm 0.2)$[mas yr^{-1}]. If this maser feature is associated with a precessing, bipolar jet in IRAS 18286−0959 and moving in the south-south-west direction, the secular motion of the IRAS 18286−0959 system roughly follows the Galactic rotation. However, this possibility is ruled when taking into account the intrinsic motion of the maser feature in the feature cluster of IRAS 18286−0959, which does not seem to trace the motion of the bipolar jet [6]. The proximity of IRAS 18286−0959 to the Galactic midplane ($z \approx 10$ pc) suggests that the parental star of the water fountain source in IRAS 18286−0959 should be intermediate-mass AGB/post-AGB star, but the origin of a large deviation of the systemic motion from the motion expected from the Galactic rotation curve is still unclear.

References

[1] Dehnen, W., & Binney, J. 1998, MNRAS, 294, 429

[2] Francis, C., & Anderson, E. 2009, New Astron., 14, 615

[3] Hammersley, P. L., Garzón, F., Mahoney, T., & Calbet, X. 1995, MNRAS, 273, 206

[4] Imai, H., et al., 2012, PASJ, submitted

[5] Reid, M. J., et al. 2009, ApJ, 700, 137

[6] Yung, B. H. K., Nakashima, J., Imai, H., Deguchi, S., Diamond, P. J., & Kwok, S. 2011, ApJ, 741, 94

Table 1: Location and 3D motion of IRAS 18286−0959 in the Milky Way estimated from the VERA astrometry

Parameter	Value
Galactic coordinates, (l, b) [deg][1] ….	$(21.80, -0.13)$
Heliocentric distance, D [kpc][1] ……	3.61 ± 0.63
Systemic LSR velocity, $V_{\rm sys}$ [km s^{-1}][1]	60 ± 5
R_0 [kpc][2] …………………………	8.0
Θ_0 [km s^{-1}][2] ……………………	220
$(U_\odot, V_\odot, W_\odot)$ [km s^{-1}][3] …………	(7.5, 13.5, 6.8)
z_0 [pc][4] …………………………	16
$R_{\rm gal}$ [kpc] ………………………	4.84 ± 0.50
z [pc] …………………………	7 ± 1
Case 1: fixed in the system	
V_R [km s^{-1}] ……………………	66 ± 19
V_θ [km s^{-1}] ……………………	148 ± 25
V_z [km s^{-1}] ……………………	-1 ± 20
Case 2: moving in $(-3, -5)$ [mas yr^{-1}] with respect to the system	
V_R [km s^{-1}] ……………………	6 ± 13
V_θ [km s^{-1}] ……………………	228 ± 17
V_z [km s^{-1}] ……………………	-7 ± 20

[1]Input value for IRAS 18286−0959.

[2]Input value for the Sun in the Milky Way.

[3]Motion of the Sun with respect to the local standard of rest, cited from [2] (c.f., [1]).

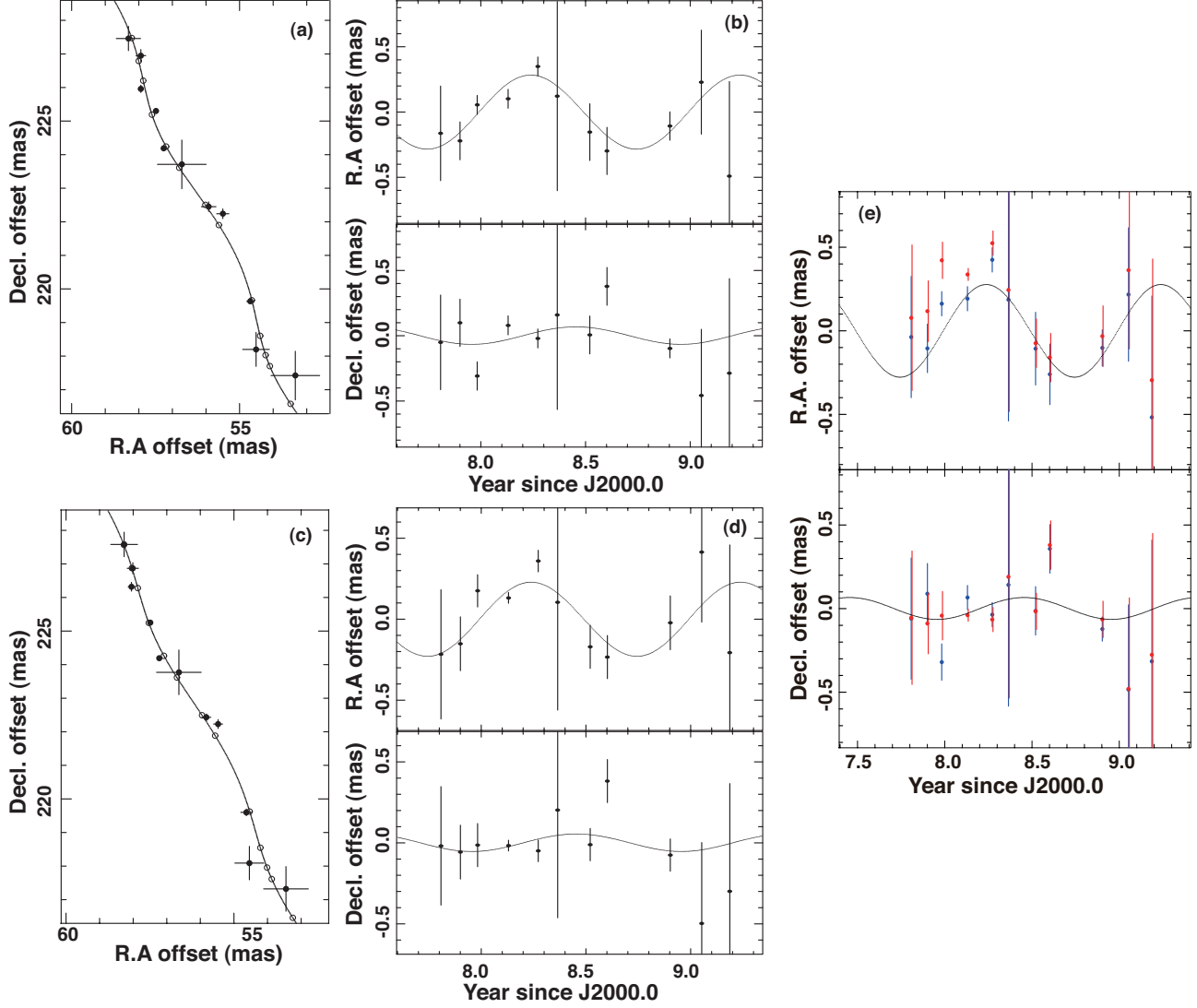[4]Height of the Sun from the Galactic mid-plane, cited from the reference [3].

Figure 1: Motions of the 53.4 km s^{-1} and 53.0 km s^{-1} components of H$_2$O masers in IRAS 18286−0959 and the kinematical models for these motions. (a) R.A. and decl. offsets with respect to the phase-tracking center of the 53.4 km s^{-1} component. A filled circle shows the data point observed and used for the annual parallax measurement. A solid curve shows the modeled motion including an annual parallax and a constant velocity proper motion. A opened circle indicates the spot position expected in the model at the observation epoch. (b) R.A. variation of the 53.0 km s^{-1} component along time. The estimated annual parallax and linear proper motion are subtracted from the observed spot position. A solid curve shows the modeled annual parallactic motion. (c) Same as (a) but for the 53.4 km s^{-1} component. (d) Same as (b) but for the 53.0 km s^{-1} component. (e) The result of the combined annual parallax fitting. Blue and red data points shows those of the 53.4 km s^{-1} and 53.0 km s^{-1} components, respectively.