

# Astrometry of 6.7 GHz Methanol Maser toward W3(OH) with Japanese VLBI Network

MATSUMOTO, Naoko, HONMA, Mareki  
(The Graduate University for Advanced Studies / NAOJ)

ISONO, Yasuko  
(Nagoya University)

UJIHARA, Hideki  
(NICT)

KIMURA, Kimihiro, MATSUMOTO, Kouhei  
(Osaka Prefecture University)

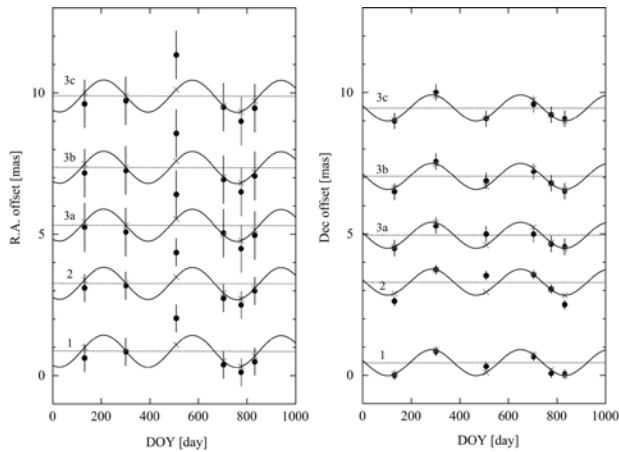
SAWADA-SATOH, Satoko  
(NAOJ)

DOI, Akihiro  
(ISAS)

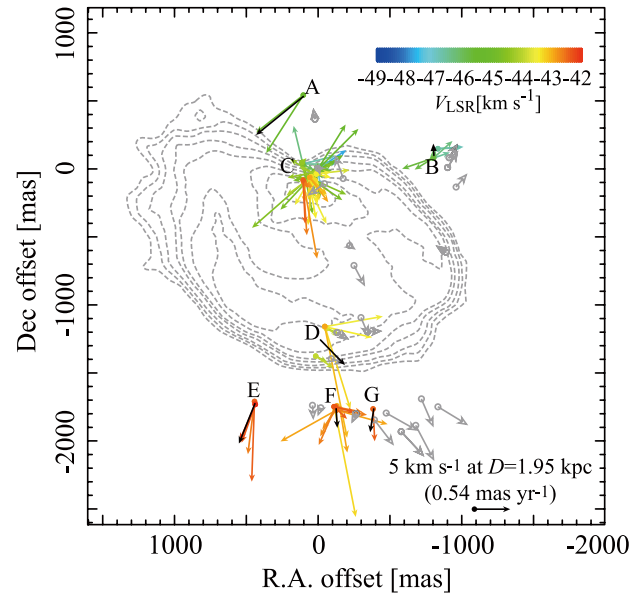
FUJISAWA, Kenta  
(Yamaguchi University)

UENO, Yuji  
(NAOJ)

We present the results of multi-epoch VLBI observations for 6.7 GHz methanol maser emission toward the UC HII region of W3(OH) with Japanese VLBI Network (JVN) [1]. Based on phase-referencing VLBI astrometry, we derived the trigonometric annual parallax to be  $0.598 \pm 0.067$  mas, corresponding to a distance of  $1.67^{+0.21}_{-0.17}$  kpc. This is the first detection of parallax for a 6.7 GHz methanol maser source with JVN, following European VLBI Network [2], and demonstrates that JVN/VERA is capable of conducting VLBI astrometry for 6.7 GHz methanol maser sources within a few kpc from the Sun. Based on in-beam mapping of the W3(OH) methanol maser, we also measured the internal proper motions of its 6.7 GHz methanol maser for the first time. The internal proper motions basically show north-south expansion with a velocity of few  $\text{km s}^{-1}$ , being similar to OH masers. The spatial distribution and the internal proper motions of 6.7 GHz methanol masers suggest a rotating and expanding torus structure surrounding the UC HII region.



**Figure 1:** Results of positional offsets variation for the maser components of  $v_{\text{LSR}} = -43.10$  (1),  $-43.80$  (2),  $-45.91$  (3a),  $-45.20$  (3b), and  $-45.60$  (3c)  $\text{km s}^{-1}$  after subtracting the best-fit proper motions. The first day corresponds to New Year's day 2008.



**Figure 2:** Internal proper motion for 6.7 GHz methanol maser components toward W3(OH). Color-codes represent the LSR velocity. The colored vectors show the directions and amplitudes of the relative proper motions on the sky plane to the reference component with the  $-45.4 \text{ km s}^{-1}$  LSR velocity. The thick black vectors show the averaged relative proper motion at each cluster of A, B, and D-G to the C cluster around the origin. The proper motion vectors of 1665 MHz OH maser (gray vectors) and the contour map of 15 GHz radio continuum emission of the UCHII region (broken lines) are taken from Bloemhof, Reid, and Moran [3].

## References

- [1] Matsumoto, N., et al.: 2011, *PASJ*, **63**, 1345.
- [2] Rygl, K. L. J., et al.: 2010, *A&A*, **511**, A2.
- [3] Bloemhof, E. E., Reid, M. J., Moran, J. M.: 1992, *ApJ*, **397**, 500.