

Astrometry of H₂O maser sources in nearby molecular clouds with VERA

Tomoya Hirota^{1,2}, Takeshi Bushimata¹, Yoon Kyung Choi^{1,3}, Mareki Honma^{1,2}, Hiroshi Imai⁴, Kenzaburo Iwadate⁵, Takaaki Jike⁵, Seiji Kamen⁴, Osamu Kameya^{2,5}, Ryuichi Kamohara¹, Yukitoshi Kan-ya⁶, Noriyuki Kawaguchi^{1,2}, Masachika Kijima², Mi Kyoung Kim^{1,3}, Hideyuki Kobayashi^{1,3,5}, Seisuke Kuji⁵, Tomoharu Kurayama¹, Seiji Manabe^{2,5}, Kenta Maruyama⁴, Makoto Matsui⁴, Naoko Matsumoto⁴, Takeshi Miyaji¹, Takumi Nagayama⁴, Akiharu Nakagawa⁴, Kayoko Nakamura⁴, Chung Sik Oh^{1,3}, Toshihiro Omodaka⁴, Tomoaki Oyama¹, Satoshi Sakai⁵, Tetsuo Sasao^{7,8}, Katsuhisa Sato⁵, Mayumi Sato^{1,3}, Katsunori M. Shibata^{1,2}, Motonobu Shintani⁴, Yoshiaki Tamura^{2,5}, Miyuki Tsushima⁴ and Kazuyoshi Yamashita²

¹ National Astronomical Observatory of Japan, Mitaka, Tokyo 181-8588, Japan

² Graduate University for Advanced Studies, Mitaka, Tokyo 181-8588, Japan

³ The University of Tokyo, Bunkyo-ku, Tokyo 113-0033, Japan

⁴ Kagoshima University, Kagoshima 890-0065, Japan

⁵ National Astronomical Observatory of Japan, Oshu-shi, Iwate 023-0861, Japan

⁶ Yonsei University, Seoul 120-749, Republic of Korea

⁷ Ajou University, Suwon 443-749, Republic of Korea

⁸ Korean VLBI Network, Seoul 120-749, Republic of Korea

email: tomoya.hirota@nao.ac.jp

Abstract. We have carried out multi-epoch VLBI observations of the H₂O maser sources associated with young stellar objects (YSOs) in nearby molecular clouds with VERA (VLBI Exploration of Radio Astrometry), which is a newly constructed VLBI network in Japan (Kobayashi *et al.* 2003). The main goal of our study is to measure the absolute proper motions and distances to nearby molecular clouds within 1 kpc from the Sun, to reveal their 3-dimensional structures and dynamical properties. Using the VERA dual-beam receiving system (Honma *et al.* 2003), we have carried out phase-referencing VLBI observations and measured annual parallaxes and absolute proper motions of the H₂O maser features with respect to the extragalactic radio sources. We have successfully detected the annual parallax of one of the H₂O maser features in Orion KL to be 2.29 ± 0.10 mas, corresponding to the distance of 437 ± 19 pc from the Sun (Hirota *et al.* 2007). In addition, the annual parallax of SVS13 in NGC 1333 is also determined to be 4.10 ± 0.17 mas, corresponding to the distance of 244 ± 10 pc from the Sun, although the life time of the maser features are only 6 months. The absolute proper motions of the H₂O maser features associated with Orion KL and NGC 1333 are derived, possibly indicating the outflow motions from the YSOs as well as the systemic motions of the powering sources.

Keywords. Astrometry, ISM: individual (Orion KL, NGC 1333), masers (H₂O)

References

Hirota, T. *et al.* 2007, submitted to *PASJ*

Honma, M. *et al.* 2003, *PASJ*, 55, L57

Kobayashi, H. *et al.* 2003, in: Y. C. Minh (eds.), *New technologies in VLBI*, ASP Conf. Ser. (San Francisco: ASP), vol. 306, p. 367

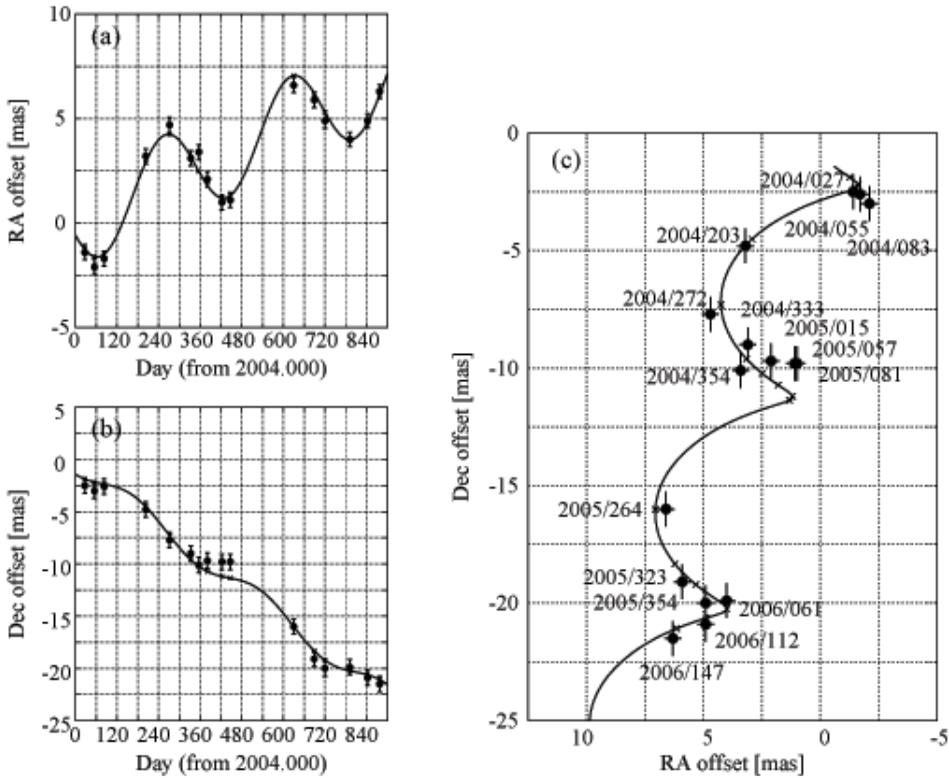


Figure 1. Results of the position measurements of the maser feature in Orion KL. (a) The movement of the maser feature in right ascension as a function of time. (b) The same as (a) in declination. (c) The movement of the maser feature on the sky. Solid lines represent the best fit model with the annual parallax (2.29 ± 0.10 mas) and linear proper motion for the maser feature. Filled circles with error bars represent the observed positions of the maser features.

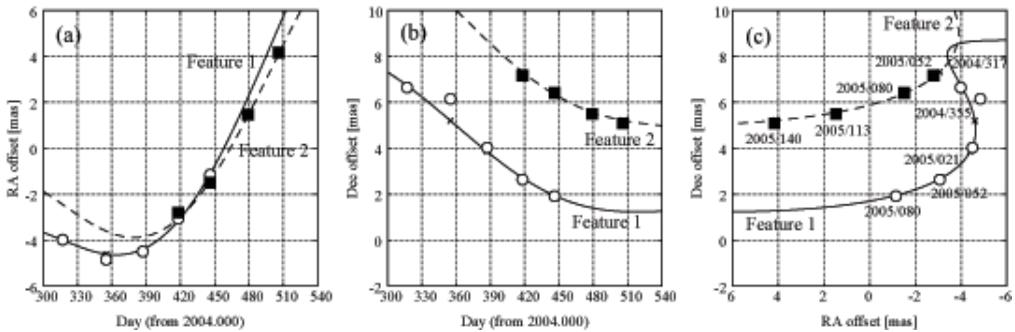


Figure 2. Results of the position measurements of the maser feature in NGC 1333 SVS13. (a) The movement of the maser feature in right ascension as a function of time. (b) The same as (a) in declination. (c) The movement of the maser feature on the sky. Solid and dashed lines represent the best fit model with the annual parallax (4.10 ± 0.17 mas) and linear proper motion for the maser features 1 and 2, respectively. Open circles and filled squares represent the observed position of the maser features 1 and 2, respectively.