

ASTROMETRY OF IRAS 22555+6213 WITH VERA:
A 3-DIMENSIONAL VIEW OF SOURCES ALONG THE SAME LINE OF SIGHT

JAMES O. CHIBUEZE,^{1,2} HIROFUMI SAKANOE³, TOSHIHIRO OMODAKA³, TOSHIHIRO HANDA³, TAKUMI NAGAYAMA⁴,
TATSUYA KAMEZAKI³, AND ROSS BURNS³

¹East Asian ALMA Regional Center, National Astronomical Observatory of Japan, 2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan

²Department of Physics and Astronomy, Faculty of Physical Sciences, University of Nigeria, Carver Building, 1 University Road, Nsukka, Nigeria

³Department of Physics and Astronomy, Graduate School of Science and Engineering, Kagoshima University, 1-21-35 Korimoto, Kagoshima 890-0065, Japan

⁴Mizusawa VLBI Observatory, National Astronomical Observatory of Japan, 2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan

E-mail: james.chibueze@nao.ac.jp

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ABSTRACT

We report results of the measurement of the trigonometric parallax of an H₂O maser source in IRAS 22555+6213 with the VLBI Exploration of Radio Astrometry (VERA). The annual parallax was determined to be 0.278 ± 0.019 mas, corresponding to a distance of $3.66^{+0.30}_{-0.26}$ kpc. Our results confirm that IRAS 22555+6213 is located in the Perseus arm. We computed the peculiar motion of IRAS 22555+6213 to be $(U_{src}, V_{src}, W_{src}) = (0 \pm 1, -32 \pm 1, 9 \pm 1)$ km s⁻¹, where U_{src} , V_{src} , and W_{src} are directed toward the Galactic center, in the direction of Galactic rotation and toward the Galactic north pole, respectively. IRAS 22555+6213, NGC 7538 and Cepheus A lie along the same line of sight, and are within 2° on the sky. Their parallax distances, with which we derived their absolute position in the Milky Way, show that IRAS 22555+6213 and NGC 7538 are associated with the Perseus arm, while Cepheus A is located in the Local arm. We compared the kinematic distances of IRAS 22555+6213 derived with flat and non-flat rotation curve with its parallax distance and found the kinematic distance derived from the non-flat rotation assumption (-32 km s⁻¹ lag) to be consistent with the parallax distance.

Key words: Galaxy: kinematics and dynamics — techniques: interferometric — stars:individual (IRAS 22555+6213)

1. INTRODUCTION

Measurement of the accurate distances of sources including star forming regions in the Milky Way is key to understanding its 3-dimensional structure. Recent CO molecular line surveys (e.g. Dame et al. 2001) provide clues into the nature of the Milky Way but the kinematic distances derived from such observations are ambiguous depending on the accuracy of the derived V_{LSR} , and the Galactic constants and model used.

Cepheus A, NGC 7538, and IRAS 22555+6213 are located within 2° on the sky (Ungerechts et al. 2000). Could this imply that all 3 sources are located close to each other? A 3-dimensional view is necessary to determine their exact location in the Milky Way. Trigonometric parallax measurement with very long baseline interferometry (VLBI) is one way to obtain the accurate distance of sources. Moscadelli et al. (2009) measured the parallax distance to Cepheus A (see also Dzib et al. 2011) and NGC 7538 to be 0.70 ± 0.04 kpc and 2.65 ± 0.12

kpc, respectively, implying that Cepheus A is located in the Local arm, while NGC 7538 is located in the Perseus arm. Determining the parallax distance is vital for comparing with Cepheus A, and NGC 7538.

2. OBSERVATIONS

We observed H₂O (6₁₅-5₂₃) masers in IRAS 22555+6213 at 22.235080 GHz at 11 epochs between 2010 May 28 and 2013 January 26 using VLBI Exploration of Radio Astrometry (VERA). Each observation epoch spanned ~8 hours, covering scans on IRAS 22555+6213, band-pass calibrators (3C454.3 NRAO530 and DA55), and a position reference source (J2302+6405). With the dual-beam system of VERA, we simultaneously observed the H₂O masers of IRAS 22555+6213 and a position reference source (J2302+6405). The data reduction was done with the VERA Data Analyzer (VEDA) developed by the software development group at the Mizusawa VLBI Observatory of the National Astronomical Observatory of Japan for astrometric analysis of VERA data (Ninuma et al., 2011).

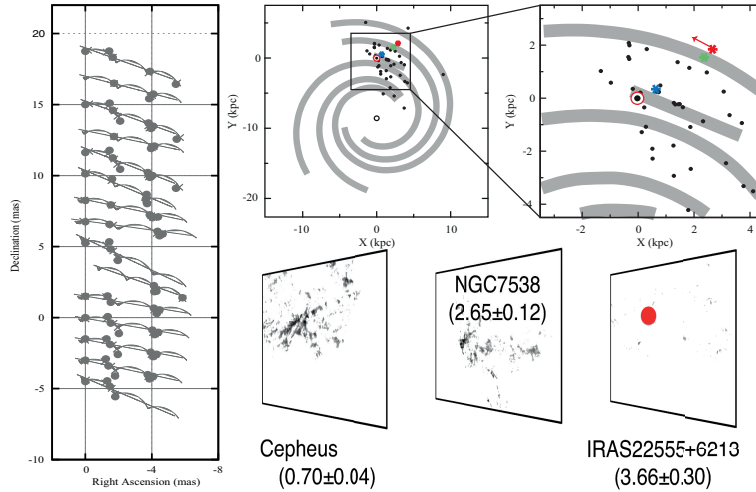


Figure 1. (left) R.A. vs Dec fits of the parallax and proper motions of the masers. (right top) Position of Cepheus A (blue star), NGC 7538 (green star), and IRAS 22555+6213 (red star) on the Galactic plane with spiral arms based on the Russeil (2003) arm model. (right bottom) A illustration of the 3-D view of the 3 sources along the same line of sight.

3. RESULTS & DISCUSSIONS

We obtained an annual parallax of the H₂O masers in IRAS 22555+6213 of 0.278 ± 0.019 mas, corresponding to a distance of $3.66^{+0.30}_{-0.26}$ kpc. Unlike Cepheus A, IRAS 22555+6213 is located at the outer end of the Perseus arm, with a peculiar motion of IRAS 22555+6213 of $(U_{src}, V_{src}, W_{src}) = (0 \pm 1, -32 \pm 1, 9 \pm 1)$ km s⁻¹, where U_{src} , V_{src} , and W_{src} are directed toward the Galactic center, in the direction of Galactic rotation and toward the Galactic north pole, respectively. Figure 1 shows the parallax fitting of the maser motions, the peculiar motion of IRAS 22555+6213 and the 3-D view of the 3 sources.

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