Annual parallax distance and kinematical property of the maser source in IRAS 19312+1950

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The studies in this poster will appear in the following papers.
H. Imai, D. Tafoya, M. Honma, T. Hirota, & T. Miyaji 2010, PASJ, 62, VERA Special Issue, in press
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Summary

IRAS 19312+1950 has been an object whose evolutionary status is in debate. This object should be one of the key objects that provide important clue to revealing final stellar evolution forming a complicated planetary nebula morphology. We have conducted comprehensive study of SiO, H_2O, and OH masers in this object as well as a measurement of the annual parallax distance and the secular motion of the object. We found double sources of SiO, H_2O maser emission, which may trace a bipolar flow. Independently, the 1612 MHz OH masers indicates the existence of a shell with a radius of R~400 AU and an expansion velocity of V_{exp}~6 km s^{-1}. We obtain an annual parallax distance to IRAS 19312+1950, $D=3.80^{+0.83}_{-0.58}$ kpc, and estimate the location in the Galaxy, (R, z) = (7.07±0.12 kpc, 28±3 pc), and the secular motion, (V_R, V_θ, V_z) = (33±28, 214±4, −14±8) [km s^{-1}] in galactic cylindrical coordinates. These results suggest that IRAS 19312+1950 should be an intermediate-mass evolved star.

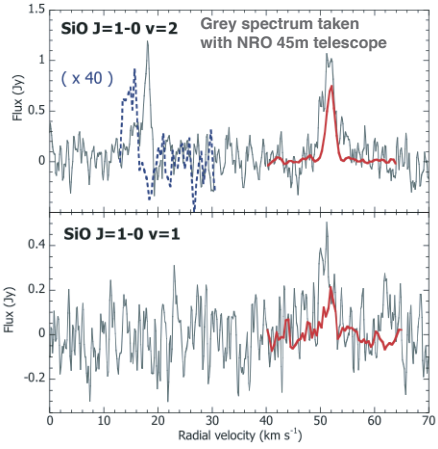

Figure 1

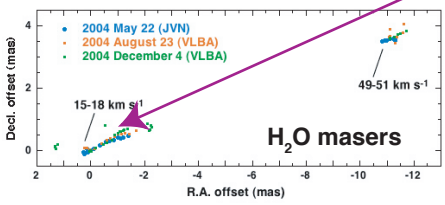

Figure 2

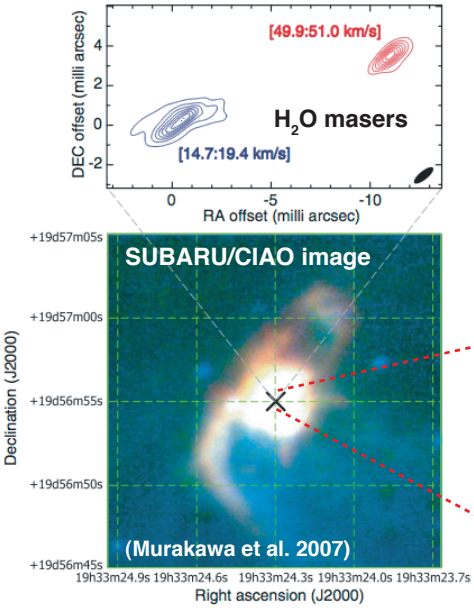

Figure 3

Interferometric observations

SiO masers: with HSA (=VLBA+VLA+GBT) on 2005/05/01 (Figure 1)
H_2O : with VLBA and JVN at 3 epochs during 2004/5/22-12/04) (Figure 2, 3)
1612 MHz OH masers: with MERLIN on 2003/04/29-30 (Figure 4)
H_2O astrometry: with VERA at 16 epochs during 2007/10/25-2009/08/29 (Fig. 5)

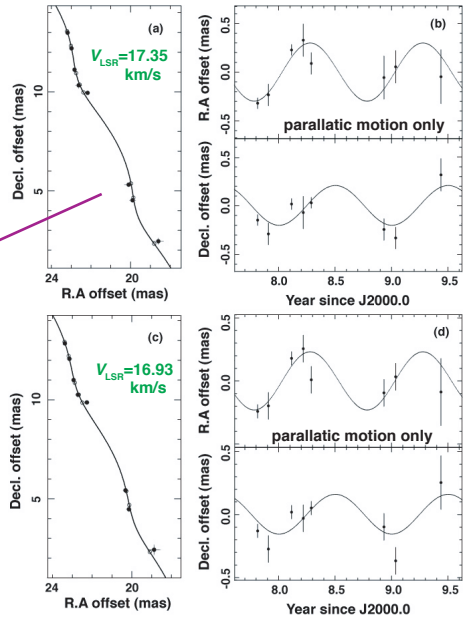

Figure 5

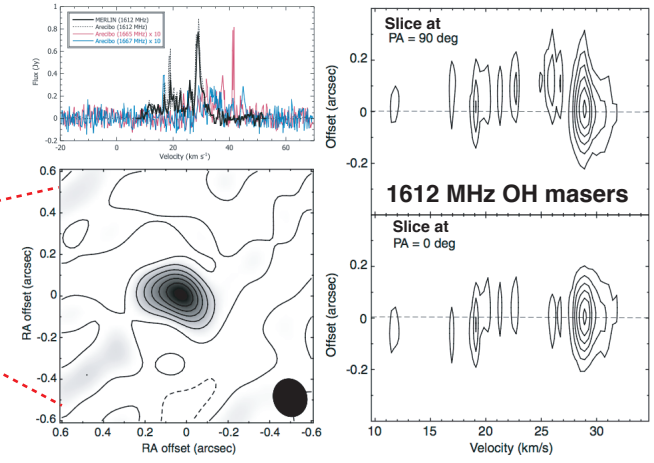

Figure 4

Discussion

1. Reestimation of the luminosity
   ≈18,000 L_{sun}
2. Enclosed mass within 5" (1,900 AU)
   3.5 $M_{sun} < M < 7.7\ M_{sun}$
3. Mass loss rate $1.0 \times 10^{-4}\ M_{sun}$ yr^{-1} $< dM/dt < 2.2 \times 10^{-4}\ M_{sun}$ yr^{-1}
4. Deviation from a circular galactic rotation ~40 km s^{-1}
   It is difficult to use such post AGB stars as a tracer of the Galactic dynamics.
5. Properties of the maser sources
   a: Doube peaked H_2O and SiO masers
   × binary system
   Cannot explain the aligned H_2O masers.
   × Keplerian rotation disk
   Angular momentum transfer problem
   ○ blobs of a bipolar outflow
   $V_{exp} > 18$ km s^{-1} ~V_{exp} (OH masers)
6. Expanding shell in 1612 MHz OH masers
   V_{exp} (OH) ~ 6 km s^{-1}
   R_{exp}(OH) ~400 AU
   typical values in AGB envelopes
   + the same bipolar flow seen in H_2O and SiO masers
7. Young stellar object?
   No! (no detection of molecular emission well observed from YSOs)
8. C- and O-rich chemistry
   Hot-bottom nuclear burning in a higher mass AGB star.

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