Water Masers around the RV Tau variable-type star IRAS 22480+6002

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IRAS 22480+6002 (AFGL 2968, IRC+60370)について

- H_2O, SiOメーザーは存在するがOHメーザーは付随しない。
- K型超巨星 (K0Ia or K4.5Ia) として同定されている
- CO J=2-1輝線(図1) から推定される運動学的距離~5 kpc

  この距離だと光度 L=140,000 $L_\odot$に相当
- 連星系かもしれない: 実視連星として同定(図2)
- 変光星らしい
- IRAS LRS: スペクトル型M0Iと再同定、しかし変光は未確認

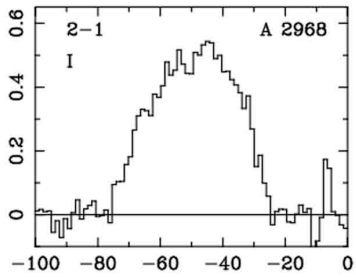

図1: CO J=2-1輝線のスペクトル (Groenewegen et al. 1999)。 Vsys=-49.3 km/s, Vexp=26.4 km/s を示す。

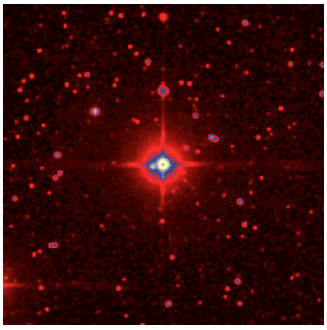

図2: 2MASS J-バンド像

JVN共同利用観測 (2005年、table 1)

- ターゲット水メーザー源: IRAS 22480+6002

  R.A.(J2000)=$22^h49^m58^s.876$, decl.(J2000)=+60°17′ 56″ .65

  (フリンジレートマッピングで推定)
- 参照電波源: J225425.2+620938

  強度約 120 mJy/beam　メーザー源からの離角 1°.94

  16MHz帯域幅では未検出
- DIR1000テープ4巻使用: 積分時間は約8時間

Table 1. Status of the telescopes, data reduction, and resulting performances in the individual epochs of the JVN observations.

Observation code	Epoch in the year 2005	Duration (hr)	Used telescopes*	Reference velocity† (km s^{-1})	1σ level noise (Jy beam^{-1})	Synthesized beam‡ (mas)	Number of detected features
r05084b ..	March 25	7.3	MZ, IR, OG, IS, KS, NB§	−52.3	0.22	1.7×1.6, −37°	20
r05116b ..	April 26	7.3	MZ, IR, OG, IS‖, KS, NB	−52.0	0.15	3.8×2.0, −14°	17
r05151a ...	May 31	8.1	MZ, OG‖, IS‖, KS, NB	−52.6	0.15	3.2×2.8, −66°	14

* Telescopes that were effectively operated and whose recorded data were valid: MZ: the VERA 20-m telescope at Mizusawa, IR: the VERA 20-m telescope at Iriki, OG: the VERA 20-m telescope at Ogasawara Is., IS: the VERA 20-m telescope at Ishigakijima Is., KS: the NiCT 34-m telescope at Kashima, NB: the NRO 45-m telescope at Nobeyama.
† Velocity channel used for the phase reference in data reduction.
‡ The synthesized beam made in natural weight; major and minor axis lengths and position angle.
§ Ceasing operation for 2.5 hr due to strong winds and pointing correction.
‖ High system temperature (> 300 K) due to bad weather conditions.

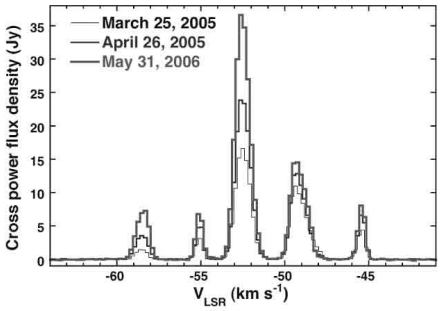

Fig. 1. Cross-power spectra of H_2O masers in IRAS 22480+6002 obtained in the baseline between the NRO 45-m and NICT 34-m telescopes at three epochs.

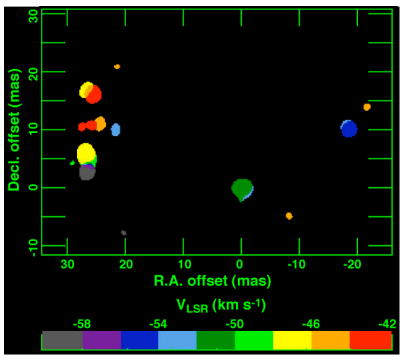

Fig. 2. Distribution of H_2O masers on 2005 March 25. The color code indicates the radial velocity of the feature, and the size of the filled circle indicates the flux density of the feature. Note that the −58.48 km s^{-1} reference component is located at the origin (light blue), but is almost overlapped with the systemic-velocity component (~ −49 km s^{-1}), shown in green.

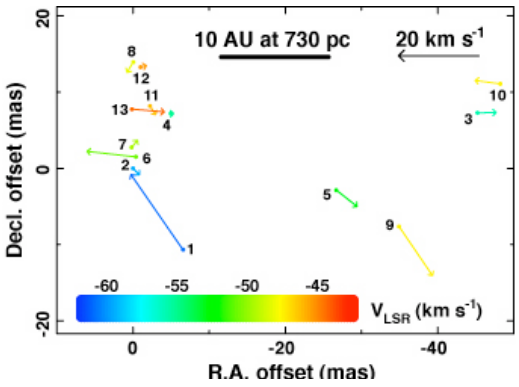

Fig. 3. Doppler velocities (colorfully displayed) and relative proper motion vectors (indicated by arrows) of H_2O masers in IRAS 22480+6002. The displayed proper motion vector is that subtracted by a velocity bias $(\overline{\mu_x}, \overline{\mu_y}) = (0.97, 0.72)$ [mas yr^{-1}] from the original vector to cancel out the average motions of all the features. A number added for each feature with a proper motion shows the assigned one after the designated name form "IRAS 22480+6002: I2007". The map origin is set to the location of the feature IRAS 22480+6002: I2007 2.

メーザー運動のまとめ

- 一様膨張運動よりもむしろ

  ランダム運動が支配的(Fig.2,3)
- 視線速度分布範囲はCO輝線の

  それの約半分(図1, Fig. 1-3)

  通常見られるものとほぼ同じ
- 統計視差法による距離推定

  1.0±0.4 kpc

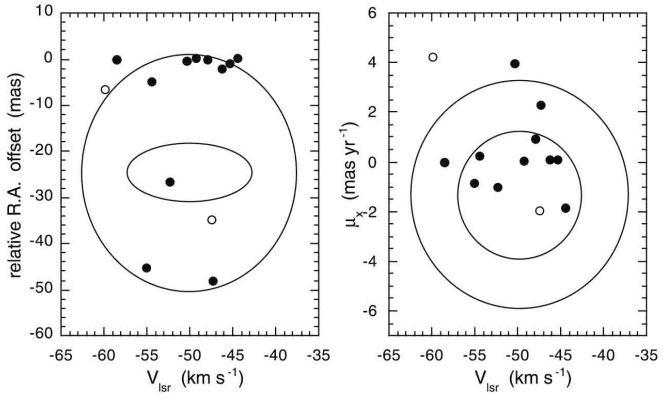

Fig. 4. Plot of the relative RA offset (left) and proper motion (right) against the radial velocity. The filled and unfilled circles indicate the three-epoch and two-epoch detections. The large and small ellipses in both panels indicate the position and proper-motion curves expected from thin spherical shell models (one-dimensional in the RA direction) with a constant expansion velocity of 12.5 km s^{-1} and a radius of 3.5×10^{14} cm, and with 7 km s^{-1} and 8×10^{13} cm, respectively both at a distance of 0.9 kpc. The observed points in the right panel do not fit to these ellipses.

考察

- 新たに推定された距離~1 kpcに基づいて物理量と

  星の性質について再推定
- L=5,800 $L_\odot$ ⇨ RV Tau型変光星と似ている
- 水メーザー源の広がりは25 AU程度

  超巨星よりもミラ型変光星に付随するものとほぼ等しい
- 視線速度が大きく異なるB型星と連星系を成していない
- 過去の文献による位置比較: (U_0, V_0)=(-71,-29)[km/s]

  ⇨ 種族IIの天体に似ている
- 比較的高温の RV Tau型変光星にメーザーは存在し得る？

  同種の R Sct にも存在する、

  CO輝線もあるから条件は揃っている

  低金属量天体の星周ガス縁構造の把握にとって重要天体