

VERAユーザーズミーティング2008

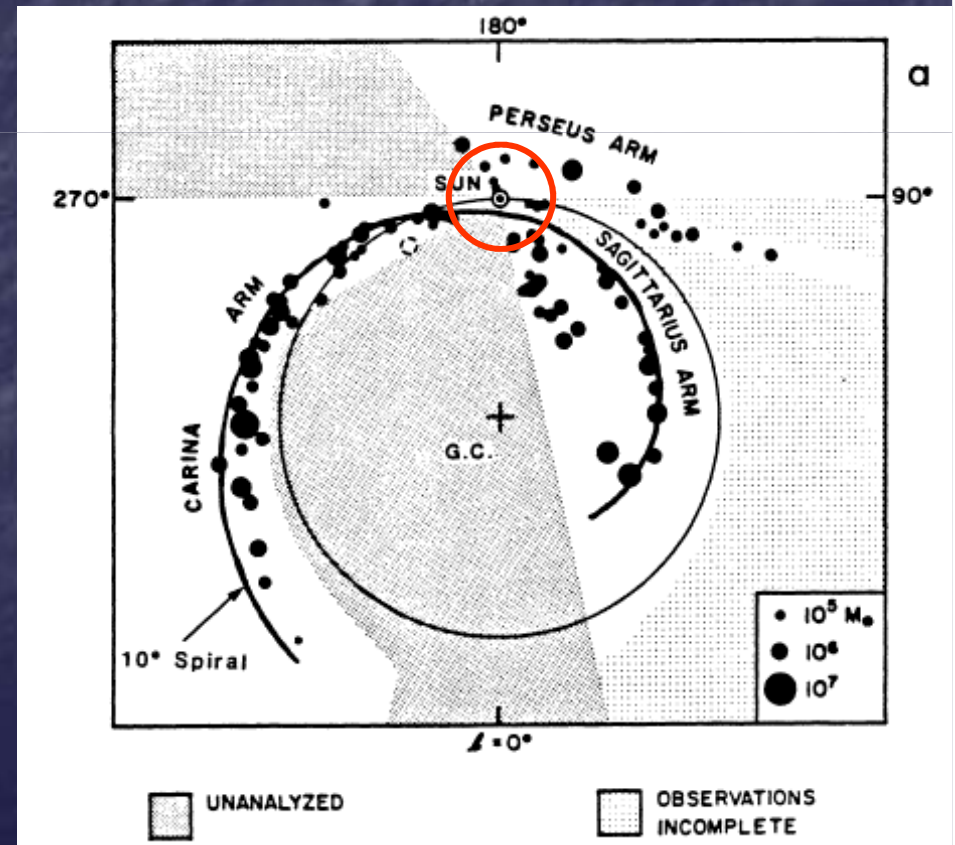
プロジェクト観測結果報告
近距離分子雲立体構造

Tomoya HIROTA (VERA, NAOJ)

Nearby SFRs project

- Distance to SFRs within 1 kpc from the Sun
- One of the initial projects (since 2004 January)
- Aim of this project
 - Distance measurements
 - 3-D structure of molecular clouds
 - Refine the physics of star-formation

Distribution of molecular clouds
(Grabelsky et al. 1988)



After the UM2006

■ Publications

- Orion KL (H₂O maser; Hirota et al. 2007, PASJ, 59, 897)
- IRAS 16293-2422 (Imai et al. 2007, PASJ, 59, in press)
- NGC1333 (Hirota et al. 2008, PASJ, 60, in press)

- Orion KL (SiO maser; Kim et al. 2008, in preparation)

After the UM2007

■ Publications

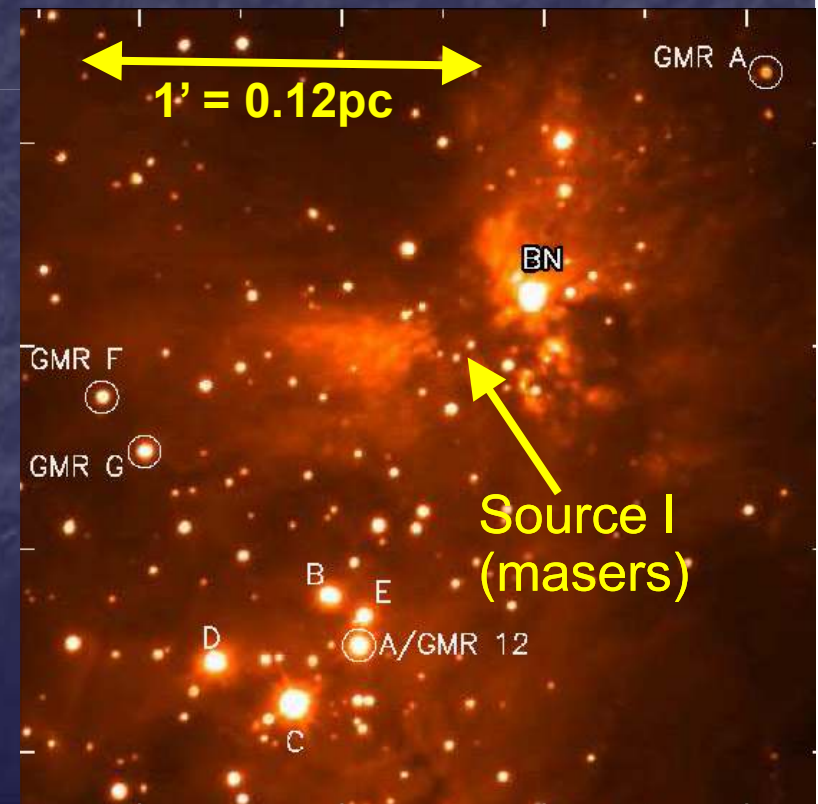
- Orion KL (H₂O maser; Hirota et al. 2007, PASJ, 59, 897)
- IRAS 16293-2422 (Imai et al. 2007, PASJ, 59, 1107)
- NGC1333 (Hirota et al. 2008, PASJ, 60, 37)

- Orion KL (SiO maser; Kim et al. 2008, PASJ, 60, in press)
- L1204G (Hirota et al. 2008, PASJ, 60, in press)

Distance to Orion Nebula

- H₂O maser in Orion KL (Hirota et al. 2007)
 - 2.29 ± 0.10 mas = 437 ± 19 pc
- SiO maser in Orion KL (Kim et al. 2008)
 - 2.39 ± 0.06 mas = 419 ± 6 pc
- Radio cont. from WTTSSs
 - $389 \pm 24 / -21$ pc
(GMR-A: Sandstrom et al. 2007)
 - 414 ± 7 pc
(4 WTTSSs: Menten et al. 2007)

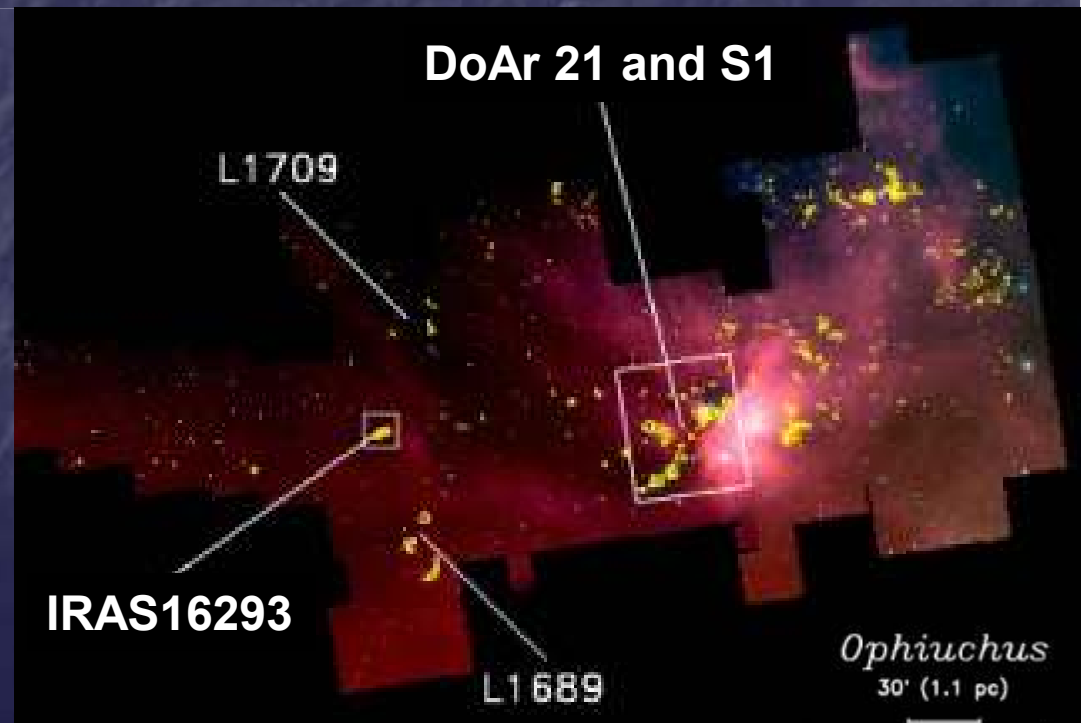
(NIR image of ONC; Menten et al. 2007)



Distance to ρ -Oph

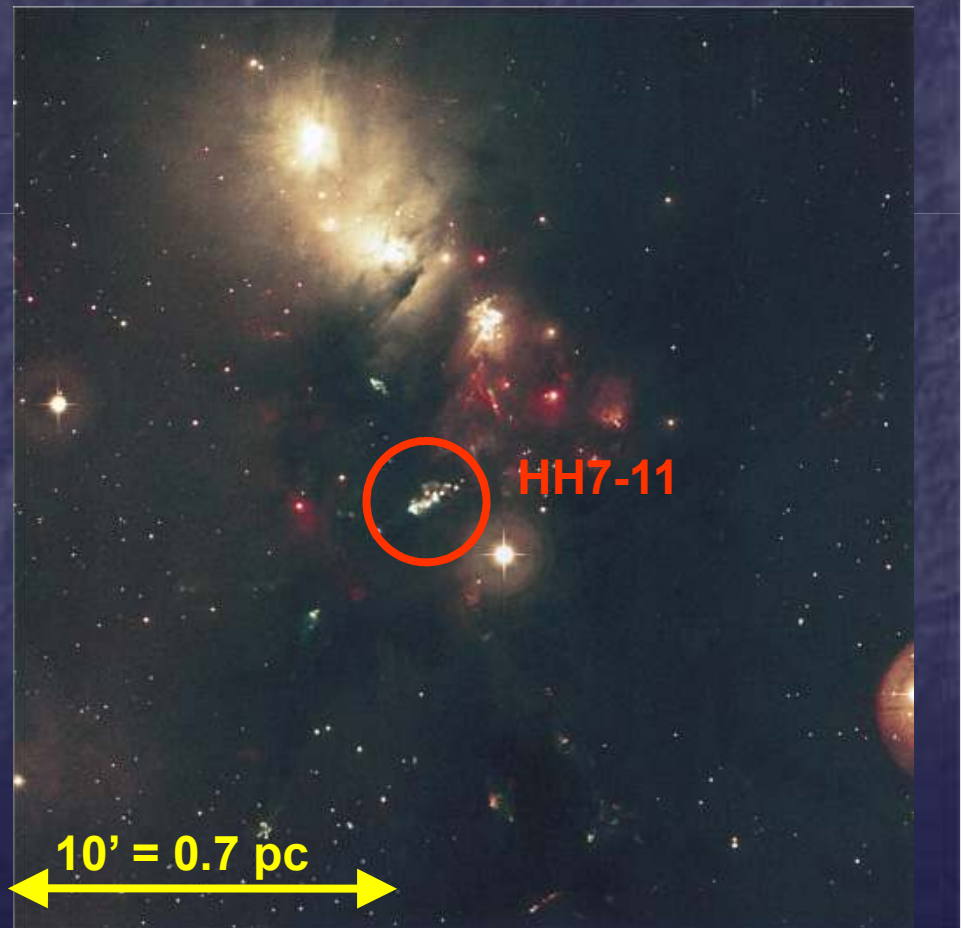
- H₂O maser in IRAS16293-2422 (Imai et al. 2007)
 - $5.6 +1.5/-0.5$ mas = $178 +18/-37$ pc
 - Maser spots > beam size; common for nearby YSOs
- Radio cont. from WTTs (Loinard et al. 2008)
 - DoAr 21:
 $121.9 +5.8/-5.3$ pc
 - S1:
 $116.9 +7.2/-6.4$ pc

(Spitzer image of ρ -oph cloud;
Jorgensen et al. 2008)



Distance to NGC1333

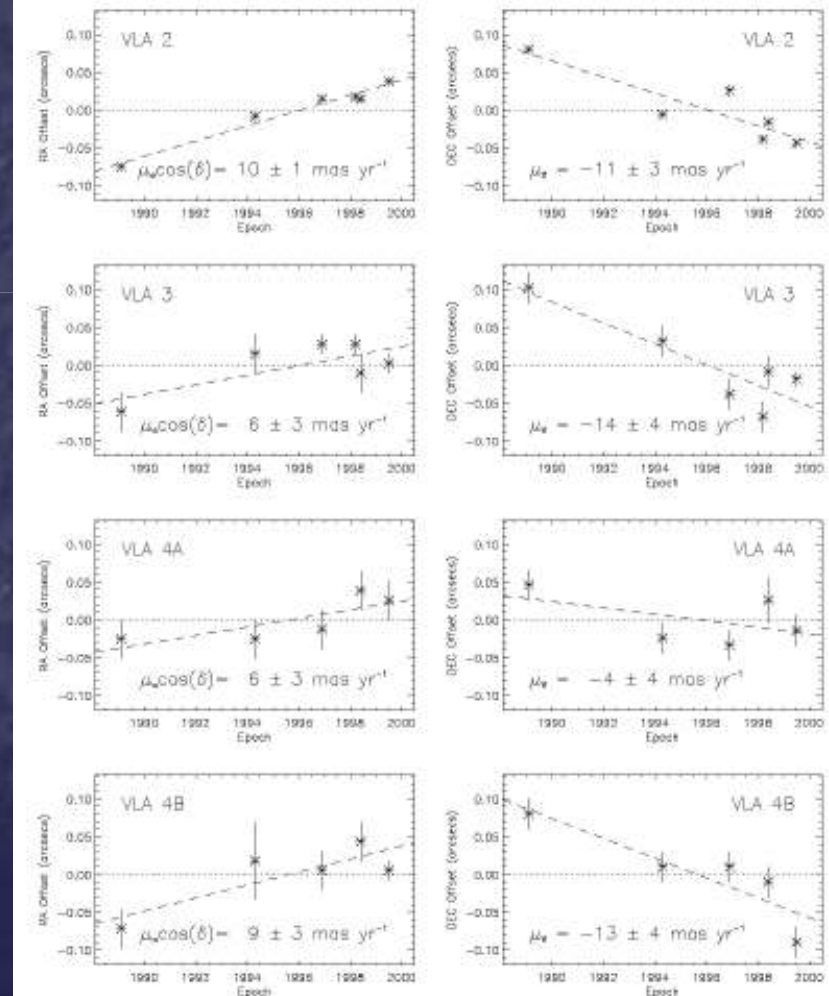
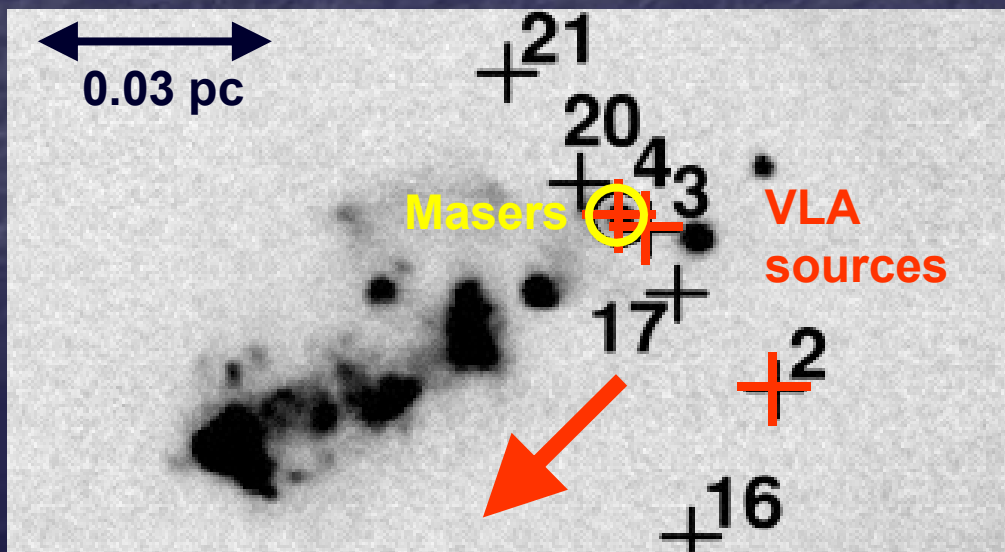
- H₂O masers (Hirota et al. 2008)
 - 4.25 ± 0.32 mas = 235 ± 18 pc
- Photometric method:
220 pc (Cernis 1989)
- HIPPRACOS:
318 \pm 27 pc for Per OB2
(de Zeeuw et al. 1999)



(SII and Ha image; Bally et al. 1996)

Proper motion of NGC1333

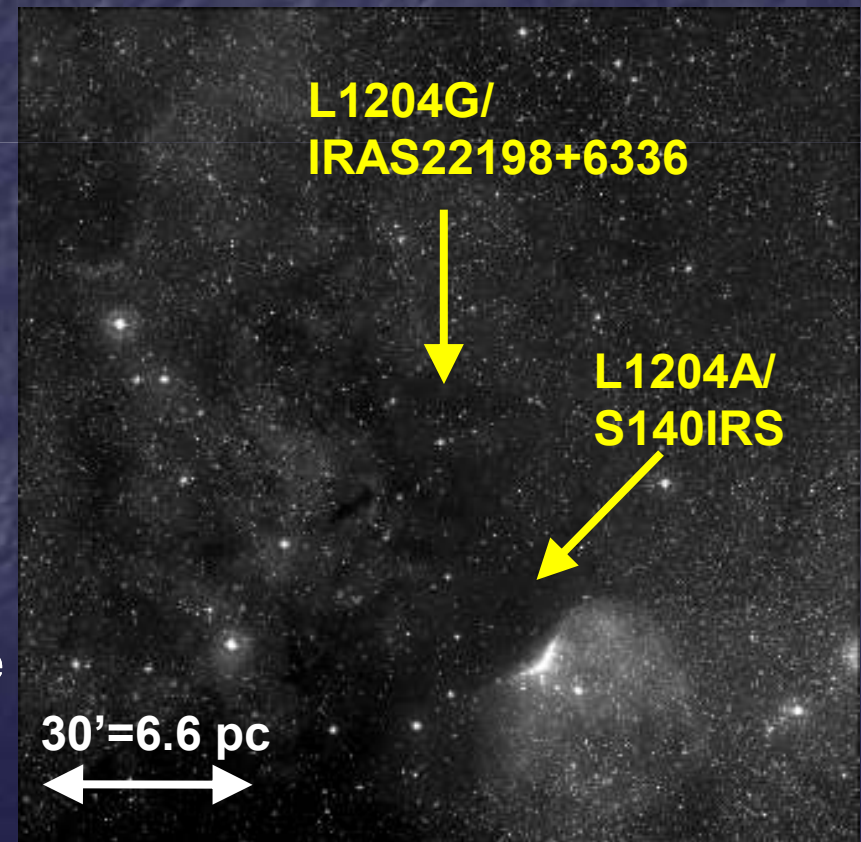
- VLA observations by Carrasco-Gonzalez et al. (2008)
 - Systematic proper motion
 $\sim(9.3+/-0.9, -10.6+/-1.8)$ mas yr⁻¹
 - Consistent with the masers
 $\sim(17.9, -7.9)$ mas yr⁻¹
 $(10.6, -10.0)$ mas yr⁻¹



Distance to L1204G

- Star-forming region in the Cepheus-Cassiopeia region
- H₂O masers in IRAS22198+6336 (Hirota et al. 2008)
 - Highly variable (<1yr)
 - Measured by using 26 spots
 - 1.309±0.047 mas =
764±27 pc

(DSS 2nd R-band image
of L1204/S140 region,
fov of 2deg. X 2deg.)



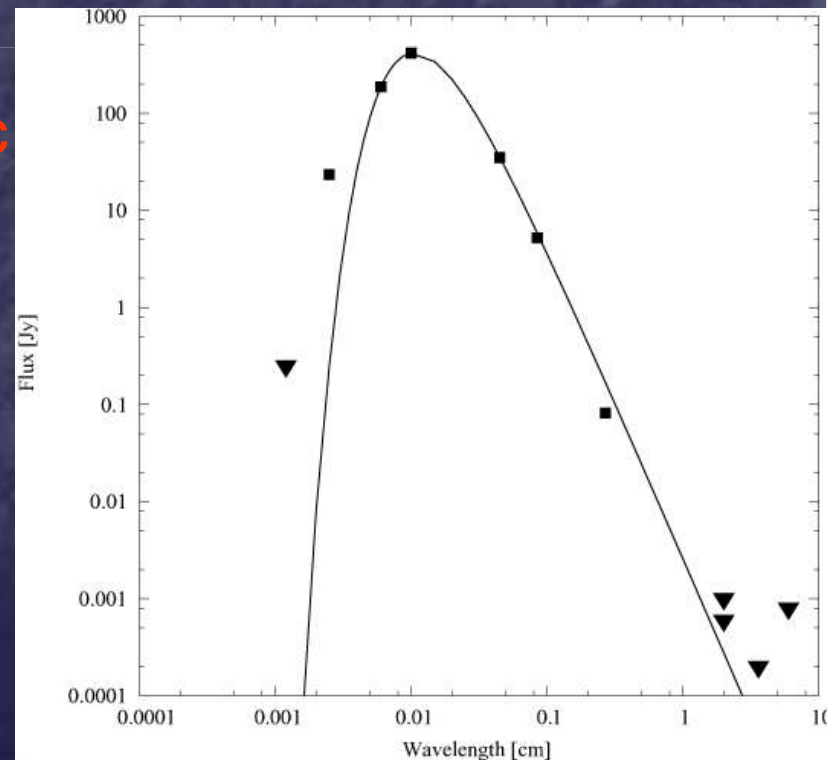
IRAS22198+6336 in L1204G

■ Previous studies

- Kinematic distance : 1.3 kpc
- 1300 L_{solar} : Massive YSO (e.g. Sanchez-Monge et al. 2008)

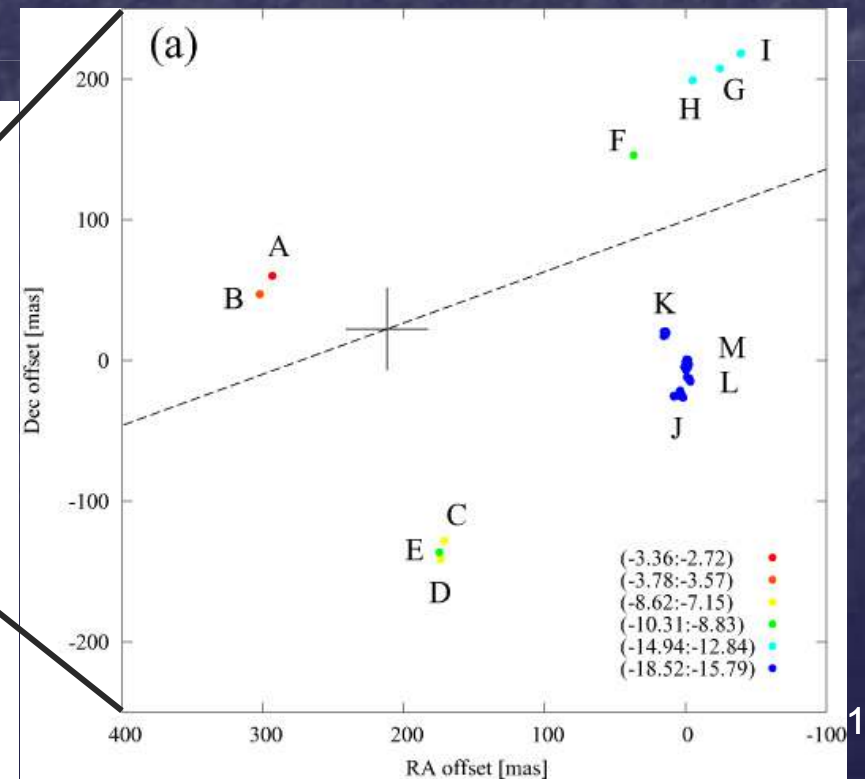
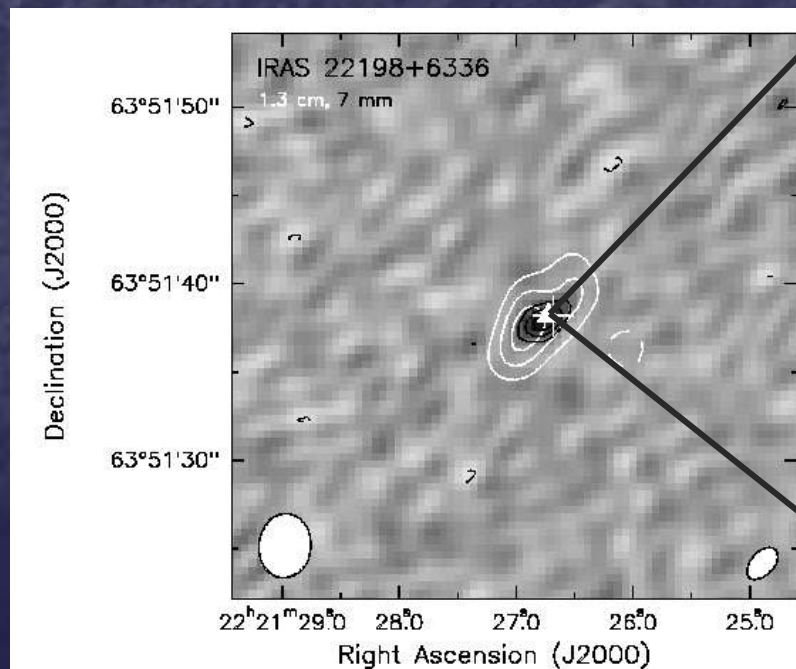
■ Present results

- Pallaractic distance: 764 ± 27 pc
- 450 L_{solar} : Consistent with intermediate-mass YSO ($< 7 M_{\text{solar}}$)
- No NIR counterpart --- Class 0/I



IRAS22198+6336 in L1204G

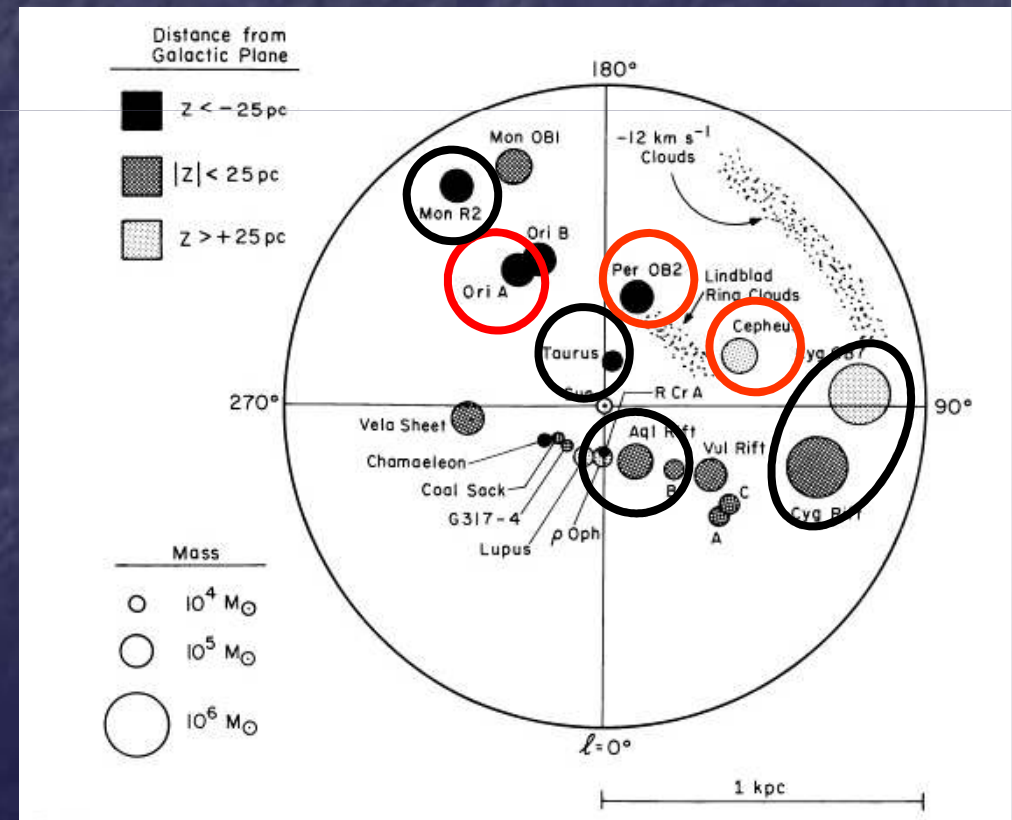
- VLA (Sanchez-Monge et al. 2008) and VERA results
 - Intermediate-mass Class 0 source, with jets/disk system?
 - To be confirmed by the VLA-A config. observations (Hirota, in prep.)



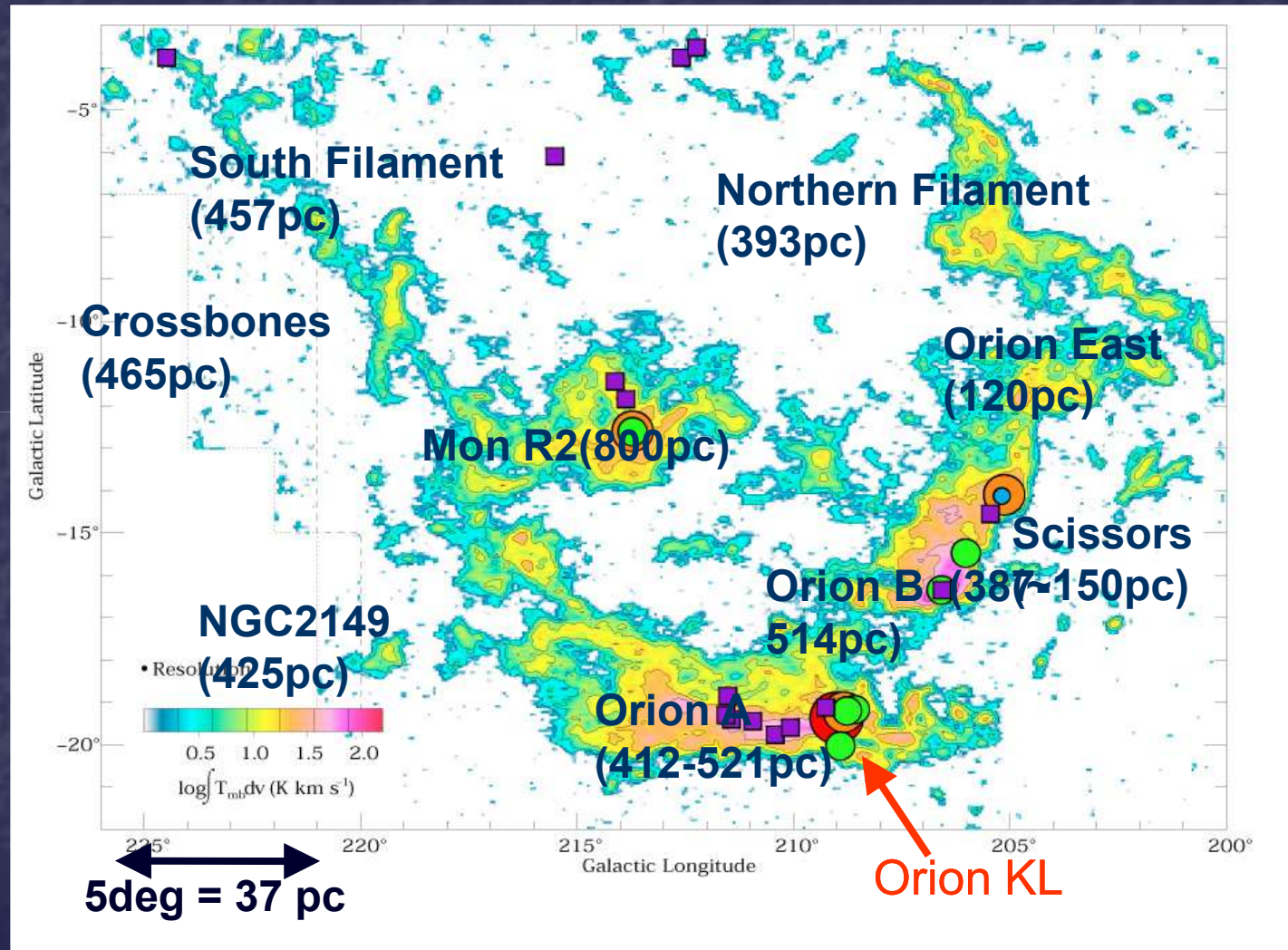
Next season

- H₂O masers in SFRs within 1 kpc from the Sun
 - Orion (Orion A)
 - Cepheus
 - Perseus
 - Taurus, Ophiuchus, Serpens, Monoceros, Cygnus ...

Distribution of molecular clouds (Dame et al. 1987)

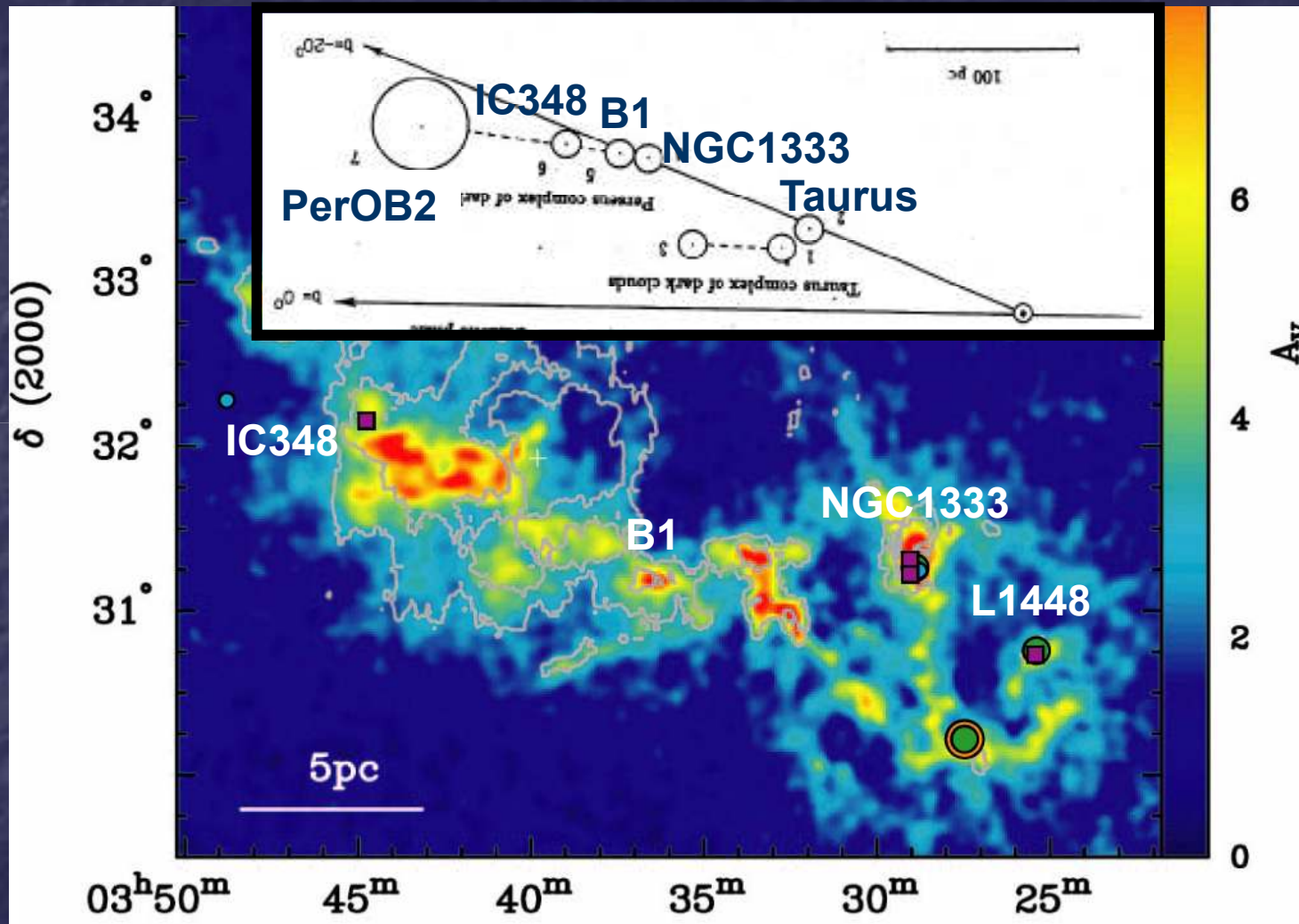


Orion-Monoceros complex



Distribution of molecular clouds (Wilson et al. 2005)

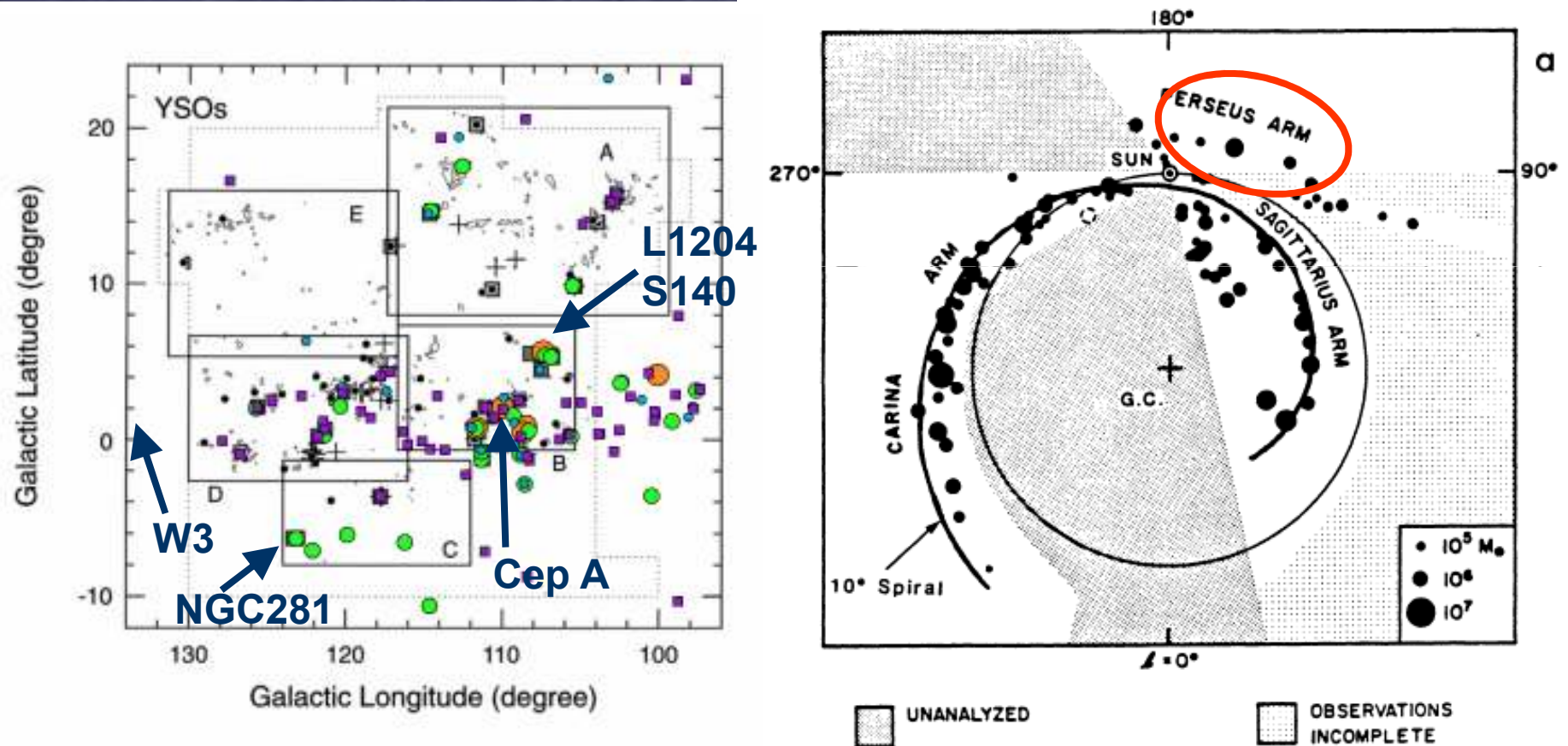
Perseus complex



Distribution of molecular clouds (Ridge et al. 2006)
and their distances (Cernis 1993)

Cepheus-Cassiopeia region

- Distance ranging from 0.1-3 kpc



Distribution of molecular clouds and YSOs
(Yonekura et al. 1997, Grabelsky et al. 1988)

Summary

- Distances to Orion KL, NGC1333, IRAS 16293-2422, and L1204G were reported
- Annual parallax of Orion KL has been refined based on the observations of the SiO masers
- VERA data have come into use with VLA/VLBA
 - to reveal 3-D structure of molecular clouds
 - to reveal dynamical properties of YSOs