VSOP AO2 PROPOSAL COVER SHEETS

DEADLINE : 8 May, 1998
SEND TO : VSOG, ISAS, 3-1-1 Yoshinodai, Sagamihara, Kanagawa 229-8510, JAPAN

(1) Date prepared : 6 May, 1998

(2) Proposal title : Non-Scattered OH Masers

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(5) Proposal Abstract :

The proposed observations consist of 2 experiments: NGC7538 and NGC6334N. These sources are caracterized by not only OH maser emission but also H2O and Methanol lines. The sizes of OH maser spots on this sources have not been measured previously with VLBI techniques but both sources have been found to be unresolved on baselines of over 7000 kms. Of the few OH maser candidates for VSOP's ultra-high spatial resolution these sources can reveal intrinsic size and structure of OH maser spots, not broadened by interstellar scattering. The size and brightness temperatures of the spots measured with no scattering effects would be greatly useful for the study of the inter- stellar medium and the masing process itself.

(6) Proposal Category (indicate all that apply):
Object type:
☐ AGN, ☑ Maser, ☐ Stellar, ☐ Pulsar, ☐ Other :
Observation type:
☐ Continuum, ☑ Spectral Line, ☐ Polarization, ☐ Time-critical, ☐ Other :

(7) Number of proposed experiments

An 'experiment' is one or more observations of one source at a fixed HALCA set-up. A request to observe the same source at 1.6 GHz and separately at 5 GHz requires two columns to be filled in in item (8) below. A request to observe the same source with HALCA simultaneously observing at 1.6 GHz and 5 GHz requires one column to be filled in. Multi-epoch observations of the same source at the same frequency – a 'monitoring experiment' – requires only one column to be filled in. Suggested observing dates, especially for for time-critical and monitoring experiments, should be specified in item (10).

The number of experiments in this proposal is: 2

(8) Details of proposed experiments

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Source name (J*hhmm*±*ddmm*)	J2311+6111	J1717-3544		
Alternative name	NGC7538	NGC6334N		
RA(B1950) (hh mm ss.ssss)	23 11 36.7	17 17 32.1		
Dec(B1950) (dd mm ss.ssss)	61 11 49	-35 44 22		
Observing frequency band (GHz)	1.6	1.6		
Continuum observations:				
Standard VSOP freq. channels?	☐	☐	☐	☐
Channel A range (MHz)				
Channel B range (MHz)				
Spectral line observations:				
Ch.A spectral line rest freq. (MHz)	1665.4018	1665.4018		
Ch.A LSR velocity (km/s)	-60.0	-10.0		
Ch.B spectral line rest freq. (MHz)				
Ch.B LSR velocity (km/s)				
FWHM of field of view required (mas)	1000	1000		
Min. spectral channels per IF channel	1024	1024		
Correlator averaging time (sec)	0.5	0.5		
No. of correlating passes (if >1)	2	2		
Total flux density (Jy)	50	100		
Correlated flux (mJy)	34000	50000		
Ground Radio Telescopes:				
Suggested array given at Item (10)?	☐	☐	☐	☐
GRT observing mode:				
128Mbps LCP (standard)	☑	☑	☐	☐
128Mbps LCP/RCP	☐	☐	☐	☐
256Mbps LCP/RCP	☐	☐	☐	☐
Preferred correlator:				
No preference	☐	☐	☐	☐
Mitaka	☐	☐	☐	☐
Penticton	☑	☑	☐	☐
Socorro	☐	☐	☐	☐
Monitoring programs:				
Number of observations	1	1		
Mean interval (days)				
Related AO1 proposal code(s)		v103		

(9) VSOP spacecraft observing mode (see Section 3 and Table 5 of the VSOP Proposer's Guide):

- [x] 2 channel x 16 MHz, 2-bit (Standard mode),
- [ ] Other:

Phase calibration tones:

- [ ] On (Standard continuum mode),
- [x] Off (Standard spectral line mode)

(Include justification of any non-standard choice at (10) below)

(10) Additional notes to the scheduler :

(11) Attach a scientific and technical justification, not in excess of 2 pages of text and 2 pages of figures. Up to one page of (u,v) plots per source may optionally be included.
(Refer to the VSOP Announcement of Opportunity for detailed instructions.)
Preprints and reprints will not be forwarded to the Scientific Review Committee.

Send two paper copies of the complete proposal to:
VSOP Observing Proposals
VSOP Science Operations Group
Institute of Space and Astronautical Science
3-1-1 Yoshinodai, Sagamihara
Kanagawa 229-8510 JAPAN
In addition, e-mail the completed LaTeX file to submit@vsop.isas.ac.jp

Information from the Cover Sheets of scheduled proposals will be made available from the VSOP WWW site.

Proposals must be received at ISAS by 8 May 1998

Scientific and Technical Justification

The sources NGC7538 (or S158) and NGC6334N appeared unresolved on baselines of over 7000 kms (Medicina, Noto, Madrid and Goldstone) during our observations on May 1996. The two sources have correlated flux densities greater than 30Jy and their likely distances do not exceed 4 kpc. This makes them very good candidates for HALCA so that the maser spot structure can be mapped and the size and brightness temperature be accurately determined.

The expected scattering angle of a plane wave source in a uniform Kolmogorov medium given by Cordes, Ananthakrishnan and Dennison (1984) for these sources at an observing frequecy of 1.6 GHz is about 20 milliarcseconds, as shown in Kemball et al. As in the case for G34.26+0.15 and G35.20-1.73 (Slysh et al. 1996), where the measured diameters were about 10 times smaller, it is highly probable that the measured diameters for the maser spots in these sources will be much smaller as well. But this would be consistent with a highly clumped small-scale distribution of free electron density turbulence at low galactic latitudes (Cordes et al. 1985). So one can suppose that these sources are observed through a hole in the free electron plasma distribution along the lines of sight with low turbulence in the Galaxy. In the case of NGC6334N the size of the maser spots was estimated to be about 12 mas (Kent and Mutel) but with much lower spatial resolution observations. The source is scattered but there is evidence for finer and smaller structure. Therefore high angular resolution observations of these sources may give the intrinsic sizes of maser spots not broadened by interstellar scattering.

The interferometer fringe separation in the Kemball et al. (1988) experiment was $\sim$5mas. An apparent angular size of a maser spot was then estimated assuming a circularly symmetric Gaussian brihgtness distribution model. The estimates may be in error due to the poor uv-coverage; also the sources may have a more complicated structure, and maser spots may be unresolved. Though the size estimates from Slysh et al. (1996) arise from slightly larger baselines our uv coverage was also poor. Thus observations with higher angular resolution may give important knowledge of internal structure of masers. The possible results will be interesting for the physics of maser emission, and for the investigation of star formation processes and interstellar scattering distribution. The prototypical OH maser W3(OH) well studied with VLBI has OH and H_20 masers distribution of about 1 arcsecond in diameter, see for example Reid and Moran (1988). So we propose to cover a field of view of 1 arcsecond. To resolve different maser spots in radial velocity it is important to have maximum number of spectral channels per IF channel. A typical image of OH maser consists of many maser spots with diameters of about 1 mas or less distributed in a region of about 1 arcsecond in diameter. So (u,v) coverage must be chosen to provide maximum angular resolution, but one needs not to fill all holes in the (u,v) plane.

References:
-Kemball, A.J., Diamond, P.J., Mantovani, F., 1988, MNRAS, 234, 713
-Slysh, V.I., Migenes, V., Kanevsky, B.Z., Molotov, I.E., Samodurov, V.A., Reynolds, J.E., Wilson, W.E., Jauncey, D.L., McCulloch, P.M., Feil, G., and Cannon, W., 1996, MNRAS, 283, L9
-Cordes, J.M., Ananthakrishnan, S., Dennison, B., 1984, Nature, 309, 689
-Cordes, J.M., Weisberg, J.M., Boriakoff, V., 1985, ApJ, 288, 221
-Kent, S.R., and Mutel, R.L., 1982, ApJ, 263, 145
-Reid, J.M., and Moran, J.M., 1988, Astronomical Masers