

# Absolute proper motion measurement of water maser source toward Sgr D HII region with VERA

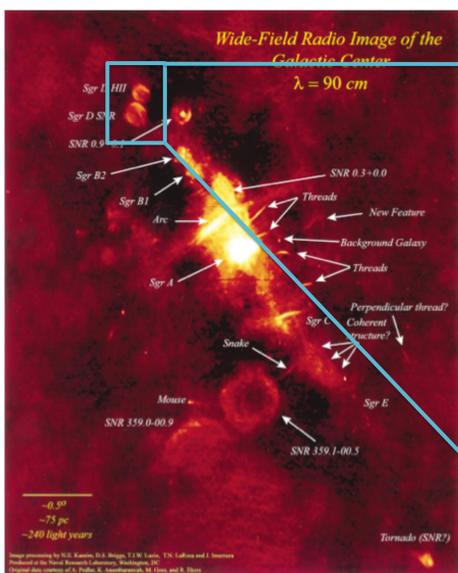
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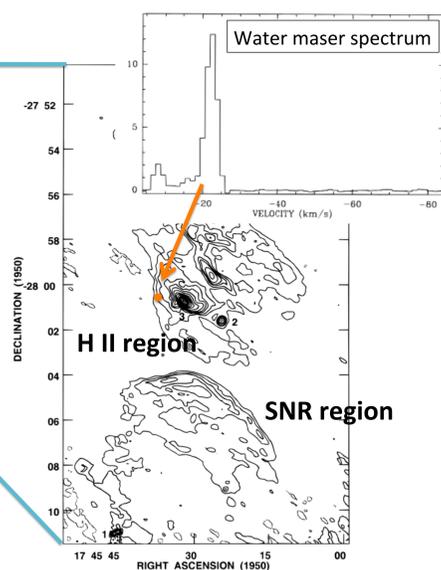
Sgr D HII region is one of the radio sources toward the Galactic Center region. Galactic longitude of this source is  $l=1.14$ deg. Line-of-sight velocity of thermal molecular line associated with this source is  $-16$  km/s, which is prohibited in flat rotation at positive galactic longitude. Narrowness of the molecular line width ( $\sim 4$ -5 km/s) seems to avoid this source locating in Galactic Center, because typical line width in Galactic Center region is 20-30 km/s. These facts make determination of distance for this source difficult.

We have conducted astrometric observations for 22 GHz water maser source associated with Sgr D H<sub>II</sub> region with VERA. We obtained absolute proper motion for this source, and the measured motion implies this source locating in near side relative to the Galactic Center. By considering the measured absolute proper motion, we constrained the location of this source on near 3 kpc arm or near central molecular zone(CMZ).

## Introduction



90 cm Radio continuum image of the Galactic Center region taken with VLA



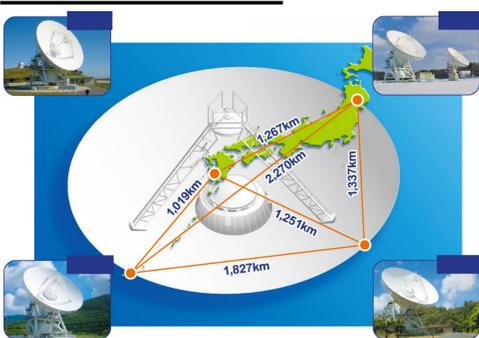
Radio continuum image of Sgr D region from Mahringer et al. (1999)

Measuring parallax and absolute proper motion with VLBI observation can constrain the location of Sgr D HII region.

Distance to Sgr D HII region has not been determined yet.

Galactic Center? or Disk?

## Observations

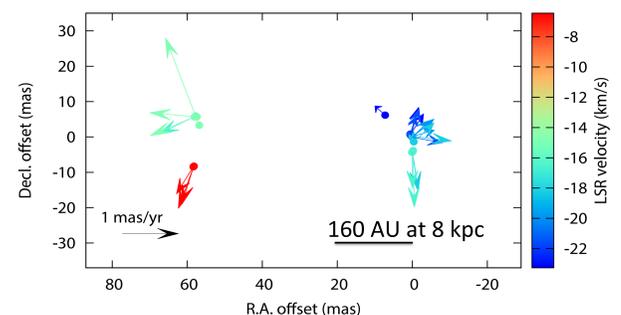


VERA array(Mizusawa, Iriki, Ogasawara, and Ishigakijima)

Array : VERA  
Target line : 22 GHz water maser  
Velocity resolution : 0.42 km/s  
Epochs : 13 epochs(2008-2011)  
Mode : 2-beam  
- A-beam Sgr D  
- B-beam J1745-2820  
position reference source

## Results

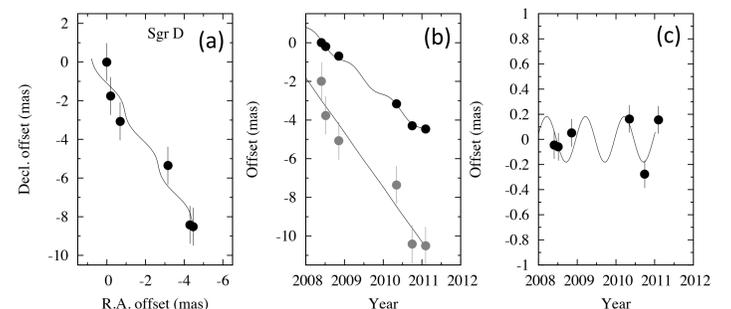
### One-beam mapping



Internal proper motion of Sgr D maser spots. Spots detected for 3 epochs are selected.

- Red shift component on east side
- Blue shift component on west side
- Projected scale is about 160 AU assuming 8 kpc
- Typical internal motion is 1 mas/yr  
- This corresponds to 38 km/s at 8 kpc.

### Absolute proper motion



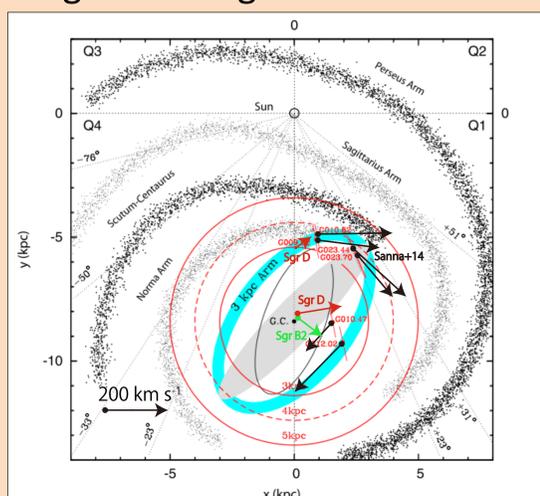
(a) Projected absolute motion (b) Time versus R.A. and Dec. offset (c) R.A. motion subtracted with the absolute proper motion

### Parallax Fitting results

	Fitted value	Error
Parallax	0.181 mas	0.076 mas
Distance	5.525 kpc	-1.634/+3.999 kpc
RA motion	-1.739 mas/yr	0.045 mas/yr
Dec motion	-2.832 mas/yr	0.395 mas/yr

## Discussion

Is Sgr D H II region in GC or Disk?



Measured motions for several maser sources in inner-Galaxy are superposed on the schematic view of the Galaxy.

Sanna et al. 2014

Reid et al. 2009

Our result

Tabular 2. UVW values for sources within 4 kpc radius

Disk case	R (kpc)	$U_{GC}$ (km s <sup>-1</sup> )	$V_{GC}$ (km s <sup>-1</sup> )	$W_{GC}$ (km s <sup>-1</sup> )
<b>Sgr D</b>	3.0(assumed)	-49±2.0	<b>75±8.3</b>	7.3±6.4
G0.09.62+00.19	3.4	-36±17	190±15	-10±4.1
G010.47+00.02	1.6	30±22	120±16	18±1.8
G10.62-00.38	3.6	-60±14	230±6.7	8.1±1.8
G012.02-00.03	2.1	26±33	220±27	1.5±5.8
G023.44-00.18	3.8	4.7±43	230±18	2.0±3.1
G023.70-00.19	3.7	51±16	170±12	4.6±2.6
GC case				
<b>Sgr D</b>	0.3(assumed)	-24±2.0	<b>140±13</b>	12±10
Sgr B2	0.1	-18±1.7	110±5.0	-38±5.6

Disk case (R=3 kpc) :  $V_{GC}$  for Sgr D is less than a half those of other sources.  
GC case (R=0.3 kpc):  $V_{GC}$  is similar to that for Sgr B2.

This result seems to indicate that **Sgr D is located in GC rather than Disk.**  
→ We have to increase the number of sources for GC region to confirm it.