

## R12a Astrometry of Sagittarius A\* using ALMA

Masato Tsuboi (ISAS/JAXA), Takahiro Tsutsumi (NRAO), Atsushi Miyazaki (JSF), Makoto Miyoshi (NAOJ), and Ryosuke Miyawaki (J. F. Oberlin Univ.)

Sagittarius A\*(Sgr A\*) is the nucleus of Milky Way or the nearest (barred) spiral galaxy. It harbors a supermassive black hole with  $4 \times 10^6 M_{\odot}$ , which is called the Galactic Center Black Hole (GCBH). We derived the proper motion of Sgr A\* relative to a phase calibrator, J1744-3116 based on the ALMA observations (2015.1.01080.S, 2017.1.00503.S and 2018.1.001124.S). The Galactic longitude component of the proper motion is mainly caused by the Galactic rotation of Sun. On the other hand, the Galactic latitude component is caused by the mass distribution in the vicinity of the GCBH. Therefore, it is important for the study around Sgr A\* to derive the proper motion. The proper motion is derived to be  $\frac{dl}{dt} = -6.08 \pm 0.01 \text{ mas year}^{-1}$   $\frac{db}{dt} = 0.53 \pm 0.02 \text{ mas year}^{-1}$ . The annual parallax of Sgr A\* is expected to be up to  $\pm 0.125 \text{ mas}$ . Because our observations are sparse, the annual parallax cannot be evaluated by them. Nevertheless the proper motion is consistent with those by previous long-term VLBI observations of VLBA and VERA, which are  $\frac{dl}{dt} = -6.379 \pm 0.026 \text{ mas year}^{-1}$ ,  $\frac{db}{dt} = -0.202 \pm 0.019 \text{ mas year}^{-1}$  (VLBA, Reid&Brunthaler 2004) and  $\frac{dl}{dt} = -6.307 \pm 0.025 \text{ mas year}^{-1}$ ,  $\frac{db}{dt} = -0.214 \pm 0.017 \text{ mas year}^{-1}$  (VERA, Oyama et al. 2021), respectively, although the interval of our observation epochs is as short as 2.8 years. The small Galactic latitude component strictly limits the mass of the second massive object around the GCBH. If the positions will be observed frequently by ALMA in a longer interval, it is promising that the estimation accuracy of the proper motion is improved significantly.