Preliminary results from the VERA monitoring of the water fountain source IRAS 18113–2503

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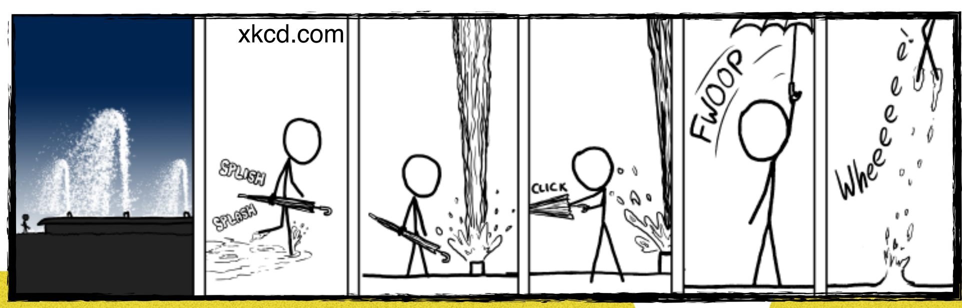
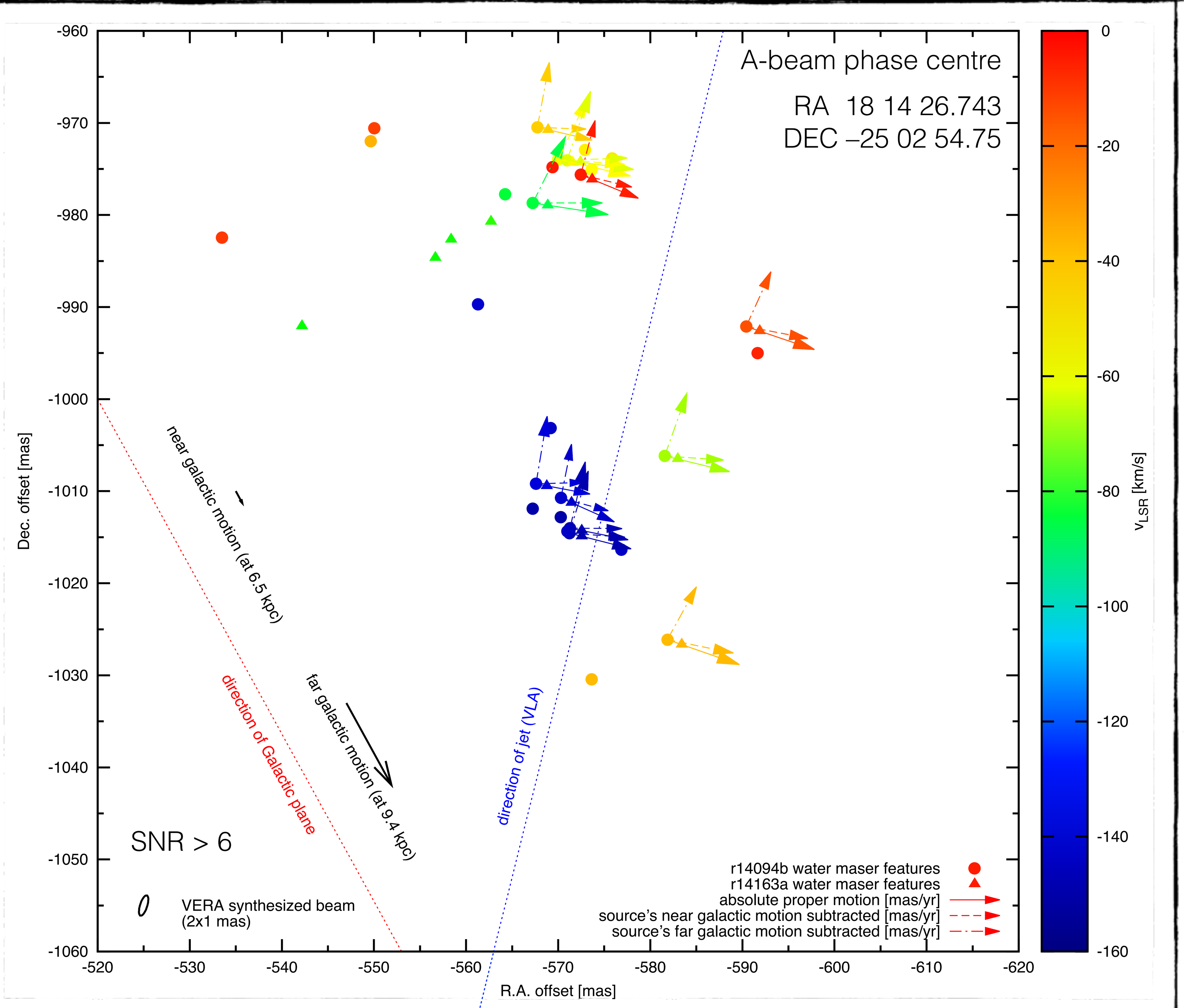
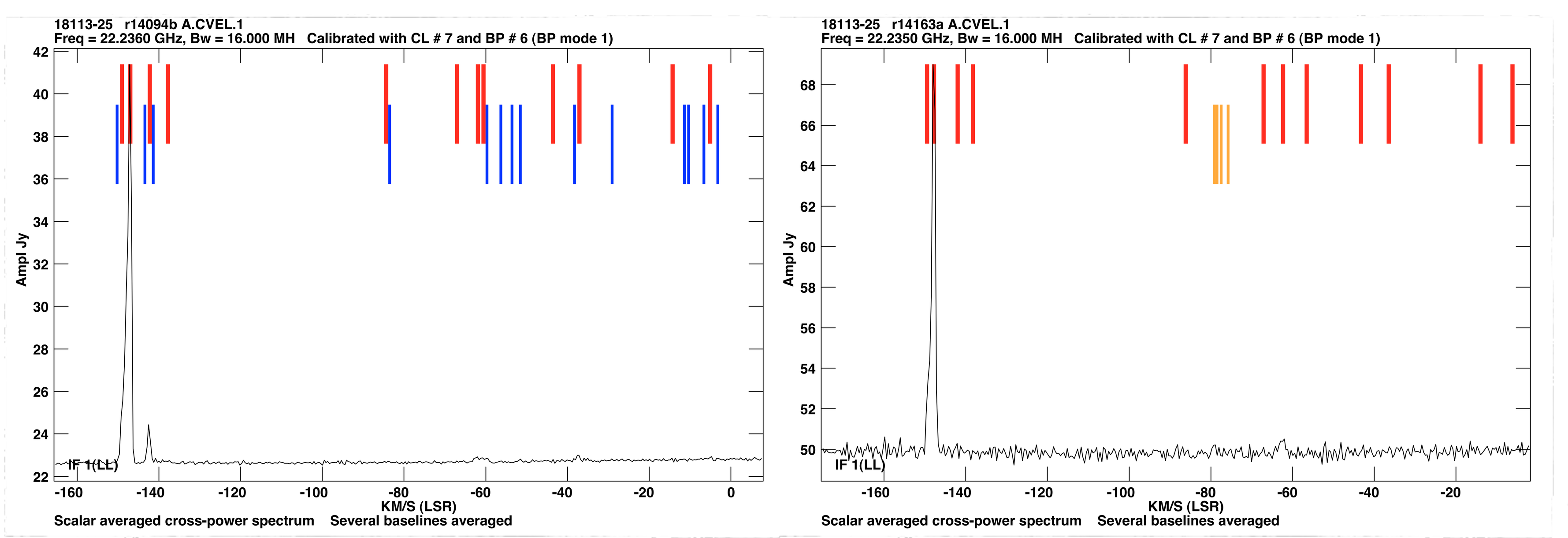


Water fountains

Water fountain sources are evolved stars with morphologically and kinematically highly collimated fast jets traced by water maser emission (Imai et al. 2002). Interferometric observations showed that the maser emission is shock-excited in bipolar outflows, which are likely driven by magnetohydrodynamical processes (Vlemmings et al. 2006). Water fountains are believed to be associated with a very short transitory phase in late stellar evolution (~1000 years) after the asymptotic giant branch period, which should play an important role in the sculpting of the intricately shaped planetary nebulae (Sahai and Trauger 1998). Due to the short lifespans of water fountains, only about a dozen have been discovered so far, which makes the detailed study of each one important.



The detected and phase-referenced maser features in the first two epochs were used to measure the absolute proper motion (internal + secular) of the masers. Subtracting the independently modeled Galactic rotation from the maser motions, we estimate the internal motions in the outflow. At the far distance, the masers follow the jet axis derived from VLA measurements, with proper motions of ~6.2–8.5 mas/yr. Based on these results, the 3D outflow velocity at 9.4 kpc is ~300–425 km/s, probably making this water fountain host the fastest known jets at the moment.



On the right, we show the previous E-VLA measurements of the water fountain from Gómez et al. 2011. We used these to derive the star's line-of-sight velocity and the direction of the jet. On the left, we see that the spectrum components have faded considerably in the VERA observations. Detected masers are indicated by colored lines (red: both epochs), showing that we could identify features even where there were no peaks present in the spectrum. Due to the weakening of the masers, we will start a single dish monitoring campaign using the Robledo 70m antenna. Axes on all maps represent spatial offsets relative to the phase center of the observing beam.

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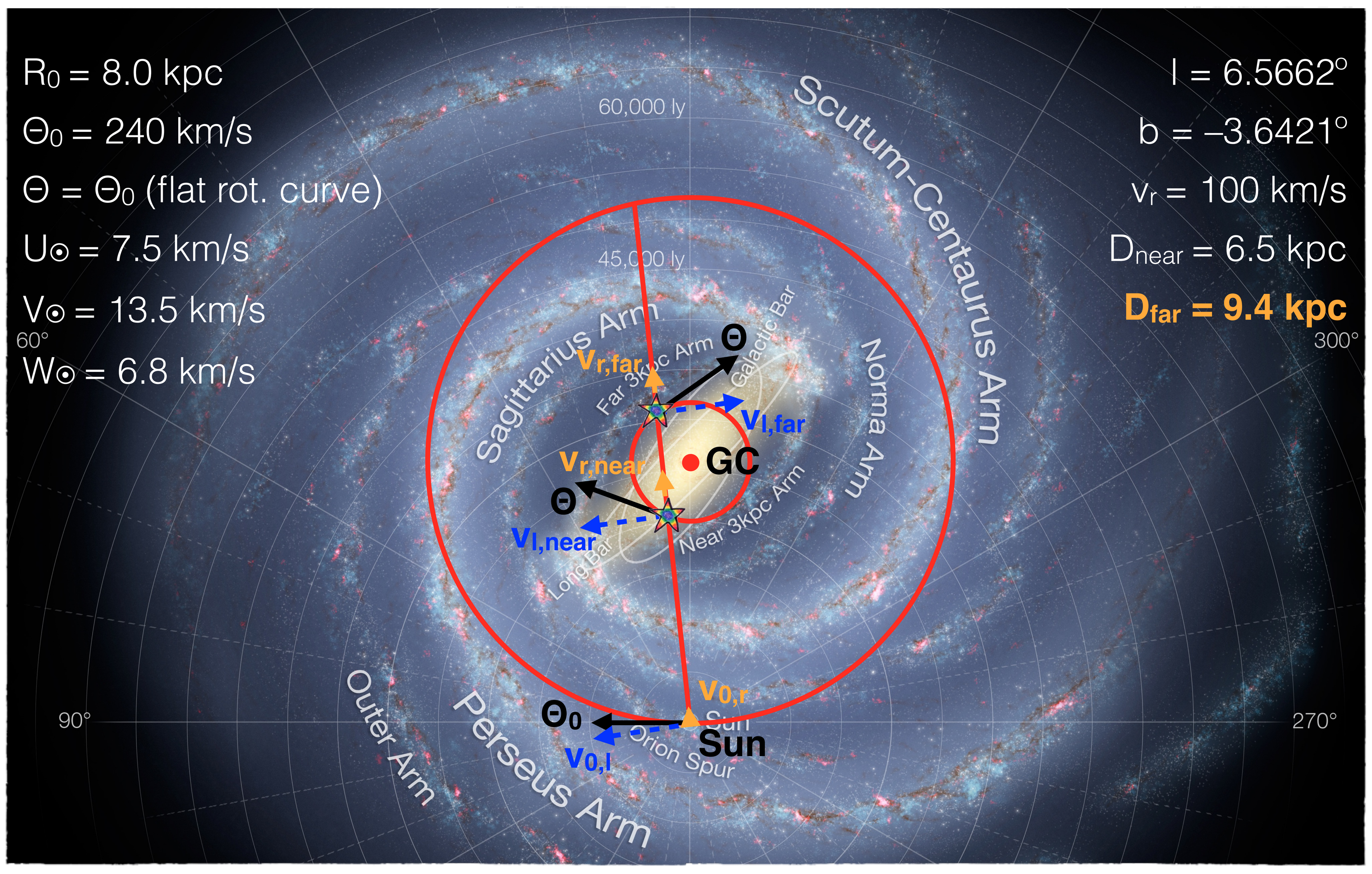
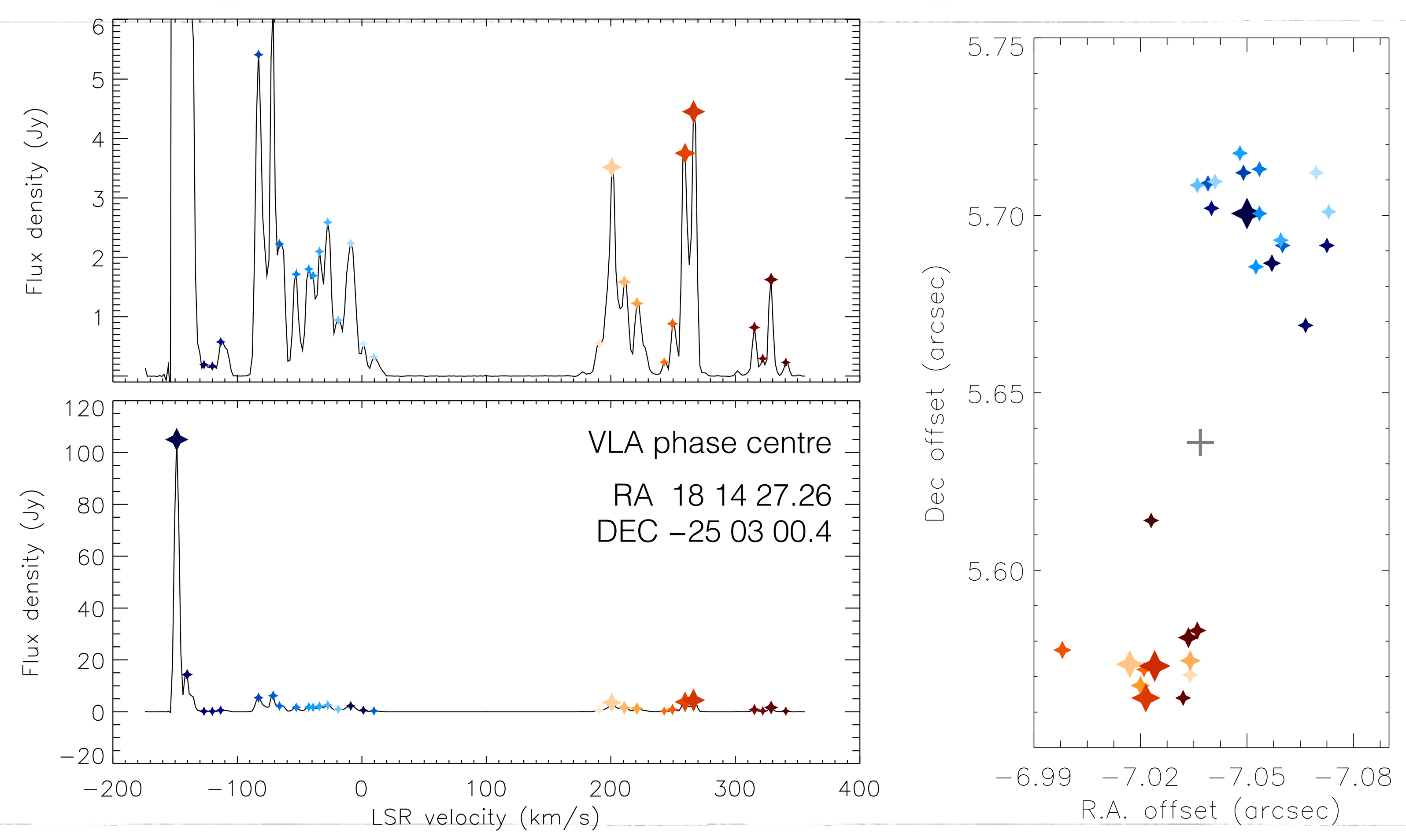
This water fountain is located towards the Galactic Centre in the Galactic thick disk, with jets spanning a very large line-of-sight velocity range of ~500km/s. Both of the lobes show a high velocity dispersion as well, ~170 km/s. The blue- and redshifted water masers are clustered in two distinct 0.″1×0.″1 regions in the sky, separated by 0.″12, with PA = –14° (Gómez et al. 2011). In order to measure the secular motion and parallactic distance to the water fountain, we started monitoring the brighter blueshifted lobe of the source with the Japanese VLBI Exploration of Radio Astrometry (VERA) network. Here we present preliminary results derived from the first two epochs, with a time separation of 69 days.



Based on the direction and line-of-sight velocity of the water fountain star, it has two possible kinematic distances. We can calculate the proper motion caused by the Galactic rotation at the two distances, then subtract it from our observed absolute maser proper motions (we did not model the effect of the parallactic motion). When we subtract the far distance proper motion, the residual motion matches the expected outflow from the VLA measurements of Gómez et al. 2011. However, when we subtract the near distance proper motion, the residual vectors are in complete disagreement with previous results. Thus D_{kin} = 9.4 kpc is more likely.



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