SGR A* IN THE MID-INFRARED REFERENCE FRAME

NO EVIDENCE OF AN INFRARED COUNTERPART, OR INTERACTION WITH NEARBY SOURCES

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We have determined the position of Sgr A* with respect to the mid-infrared (5-25 m) sources in the central parsec by direct correlation of our 12.4 m array image (Gezari et al. 1994) and the new 2-cm continuum VLA map (Yusef-Zadeh 1997; private communication), without a priori knowledge of any other position determinations. Menten et al. (1997) recently succeeded in registering the radio and near-infrared (2.2 m) reference frames with high precision (+0.03 arcsec) using VLA observations of Sgr A*, SiO masers and H2O masers. Unfortunately, registering the mid-infrared and radio reference frames with comparable accuracy cannot be done by applying the 2.2 m calibration. Most near-infrared sources have no detectable mid-infrared counterparts, and it is not obvious which of those that do are coincident (if any), since near-infrared and mid-infrared emission generally does not arise from the same physical source component. Dramatic examples of shifts between the brightest near- and mid-infrared peaks can be seen in Orion BN/KL and the Ney-Allen Nebula (Gezari and Backman 1994; Gezari, Backman and Werner 1997) corresponding to 0.1 - 0.5 arcsec if they were located at 8.5 kpc. Further, several Sgr A West IRS sources are displaced significantly in the infrared and radio, suggesting they may actually be compact clusters of objects.

Our alignment of the mid-infrared and radio source distributions places Sgr A* in our 12.4 m image with an offset of (α, δ) = -0.1, -5.4 arcsec from IRS7(12.4 m), with +0.1 arcsec uncertainty. This differs by 0.3 arcsec (radial distance) from the Menten et al. offset for Sgr A* relative to IRS7 at 2.2 m, a discrepancy which is outside the errors and which may be attributable to real differences in the source positions at 12.4 m and 2.2 m, as discussed above. Since IRS7 shows dramatic structural differences between the radio and infrared, the offset from IRS1 (a potentially simpler source) to Sgr A* of (α, δ) = -5.2, -0.4 arcsec at 12.4 m may be more useful.

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High-resolution (~0.3 arcsec) multi-configuration 2-cm VLA observations of IRS7 (Yusef-Zadeh and Melia 1992) resolved an asymmetrical bow-shock/wake structure streaming northward. When the new VLA image by Yusef-Zadeh (1997; private communication) is aligned with our 12.4 m image (Figure 1) using our mid-infrared astrometric calibration, the apex of the radio bow-shock coincides with the peak of IRS7(12.4 m), illustrating rather dramatically that the radio and infrared emission from IRS7 arise from entirely different source components. The source geometry also constrains the origin of the wind. The symmetry axis of the wake projects directly through the peak of IRS7(12.4 m), onward through a position noticeably east of Sgr A*. In their analysis of the bow-shock, Yusef-Zadeh and Melia (1992) proposed that the IRS7 wake was caused by a wind originating near the IRS16 cluster, rather than at Sgr A*. The present result supports that conclusion.

On close examination, much of the published infrared position data for infrared sources in the central parsec are found to suffer from plate-scale and field rotation errors. Stolovy et al. (1996) reported the detection a counterpart to Sgr A* at 8.7 m. However, their published image is rotated slightly with respect to the radio reference frame and our 12.4 m image. Correcting this rotation error shifts the position of Sgr A* directly on to the weak deconvolved feature they identified, which would seem to strengthen their claim of a detection. However, the recent work of Cortera et al. (1997; elsewhere in these proceedings) places Sgr A* in a "hole" in their deconvolved image, which they present as a non-detection of Sgr A* at 8.7 m. Applying our position for Sgr A* moves it further into the hole, which would seem to strengthen their contention that Sgr A* does not coincide with any mid-infrared source. Our previous upper limits 12.4 and 20.0 m (Gezari et al. 1994) and our present results show no emission structure which could be associated with the presence of Sgr A*.

The Menten et al. (1997) calibration places Sgr A* in a seemingly random position among several weak, non-descript 2.2 m stellar sources, coinciding with none of them. Our position for Sgr A* (0.3 arcsec NW of theirs) puts Sgr A* no closer to a conspicious candidate. Neither the present results nor those of any other group suggest that SgrA* has an unambiguous infrared counterpart. There is also no evidence that Sgr A* interacts with any of the compact sources, or perturbs the extended mid-infrared or radio emission around it (e.g., the east-west bar). Other than the fact that it appears from our viewing direction to be "in the middle of everything", there are presently no observations which tie Sgr A* to the Sgr A West sources. This leads to the logical but rather unappealing conclusion that Sgr A* could be located anywhere along the line-of-sight within several parsecs of the Galactic Center. Yet the chance alignment of such a unique source with

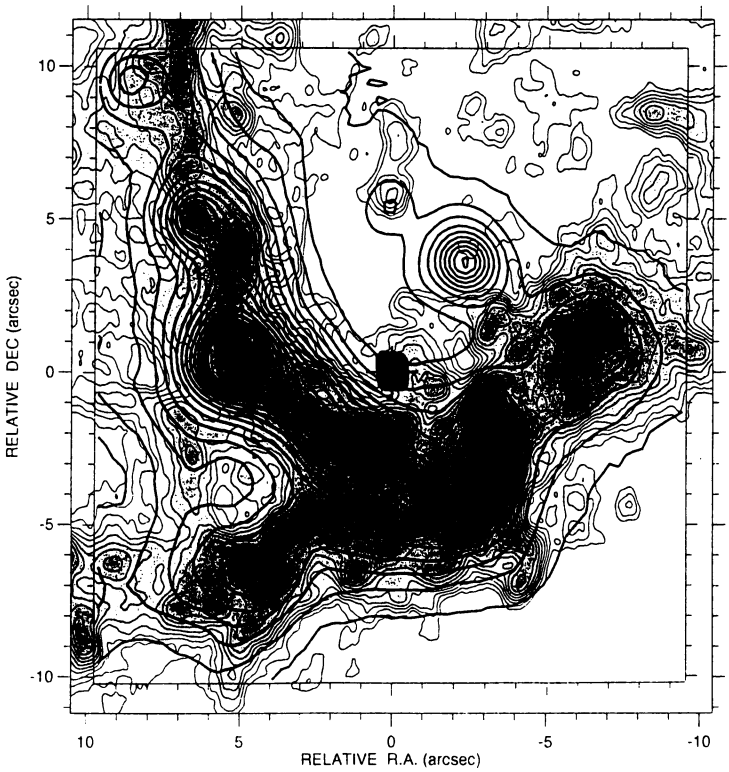

Figure 1. 12.4 m continuum map (thick lines) of Sgr A West by Gezari et al. (1994) overlaid on the core of the new 2-cm continuum 0.3 arcsec resolution VLA map (thin lines) by Yusef-Zadeh (1997, private communication), which has been smoothed for clarity. The positional calibration was based on spatial registration of the two maps without preconceptions about which compact sources must coincide, e. g., IRS 7 (+0.1,+5.4). The infrared and radio peaks are shifted slightly in several cases, suggesting the presence of cluster sources. The bright 2-cm point source Sgr A* (0,0) is saturated and appears as a dark rectangle.

the center of Sgr A West is quite unlikely. Thus it is clear that Sgr A* is either quite benign, having no observable effect on its neighbors, or it is well separated from the extended dust and gas clouds surrounding it in the Sgr A West source complex.

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