HIGH QUALITY VLA IMAGING OF SGR A WEST AT 6 CM

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ABSTRACT. VLA data of the Galactic center at 6 cm from the A, B, and C configurations have been combined to produce a high quality image at $0.76'' \times 0.41''$ resolution with a dynamic range of ≈ 5000. The new combined array image enables a clear definition of the diffuse and filamentary structures in Sgr A West. The bulk of the image processing was carried out with the National Center for Supercomputing Applications' Cray XMP-48 at Urbana-Champaign.

1. Discussion

Previous high-resolution images of Sgr A West have mainly emphasized the bright compact features in the arms (e.g., Lo and Claussen 1983) owing to incomplete sampling of the shorter baselines. By rectifying this defect and reconstructing the extended emission as well, our new image enables a more complete overview of the region (see Figure 1). In particular, this image delineates very clearly the substantial filamentary emission in and around the arms of Sgr A West, and shows that it is generally oriented east-west. In addition, we find that there is extensive low level and diffuse emission; the bright, compact features in the arms are superposed upon it, and it also pervades the regions exterior to the arms.

We now discuss some of the above features in a little more detail. The combination of the prominent filament system which appears to cross the top of the northern arm and the elongated streamers in the western arc are suggestive of locii that are converging from east to west, as if they represent field lines in a configuration similar to those approaching the center of a current ring. This notion is emphasized by the long "threads" discovered by Yusef-Zadeh (1986) that diverge from Sgr A West to

M. Morris (ed.), The Center of the Galaxy, 453–455.

the east. The structure and orientation of these filaments and "threads" suggest that a poloidal magnetic field pervades the central few parsecs of the Galaxy. Should these features represent magnetic flux tubes, one is left with the problem of why these and not others are radiating. One possibility is that there is an intersection of the large-scale poloidal field and the molecular ring field lines. If magnetic field line reconnection occurs, it may be possible to load some of the intersecting lines with gas from the ring.

A detailed inspection of the filaments superposed upon the top of the northern arm reveals further sub-structure. If these filaments do in fact trace large-scale poloidal field lines, it is interesting that the filamentary emission to the east of the northern arm is different in character from that to the west; this may reflect a difference in local conditions. To the west, the scale size of any curvature in the filaments is much smaller than in the eastern filaments. Unlike the gently curving eastern filaments, the main western filament clearly contains a number of transverse oscillations, the amplitude of which grows from west to east. The qualitative impression is one of helicity, because detailed inspection reveals an increase in the surface brightness at the bends.

The brightest thermal structures in Sgr A West are the northern arm and the western "bar". The former presents the most coherent appearance of the three arms. It has been suggested that the northern arm shows evidence for a double-helix or braided structure. The ridge line of the emission can certainly be traced from side to side of the arm, especially close to its base. However, there is no convincing evidence for surface brightness enhancements at the bends as might be expected from a helical structure. Moreover, a second strand wrapped around the first is even harder to discern. The reality of helicity and braiding in the northern arm remains unproved.

The filaments are partially resolved, with a typical FWHM of ≈ 0.05 pc ($D = 8.5$ kpc), lengths in the range 0.5–1.5 pc, and mean brightness temperatures in the range 200–600 K. Assuming thermal emission and a fiducial gas temperature of 10^4 K, we find that the filaments are optically thin ($\tau < 0.1$) with electron densities $N_e \approx 10^4$ cm^{-3} yielding pressures of roughly 3×10^{-12} dyne cm^{-2}. We find the mass of a typical filament is a few tenths of a solar mass. Similarly, in the brighter blobs in the arms, we find a radius of the order of 0.5 pc, brightness temperatures of $\approx$ 1000–3000 K, optical depths of $\approx$ 0.1–0.3, densities of ≈ 0.5–1×10^4 cm^{-3}, and masses of $\approx$ 0.5 solar masses. The fainter and more diffuse material in the arms is also optically thin with densities $N_e > 0.5 \times 10^4$ cm^{-3}, depending on the path length.

2. References

Lo and Claussen, 1983, Nature, **306**, 647.
Yusef-Zadeh, 1986, Dissertation, page 171.

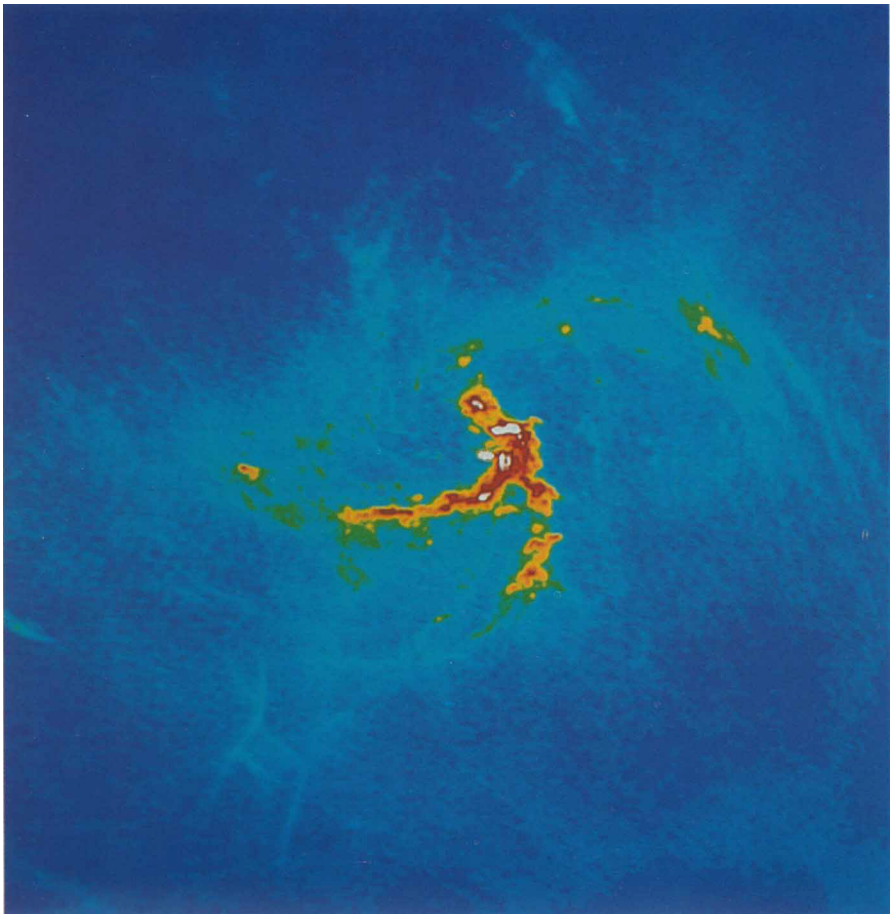

Figure 1.—Sgr A West at 6 cm and $0.76'' \times 0.41''$ resolution. The pixel size is $0.11''$ and a 1024 square section of a 4096 square image is shown. This figure is oriented with west to the top of the page and north to the left in order to emphasize the converging nature of the locii of the filamentary structure.

https://doi.org/10.1017/S0074180900186887 Published online by Cambridge University Press