IAU Colloquium 164: Radio Emission from Galactic and Extragalactic Compact Sources
ASP Conference Series, Vol. 144, 1998
J. A. Zensus, G. B. Taylor, & J. M. Wrobel (eds.)

Sgr A* and Company—Multiwavelength Observations of Sgr A* and VLA Search for "Sgr A*'s" in LINERs

H. Falcke[1,2], W. M. Goss[3], L. C. Ho[4], H. Matsuo[5], P. Teuben[1], A. S. Wilson[1], J.-H. Zhao[4], & R. Zylka[2]

Abstract. We report first results from a multiwavelength campaign to measure the simultaneous spectrum of Sgr A* from cm to mm wavelengths. The observations confirm that the previously detected submm-excess is not due to variability; the presence of an ultracompact component with a size of a few Schwarzschild radii is inferred. In a VLA survey of LINER galaxies, we found Sgr A*-like nuclei in one quarter of the galaxies searched, suggesting a link between those low-power AGN and the Galactic Center.

1. Introduction

The closest compact, flat spectrum radio core in the center of a galaxy is Sgr A* in the Galactic Center (GC). NIR observations of the GC have convincingly demonstrated the presence of a dark mass of $2.5 \cdot 10^6 M_\odot$ (Eckart & Genzel 1996) which is most likely due to a black hole associated with Sgr A*. Here we present the results of two observational campaigns that may shed further light on the nature of Sgr A* and of flat spectrum radio cores in galactic nuclei in general.

2. Multiwavelength Campaign for Sgr A*

Early mm- and submm-observations of Sgr A* suggested the presence of a submm-excess in the spectrum of Sgr A* (Zylka et al. 1992). Since Sgr A* can be variable it was, however, not clear, whether this excess was due to non-simultaneous measurements, a systematic error, or an intrinsic up-turn of the spectrum. Nevertheless, so far the excess at submm-wavelengths has persisted in non-simultaneous measurements by various other groups (see Morris & Serabyn 1996). As a further step, we have now performed a campaign to measure quasi-simultaneously the spectrum of Sgr A* to exclude the effects of variability on the broad-band radio spectrum.

The observation were carried out at four different telescopes—VLA A-Array (20, 6, 3.6, 2, 1.3, & 0.7 cm), IRAM (3, 2, & 1.3 mm), BIMA C-Array (3mm), and Nobeyama 45m (3 & 2 mm)—on three consecutive days on October 25/26/27, 1996. The data were reduced by the individual groups following standard procedures. For BIMA we did not use the longer baselines because of coherence problems; the IRAM 1.3mm observations were affected by weather.

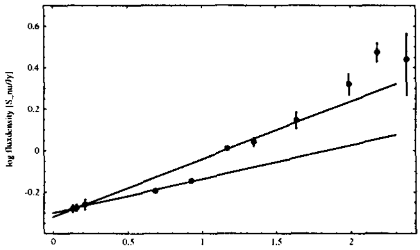
[1]Dept. Astronomy, University of Maryland, College Park, MD 20742-2421, USA

[2]Max-Planck-Institut für Radioastronomie, Bonn, Germany.

[3]National Radio Astronomy Observatory, Socorro, NM, U.S.A.

[4]Harvard/CfA, Cambridge, MA, U.S.A.

[5]Nobeyama Radio Observatory, Japan



log ν [GHz]

Figure 1. Spectrum of Sgr A* averaged over all telescopes at each wavelength for October 25-27, 1996.

The resulting spectrum is shown in Fig. 1 where we have averaged the fluxes at each wavelength from all days and telescopes. The VLA spectrum shows a marked break at 10 GHz. Below the break it can be described as a power-law $S_\nu \propto \nu^\alpha$ with $\alpha = 0.16$ and above the break as a power-law with $\alpha = 0.28$. The combined 3 and 2mm fluxes seem to be significantly above the extrapolation from the VLA fluxes. As discussed in Falcke (1996) such an excess, if due to self-absorption, indicates an ultra-compact region of $\sim$ 2–3 Schwarzschild radii. This region could in principle be resolved by future, global (sub)mm-VLBI experiments and thus one could directly probe the black hole nature of Sgr A*.

3. VLA Survey of Nearby LINER Galaxies

To see whether Sgr A* is really unique, we have surveyed a sample of 48 nearby LINER galaxies, selected from Ho et al. (1995), with the VLA in A-configuration at 2cm. We found that a quarter (mostly spirals) of the galaxies surveyed showed a compact, flat-spectrum core above a 5 σ detection limit of $\sim$ 1 mJy. Hence, we conclude that a nucleus like Sgr A* is not a unique feature of our galaxies, but can be found in other nearby galaxies, especially in those with signs of optical nuclear activity. Since the cores we found show a good radio/Hα correlation, it is very likely that they are indeed directly associated with the nuclear engine.

Acknowledgments. Observations of Sgr A* were performed by MG & J.-H.Z (VLA), RZ (IRAM), PT & HF (BIMA), HM (Nobeyama). The LINER survey was prepared and performed by HF, LH, & AW. This work was in part supported by NASA and NSF (NAGW-3268, NAG8-1027, AST9529190). The National Radio Astronomy Observatory is a facility of the National Science Foundation, operated under a cooperative agreement by Associated Universities, Inc.

References

Eckart, A., & Genzel, R. 1996. *Nature*, **383**, 415–417.

Falcke, H. 1996. In *Unsolved Problems of the Milky Way*, eds. L. Blitz & P. J. Teuben (Dordrecht: Kluwer), 169–180.

Ho, L. C., Filippenko, A. V., & Sargent, W. L. M. 1995. *ApJS*, **98**, 477–593.

Morris, M., & Serabyn, G. 1996. *ARA&A*, **34**, 645–702.

Zylka, R., Mezger, P. G., & Lesch, H. 1992. *A&A*, **261**, 119–129.