Sgr A* and Company - Multiwavelength observations of Sgr A* and VLA search of "Sgr A*'s" in LINERs[1]

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, p. 685). 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.

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

[2] Max-Planck-Institut für Radioastronomie, Auf den Hügel 69, D-53121 Bonn, Germany.

[3] NRAO Socorro

[4] Harvard/CfA

[5] NRO/Japan

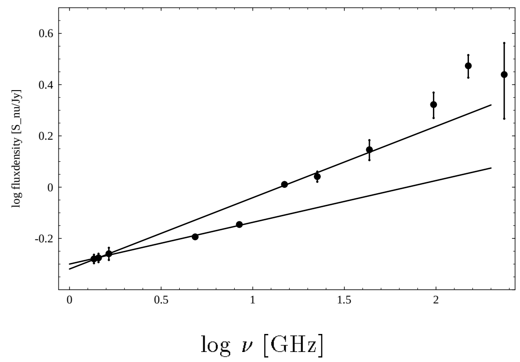

Figure 1. Spectrum of Sgr A* averaged over all telescopes at each wavelength for October 25-27, 1996.

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 powerlaw $S_\nu \propto \nu^\alpha$ with $\alpha = 0.16$ and above the break as a powerlaw 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.

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