

# DIFFRACTION-LIMITED IR SPECKLE MASKING OBSERVATIONS OF THE CENTRAL REGIONS OF SEYFERT GALAXIES

M. WITTKOWSKI<sup>1,2</sup>, Y. BALEGA<sup>3</sup>, T. BECKERT<sup>2</sup>, W.J. DUSCHL<sup>2,1</sup>,  
K.-H. HOFMANN<sup>1</sup> AND G. WEIGELT<sup>1</sup>

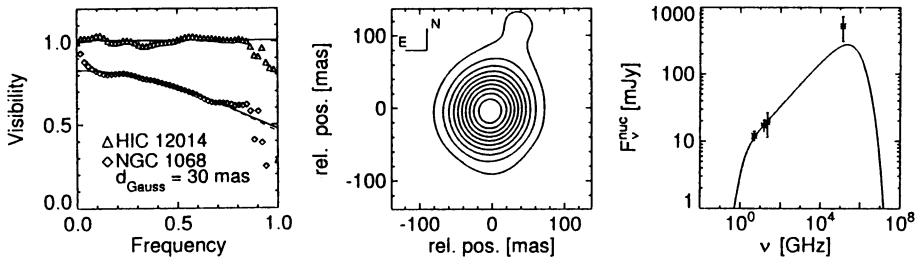
<sup>1</sup>*Max-Planck-Institut für Radioastronomie, Bonn, Germany*

<sup>2</sup>*Institut für Theoretische Astrophysik, Heidelberg, Germany*

AND

<sup>3</sup>*Special Astrophysical Observatory, Russia*

We present speckle masking observations ([2],[4]) of Seyfert galaxies with the Russian 6 m telescope. Diffraction-limited resolution of 76 mas in the K-band was obtained for the first time. This resolution is similar to the resolution of recent MERLIN and VLA observations of galactic centers, thus allowing us to study the radio-IR spectrum of the same structures. Figure 1 shows the decreasing K-band visibility function of NGC 1068 and the contour plot of our reconstructed image ([5]). The results show that NGC 1068 is resolved with a FWHM diameter of 30 mas or 2 pc for an assumed Gaussian flux distribution. The image is elongated in northern direction, which is approximately the direction of the radio jet. In the right panel of figure 1 the observed flux values at 5,15 and 22 GHz (from [3]) are plotted together with our K-band flux. The spectral index between 5 GHz and the K-band is approximately 1/3. This spectrum can be explained by synchrotron emission of quasi-monoenergetic relativistic electrons (as for our Galactic Center by [1]). Assuming that the observed flux is mainly nuclear light (from, for example, scattering lobes above and below a torus, without absorption and re-emission) we use the same synchrotron model as has been used for the Galactic Center to explain our data. With this model, we find a source radius of  $R \sim 10^{15}$  cm, a magnetic field of  $B \sim 11$  G, a electron number density of  $n_e \sim 1.1 \cdot 10^3$  cm<sup>-3</sup> and a mean electron energy of  $\sim 2.7$  GeV. The corresponding model spectrum is shown in the right panel of fig. 1. The observed flux value at 2.2  $\mu$ m lies slightly above the model spectrum. This could be caused by flux contributions from additional components, for example, a central stellar cluster, an accretion disk or thermal radiation from a dusty torus. We have also observed the central regions of other galaxies. For example, for NGC 4151, we found a dominant



*Figure 1.* Left: Azimuthally averaged visibilities of NGC1068 and the unresolved reference star. Middle: Contour plot of the reconstructed image. Right: A comparison of the model spectrum with the flux determinations at 5,15,22 GHz and 2.2  $\mu\text{m}$ .

central core, which is not resolved, and therefore has a diameter of  $< 20$  mas.

### References

- [1] Beckert T. et al., 1996, A&A307, 450
- [2] Lohmann A.W. et al., 1983, Appl. Opt. 22, 4028
- [3] Muxlow T.W.B. et al., 1996, MNRAS 278, 854
- [4] Weigelt G.P. 1977, Opt Comm. 21, 55
- [5] Wittkowski M.. et al., 1997, submitted

M. DOPITA: You have not considered the possibility that the K-band object is simply the region of hot dust near its sublimation temperature. This should be visible, given that NGC 1068 is a hidden broad-line region (HBLR) Seyfert, and the sublimation radius for the object is 2-3 pc, similar to what you observe. Could you comment on the possibility that hot dust emission is the dominant emission process at K ?

M. WITTKOWSKI: Yes, this is another possibility. We make our hypothesis, because the spectral index is just very close to  $1/3$  and a hot dust emission possibly peaks in the MIR and FIR and not already at 2.2  $\mu\text{m}$ .

N. THATTE: NGC 1068 has a steeply rising spectrum in the K-band, which would need a spectral index  $\alpha = 4.9$  ( $S_\nu \sim \nu^{-\alpha}$ ) to fit it. This is inconsistent with a synchrotron origin to the near-IR compact emission.

M. WITTKOWSKI: The K-band flux contain, of course, additional contributions, which could change the spectral index of the 30 mas source.

H. ZINNECKER: Have you also obtained H-band speckle images in order to determine the infrared colour of the 2 pc infrared core of NGC 1068 ? This would help to constrain its nature.

M. WITTKOWSKI: Yes, we have obtained H-band images. I agree, further observations with similar spatial resolution at other wavelengths are needed to constrain the models.