at the 3.6-m telescope by an improved version taking advantage of the progress in detector technology. Recently, a corresponding Memorandum of Understanding has been signed by the Sternwarte Jena and ESO. Similar to TIMMI, this new instrument will follow the concept of an 'infrared EFOSC', i.e. it is a focal reducer with variable magnification allowing for grism spectroscopy and polarimetry. The principal investigator for TIMMI2 is Hans-Georg Reimann, Jena (Germany). The TIMMI2 observing modes will be:

- diffraction-limited imaging at 10 and 20 μm
- imaging polarimetry at 10 μm
- low-resolution (i.e. $\lambda/\Delta\lambda \approx 200$) long-slit spectroscopy at 10 and 20 μm
- a medium-resolution (i.e. $\lambda/\Delta\lambda \approx 1000$) cross-dispersed Echelle mode is being considered.

For more details please consult the ESO web-page (http://www.eso.org/vlt/instruments/visir/timmi2, or the Sternwarte Jena web-page (http://www.astro.uni-jena.de/Users/rei/timmi2.html. Design work for TIMMI2 has already progressed substantially before the official signature of the Memorandum of Understanding. The present planning for TIMMI2 foresees the release of TIMMI2 to ESO visiting astronomers at the end of 1998. As a concluding remark it should be noted that TIMMI2 will be by far the most advanced instrument available at any observatory (including visiting instruments).

4. Performances

Both VISIR and TIMMI2 will allow for imaging and long-slit spectroscopy with diffraction-limited spatial resolution, i.e. factors of 10 to 20 better than ISOCAM, the imaging instrument of ISO, however, generally at the price of compromised sensitivity. Readers interested in the full details should consult the web pages giving sensitivity estimates for spectroscopy for the different cases. It should be noted that these sensitivity numbers depend largely on the Earth's atmosphere. Within the clear parts of the atmosphere, TIMMI2 and even more VISIR in spectrospcopy are extremely competitive with ISO. In the case of objects smaller than typically 3 arcsec, TIMMI2 and VISIR can outperform ISO substantially. In imaging the point-source sensitivity at 10 μm (10σ in 1 hour) is estimated to be 5 mJy for TIMMI2 and 0.6 mJy for VISIR.

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10- and 20-μm Imaging with MANIAC[1]

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Introduction

MANIAC is the new Mid- And Near-Infrared Array Camera built at the Max-Planck-Institut für Extraterrestrische Physik (MPE). It is designed as a modular two-channel instrument that will offer simultaneous observations in the near infrared (NIR) from 1 to 5 μm and in the mid-infrared (MIR) from 8 to 28 μm as well as a mid-infrared imaging spectroscopy mode. The first phase of the project, the MIR channel, has been completed and successfully commissioned in March 1996 at the ESO 2.2-m telescope at La Silla. Further improvement of data quality was achieved on a second observing run during October/November 1996 at the same place. In this article we present first results of broad-band N (8–13 μm) and Q (18–23 μm) observations, the latter being the first full Q-band images taken from La Silla.

Mid-Infrared Channel

The MIR channel is based on a 128 × 128 pixel Si:As array manufactured by Rockwell International, U.S.A. The array can be operated in different read-out modes with single read or double sampling being the modes most commonly used. The control electronics from Wallace Instruments, U.S.A., can read out the detector using four output channels at a top speed of 400 images per second.

MANIAC's field of view is 44 × 44 arcsec^2 (scale = 0.345 arcsec/pix) at the Cassegrain focus of the 2.2-m telescope with the f/35 secondary. The spatial resolution is determined by the diffraction limit of the telescope. The camera optics is a purely reflective gold-coated three-mirror system with achromatic performance. At present, the camera is equipped with a total of 13 broad- and narrow-band filters with a spectral resolution between 2 and 70. The filter set is complemented by a circular variable filter (CVF) operating from 7 to 14 μm at a spectral resolution of about 50.

Observations at MIR wavelengths require cryogenic temperatures for the instrument to minimise its own thermal emission. Therefore, detector, filters and mirrors are cooled down to 4.2 K using liquid helium. Technical details about optical design and data-acquisition system are described elsewhere (Böker, 1996, Böker et al., 1997).

Performance

Extensive testing was done in the laboratory and under observing conditions. The detector is linear up to $8 \cdot 10^6$ electrons (full well capacity). The total transmission at 10 μm including optics, filters, and detector is 11%. The measured noise equivalent power in the N-band is NEP = 2. . .5 mJy/arcsec^2 (1σ, 1 hour), depending on the observing conditions we have had during our two runs. Our data show only a small amount of excess noise indicating that the instrument is running close to background-limited performance.

The use of the Q-band filter (18–23 μm) is restricted to good observing conditions, which means a dry atmosphere. The full well capacity is already passed by the fastest possible read-out at about 20% humidity.

The well-known chop-nod technique was applied throughout our observations. During the observations it became clear that the chopping f/35 secondary at the 2.2-m telescope is certainly not optimised for use at MIR wavelengths. The

[1]MANIAC is not an ESO instrument. It is described here because it is used on the ESO/MPG 2.2-m telescope at La Silla and it covers the same wavelength range as the ESO instruments VISIR and TIMMI2 described in the preceding article.

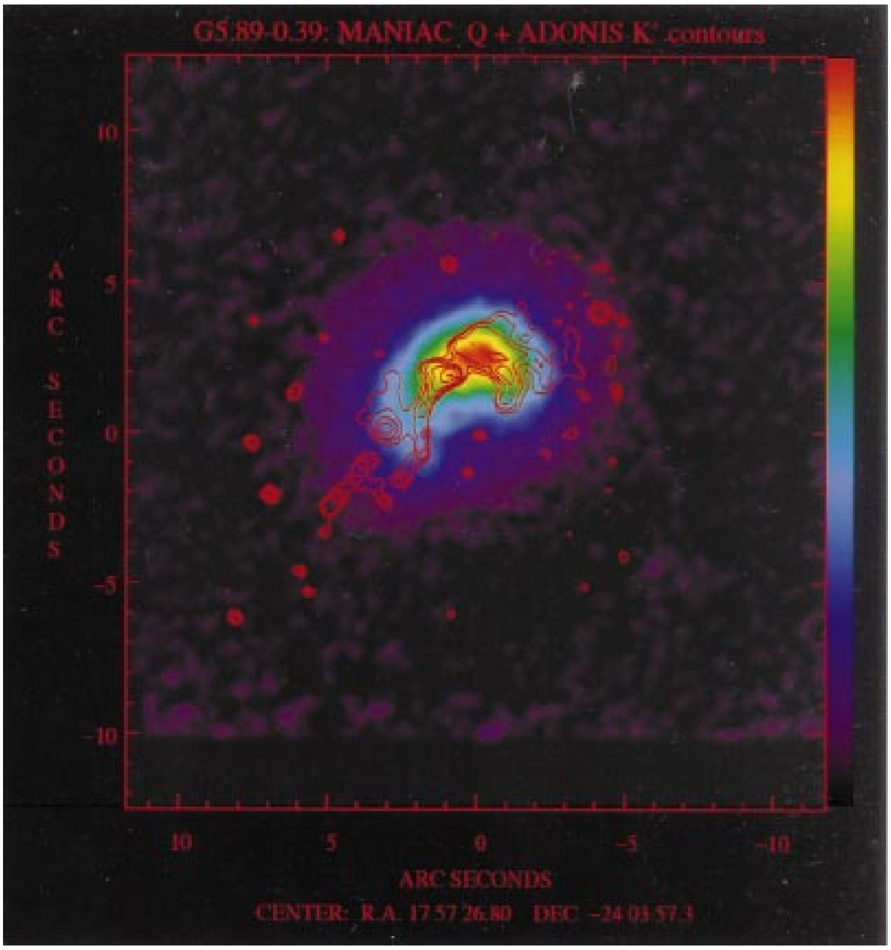

Figure 1: Mid-infrared Q-band image of the ultracompact HII region G5.89–0.39 with an overlay of near-infrared K′ contours.

chopper adjustment is quite critical with respect to the residual background structure in the final images. The best background cancellation level of about 10^{-5} was achieved by a combination of rotating and DC-tilting the secondary into certain positions, depending on the telescope zenith distance and hour angle.

First Results

Ultracompact HII Region G5.89–0.39

Using MANIAC at the 2.2-m telescope, the ultracompact HII region G5.89+0.39 was imaged for the first time in the Q band. Figure 1 shows our Q-band image tracing extended thermal emission from hot dust. We have overlayed contours representing near-infrared K′ data obtained with ADONIS/SHARP II (Stecklum et al., 1997). The K′ data delineate a similar overall banana-like structure quite different from the compact and more symmetric shell structure seen in the free-free radio continuum (Wood and Churchwell, 1989).

It is remarkable that the varying optical depth over one decade of wavelength from K′ to Q does not lead to a significant change of the morphology. This fact and the high surface brightness in the Q band indicate that the emission originates from an optically thick region. The lack of any infrared emission from the south-west part of the radio shell suggests an enormous extinction due to cold foreground dust. These features can be understood as signs of a very dense dust shell created by the interaction of both radiation pressure and wind from the central O6 star with the dense ambient remains of the parent molecular core. Obviously, the shell now starts to break-up.

Protoplanetary Nebulae

Stars in the post-AGB evolutionary stage are surrounded by a detached

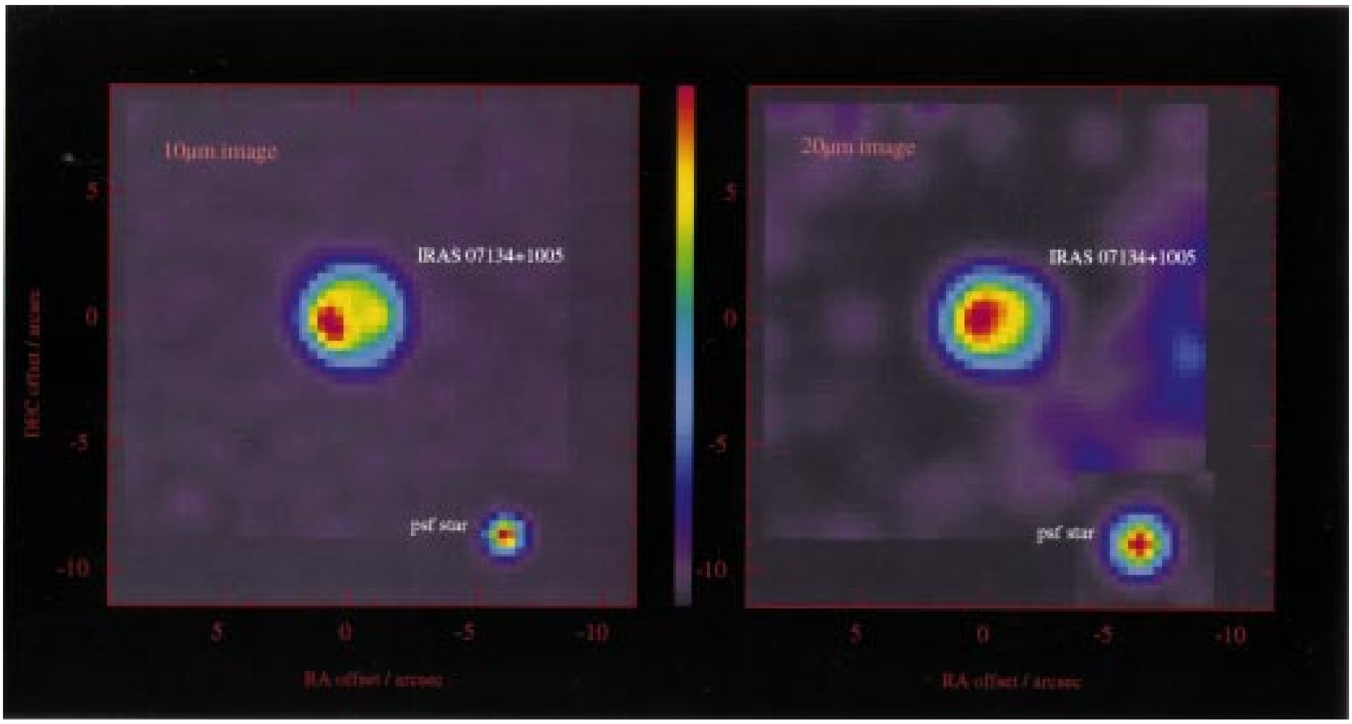

Figure 2: The protoplanetary nebula IRAS 07134+1005. The non-symmetric structure is seen both in the N-band image (left) and in the Q-band (right).

envelope of dust and gas. Due to their small angular extent, only little is known about the spatial structure of these envelopes. Using MIR cameras such as MANIAC, the emission of the warm dust particles located in the inner part of the dust shells can be spatially resolved. During the October 1996 observing run, a total of 5 objects have been searched for extended emission in the N and Q-bands; these data are in the process of being analyzed. As an example, we show in Figure 2 images of the post-AGB object IRAS 07134+1005. Extended emission is clearly seen in both images. Earlier results of this object have been published by Kömpe et al., 1997. We plan to compare the N and Q-band images with data at longer wavelengths and with the results of radiative transfer calculations modelling the spectral energy distributions of the objects.

Starburst Galaxy NGC 7552

One of the primary scientific goals for MANIAC are observations of galactic nuclei and their physical properties. As an example for the kind of data MANIAC can provide, we present in Figure 3 the N-band continuum image of NGC 7552, a southern barred spiral of Hubble type SBbc(s). Barred spirals very often show rings of molecular gas that are believed to form because of dynamical resonances between the orbiting molecular gas and the non-axisymmetric potential of the stellar bar. These so-called Lindblad Resonances often are the site of massive star formation and contain large amounts of warm dust. Our N-band image shows that the ring structure consists of various emission patches, presumably giant molecular clouds that are rotating around the dynamical centre. Such MIR data add important information to the detailed photometric and spectroscopic analysis of the central regions of galaxies. The goal is to develop reliable age determination methods for individual regions and to derive the evolutionary history of galactic nuclei. For the case of NGC 7552, this has been demonstrated in Schinnerer et al., 1997.

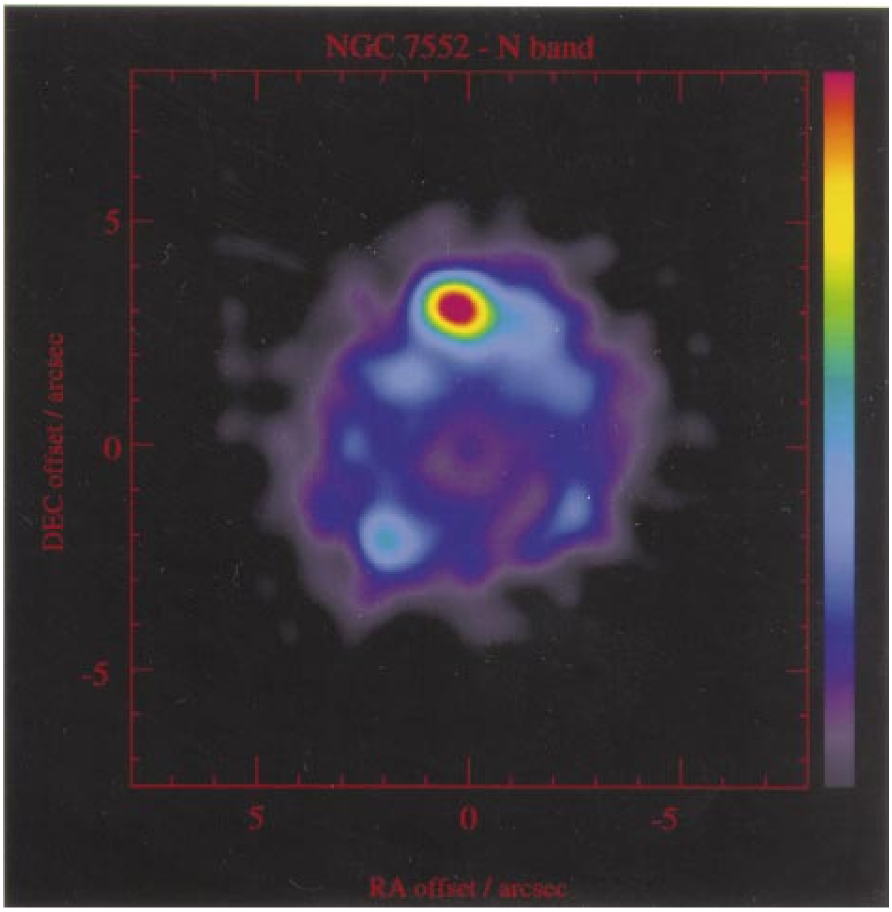

Figure 3: Star formation at the central region of the galaxy NGC 7552. Note that the integrated flux of the starburst ring in the N-band is only about 2.5 Jansky.

Acknowledgement

Commissioning a new instrument at any telescope is always a bit of a challenge. Both runs would certainly not have been so successful without the big efforts of the La Silla staff. We like to thank very much the 2.2-m Telescope Team for their support and for opening the telescope to daytime observation. Special thanks to the whole Infrared Group for all kinds of help, for their enthusiasm, and for many discussions.

One of us (TL) acknowledges the hospitality of the MPE infrared group while working in Garching.

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SOFI at the NTT

SOFI is currently being integrated in Garching with the goal of installing and commissioning it at the NTT by March 1998 and making it available to Visiting Astronomers in Period 61. This new instrument is a 1–2.5 μm imager/spectrometer which will offer:

- broad- and narrow-band imaging with a choice of pixel scales and maximum field of $5 \times 5'$
- polarimetry using a Wollaston prism
- long-slit grism spectroscopy at Rs $\sim$ 500
- cross-dispersed echelle spectroscopy at Rs $\sim$ 4000

Please check the ESO Web Site in July for further details on the capabilities of SOFI and information about its status and the Call for Proposals.

A. MOORWOOD, Garching, April 1997