

N91-142177

Near-Infrared Mapping of Spiral Barred Galaxies

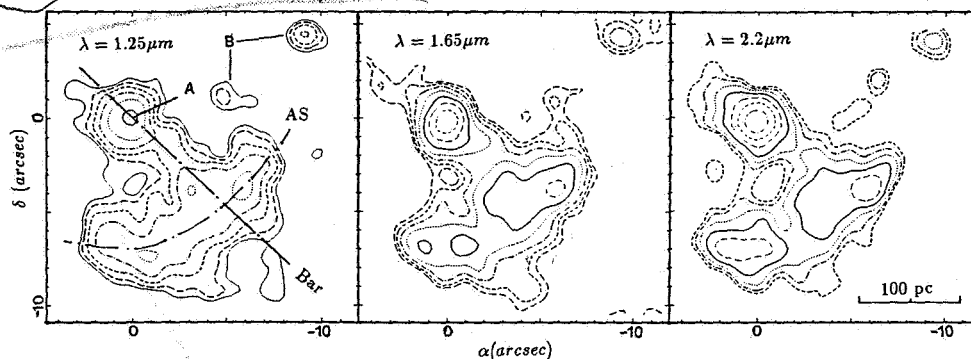
P. GALLAIS, D. ROUAN, F. LACOMBE

DESPA, Observatoire de Meudon, 92195 Meudon, FRANCE

In external galaxies, near-infrared emission originates from stellar populations, hot dust, free-free emission from H^+ regions, gaseous emission, non-thermal nucleus if any. Because of the low extinction compared to the visible, infrared wavelengths are useful to probe regions obscured by dust such as central parts where *starburst* phenomena can occur because of the large quantity of matter.

The results presented below were obtained with a 32×32 InSb CID array cooled at 4K, at the f/36 cassegrain focus of the 3m60 Canada-France-Hawaii telescope with a spatial resolution of $0.5''$ per pixel.

The objects presented below are spiral barred galaxies mapped at J($1.25\mu\text{m}$), H($1.65\mu\text{m}$) and K($2.2\mu\text{m}$). The non-axisymmetric potential due to the presence of a bar induces dynamical processes leading to the confinement of matter and peculiar morphologies. Infrared imaging is used to study the link between various components. Correlations with other wavelengths ranges and 2-colors diagrams ([J-H],[H-K]) lead to the identification of star forming regions, nucleus. Maps show structures connected to the central core, are they flowing away or toward the nucleus?



Isophotes maps of NGC 5236 at J, H and K. Region A (nucleus), B ($6\text{cm}/10\mu\text{m}$ peaks) and AS (arc-like structure) are quoted on the J map; direction of the bar is also drawn. Contours are separated by 0.5 mag/arcsec^2 , lowest contours are $16.5 \text{ mag/arcsec}^2$.

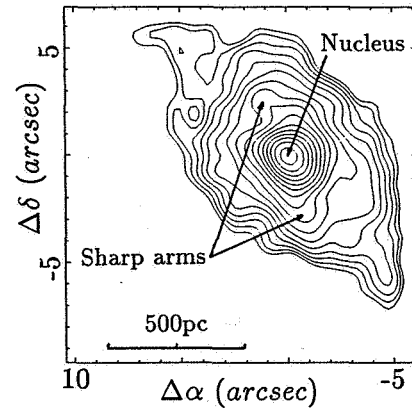
M83 is the nearest barred spiral located at a distance of 3.75 Mpc. It features an "amorphous" nuclei at visible wavelengths^{3,4} while infrared maps show a rather complex structure.

- A point-like source, which has typical color indices of a normal stellar nucleus, reddening by $A_V = 2$ and mixed with gaseous content.
- An arc-like structure, at 120 pc of the nucleus, showing a patchy distribution and extending from south-east to north. Southern color indices are characteristic of a giant and/or supergiant population while northern ones reveal the presence of gas.
- At north, a point-like source correlated with a low flux level source to radio and $10\mu\text{m}$ peaks^{5,6} characterizes a starburst region.

From these observations, several conclusions result:

- The star forming region, detected in the visible and the infrared cannot be very compact and must extend to the edge of the matter concentration.
- The general shape of the near-infrared emission and the location of radio and $10\mu\text{m}$ peaks suggest the confinement of matter between the inner Linblad resonances localized from CO measurements about 100 and 400 pc.
- The distribution of color indices in the arc from southern part to the star forming region suggests an increasing amount of gas and a time evolution eventually triggered by super nova explosions.
- Close to the direction of the bar, a bridge-like structure connects the arc to the nucleus with peculiar color indices. Perhaps, this structure can be linked to a high velocity component seen in UV and we can attribute it to a "jet" and/or a matter flow along the bar toward the nucleus, fuelling it.

Isophotes map of NGC 1068 at J. Contours are separated by $0.25 \text{ mag/arcsec}^2$, the lowest contour is $16.5 \text{ mag/arcsec}^2$.

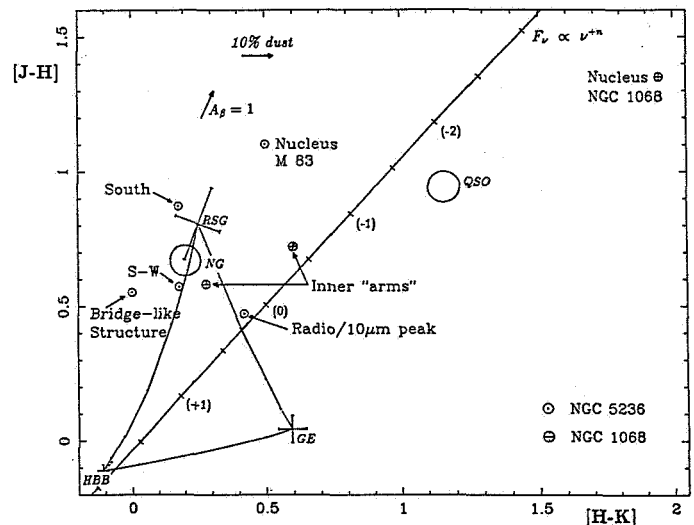


NGC 1068 is the nearest Seyfert 2 galaxy. It has been subject of many studies at all wavelengths. This object was mapped at J, H, K, L and M, and in polaro-imagery. *Results are given*

- No infrared counterpart to the radio jet, however a small structure is present at the north of the nucleus.
- Color indices of the nucleus are typical of quasar, if we assume that a hot dust component contributes to the emission. This agrees with the assumption of an obscured Seyfert 1 nucleus.
- A strong stellar bar oriented north-east/south-west.
- Two sharp arms linked to the nucleus, starting from north to north-east and south to south-west oriented in the direction of the bar. Color indices are those of a stellar component with contribution of ionized gas.

Two-colors diagram (J-H)/(H-K).

⊙ and ⊕ refer respectively to NGC 5236 and NGC 1068. The colors of three possible infrared contributors, red super giants (RG), gaseous emission (GE) and a 42500K blackbody (HBB) are plotted joined by mixed lines (from Campbell and Terlevich, 1984¹⁰). Straight line represents colors of a power-law with various spectral indices and filled circles represent the area populated by "normal" galaxies (NG) and quasars (QSO).



References

1. Tiphène, D., Rouan, D. and Lacombe, F., 1987, *Infrared Astronomy with Arrays*, Eds C.G. Wynn-Williams and E.E. Becklin, Hilo, Hawaii, march 24-26 1987.
2. Lacombe, F., Tiphène, D., Rouan, D., Léna, P. and Combes, M., 1989, *Astron. Astrophys.*, **215**, 211.
3. Pastoriza, M.G., 1975, *Astrophys. Spa. Sci.*, **33**, 173.
4. Wood, R. and Andrews, P.F., 1974, *Mon. Not. R. astron. Soc.*, **167**, 13.
5. Telesco, C.M., Decher, R. and Ramsey, D., 1986, in *Star Formation in Galaxies*, C.J. Lonsdale Persson (Editor), NASA Conference Publication 2466, p.497.
6. Telesco, C.M., 1988, *Ann. Rev. Astron. Astrophys.*, **26**, 343.
7. Bohlin, R.C., Cornett, R.H., Hill, J.K., Smith, A.M. and Stecher, T.P., 1983, *Astrophys. J. Letters*, **274**, L53.
8. Keel, C.W., 1987, in *Observational Evidence of Activity in Galaxies*, IAU Symposium n°121, Kachikian et al. (eds), p.25255.
9. Shlosman, I., Frank, J. and Begelman, M.C., 1989, *Nature*, **338**, 45.
10. Campbell, A.W. and Terlevich, R., 1984, *Mon. Not. R. astron. Soc.*, **211**, 15.