

OBSERVATIONS OF MULTIPLE NUCLEUS GALAXIES

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Disturbed Galaxies with two nuclei display the final state of the interaction process of two galaxies (Kollatschny et al., 1986; Fricke and Kollatschny, 1989). A few of these double nucleus galaxies contain Seyfert nuclei.

Seyfert galaxies with multiple nuclei

The "Catalogue of Quasars and AGN's" of Veron & Veron (1989) contains 243 galaxies of Seyfert-type 1, 2 or 3 with $m_V \leq 15$ and $v_{\text{rad}} \leq 20,000 \text{ km s}^{-1}$. Seven of these Seyfert galaxies have two optical nuclei; the nuclei have typical separations of 3 to 10 arcsec corresponding to 2 - 6 kpc.

For all these morphological disturbed multiple Seyfert galaxies, it is necessary to determine the internal velocity field to be sure that they are two galaxies in the late stages of merging. Direct images and the velocity fields along the line joining the two nuclei are shown in Figs 1 and 2 for the Seyfertgalaxies Mkn 266 and Mkn 739 (Kollatschny and Fricke, 1984; Netzer et al., 1987).

Table 1: Luminosities of multiple nucleus and 'undisturbed' Seyfert galaxies

	mult. nucl.	undist.	
$\log L_V[w]$	37.40	36.99	Sey 1
	37.14	36.66	Sey 2
$\log L_B[w]$	37.05	36.64	Sey 1
	37.09	36.22	Sey 2
$\log L_{\text{FIR}}[w]$	37.63	36.70	Sey 1
	37.88	36.76	Sey 2
$\log L_{\text{radio}(6\text{cm})}[w]$	32.12	31.39	Sey 1
	32.81	31.71	Sey 2
$\log H\alpha[w]$	35.96	35.21	Sey 1
	34.85	34.21	Sey 2

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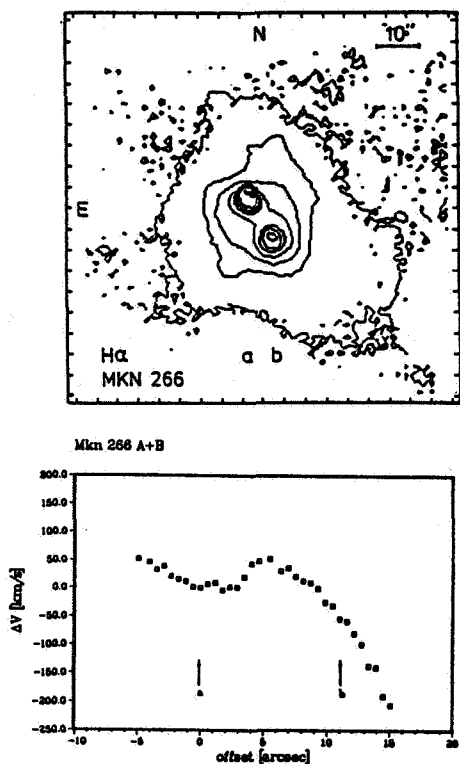


Fig. 1a,b: Optical image and relative velocity of the gas parallel to the nuclei of Mkn 266

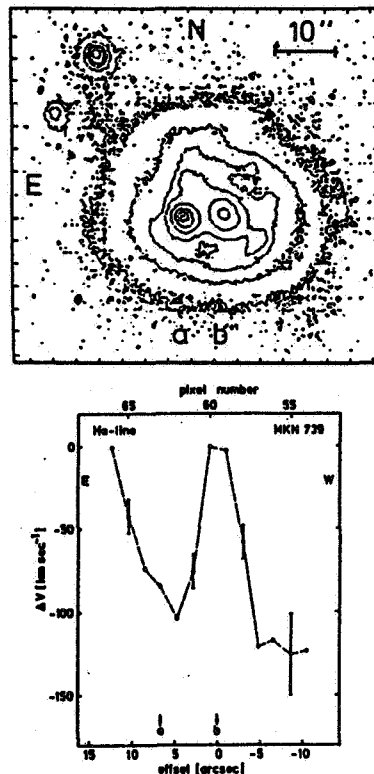


Fig. 2a,b: Optical image and relative velocity of the gas parallel to the nuclei of Mkn 739

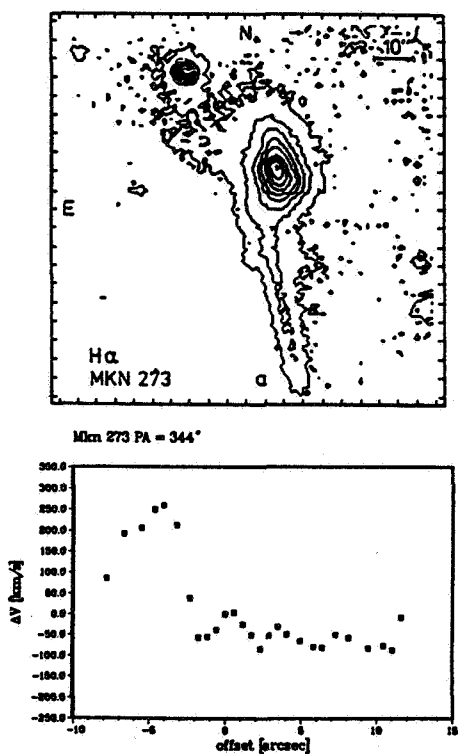


Fig. 3a,b: Optical image and relative velocity (P.A.:344°) of the gas of Mkn 273

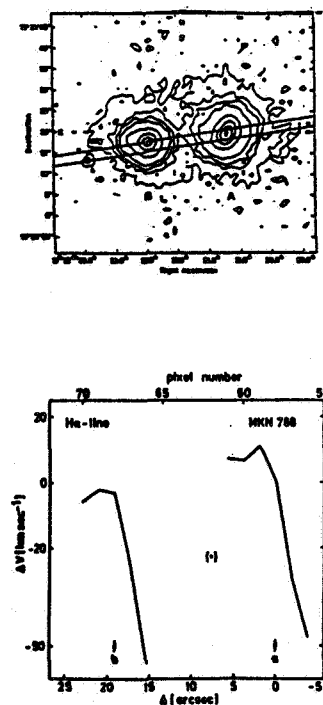


Fig. 4a,b: Optical image and relative velocity of the gas parallel to the two nuclei of Mkn 788

Making the assumption that the Seyfert galaxies Mkn 231 and Mkn 273 (Fig. 3) (Yorke and Kollatschny, 1985) are galaxies in the final state of merging, having strong tidal arms but unresolved nuclei, one can estimate that 4 percent of all Seyfert galaxies are in the merging process.

The luminosities of multiple nucleus Seyfert galaxies are extremely high in comparison to morphologically undisturbed Seyfert galaxies. In Table 1, mean values of the visual and blue luminosities and of the far-infrared and radio (6 cm) luminosities as well as the H α fluxes are listed for both classes. In addition we have separated Seyfert 1 and Seyfert 2 galaxies.

In all cases the luminosities of double nucleus Seyfert galaxies are higher by a factor of more than two with respect to 'undisturbed' Seyfert galaxies. This result might be explained by higher luminosities in the early phases of a Seyfert's life - under the assumption that the nonthermal activity is triggered by tidal interaction - and/or additional strong starburst phenomena.

Due to strong nuclear absorption, the UV spectra of these Seyfert nuclei are unusually weak.

Non-Seyfert nuclei in double nucleus galaxies

Corresponding to the Seyfert survey, we have obtained the H α and FIR luminosities as well as the [OIII] λ 5007/H β line ratios of a small sample of non-Seyfert nuclei in double nucleus galaxies. Figs. 4a,b show the direct image and the velocity field of the double starburst galaxy Mkn 788 (Kollatschny et al., 1986). We have compared our measurements with those of 'normal' interacting galaxies of Keel et al. (1985) and Bushouse (1987). The mean FIR luminosity per nucleus in multiple systems is the same as that of interacting galaxies. But the mean H α luminosities as well as the [OIII] λ 5007/H β line ratios (see Fig. 5) are higher by a factor of 1.5 - 2 than those of 'normal' interacting galaxies.

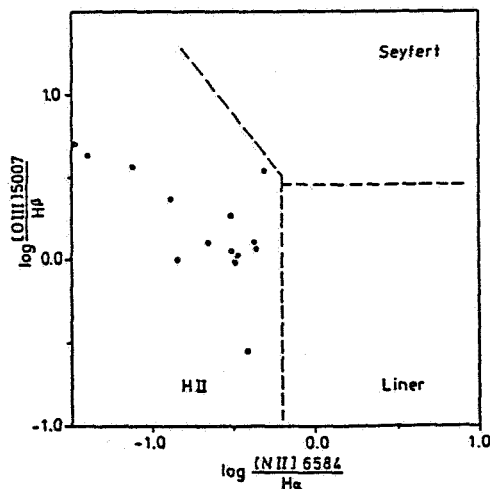


Fig. 5a: Line ratios for the individual non-Seyfert nuclei of the double nucleus galaxies Mkn 296, 463, 480, 739, 788, 789, 930, 1027

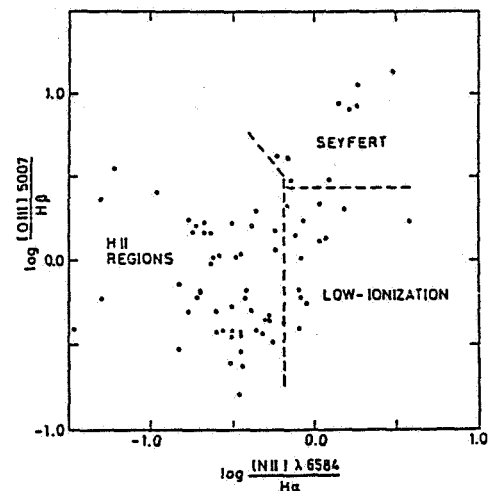


Fig. 5b: Observed line ratios in the spectra of interacting galaxies (Keel, 1985)

Partly based on observations at the German-Spanish Astronomical Center, Calar Alto, operated by the Max-Planck-Institut für Astronomie in Heidelberg, jointly with the Spanish National Commission for Astronomy.

References

- Bushouse, H.A., 1987: *Astrophys. J.* **320**, 49
- Fricke, K.J., Kollatschny, W., 1989: *IAU-Symp. 134 on "Active Galactic Nuclei"* (D. Osterbrock ed.), p. 425
- Keel, W.C. et al., 1985: *Astron. J.* **90**, 708
- Kollatschny, W., Fricke, K.J., 1984: *Astron. Astrophys.* **135**, 171
- Kollatschny, W., Fricke, K.J., Hellwig, J., 1986: *Proc. on "Structure and Evolution of Active Galactic Nuclei"* (G. Giuriccin ed.), p. 605
- Kollatschny, W., Netzer, H., Fricke, K.J., 1986: *Astron. Astrophys.* **163**, 31
- Netzer, H., Kollatschny, W., Fricke, K.J., 1987: *Astron. Astrophys.* **171**, 41
- Veron-Cetty, M.-P., Veron, P., 1989: *A Catalogue of Quasars and Active Galactic Nuclei (4th Edition)*, ESO Scientific Report No. 7
- Yorke, H.W., Kollatschny, W., 1985: *Proc. on "Extragalactic Infrared Astronomy"* (P.M. Goudhalekar ed.), p. 1