

ACTIVITY OF INTERACTING GALAXIES  
Mkn 673: A Close-by "E+A" Galaxy

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ABSTRACT. The close-by double nucleus galaxy Mkn 673 shows spectra and colors which are typical for "E+A" cluster galaxies.

In 1978 Butcher and Oemler (1978) reported an excess of blue galaxies in the cores of rich clusters at high redshift in comparison to nearby clusters. In spite of pertinent photometric and spectroscopic investigations of distant clusters this "Butcher-Oemler effect" is still controversial (e.g. Koo, 1988). In a spectroscopic analysis of galaxies in the distant cluster 3C295 Dressler and Gunn (1983) found three galaxies with strong Balmer absorption spectra but colors typical of Sb-spiral galaxies ( $\langle B-V \rangle = 0.54-0.84$ ), i.e. incompatible with the observed spectra. This new class of galaxies was interpreted as a mixture of an old stellar population with blue luminous A stars. These "E+A"-galaxies were explained as "post-starburst" galaxies.

For a better understanding of these galaxies and their evolution it is important to find the mechanism which is triggering the star formation. Two possibilities have been discussed: ram-pressure-induced star formation or galaxy interaction. If nearby galaxies could be found which show properties typical for the "E+A" galaxies, a detailed study of those could possibly allow to distinguish between these two mechanisms.

In our ongoing investigation of double-nucleus galaxies (e.g. Kollat-

schny et al., 1986) we carried out multifrequency observations of Mkn 673 ( $m_V = 13.9$ ,  $z = 0.036$ ) (Fig. 1). The optical spectra of both nuclei are shown in Fig. 2 and 3. They are almost identical with the composite "E+A"-spectrum of Dressler and Gunn and in addition they show in the red part  $H\alpha$ , [NII], [SII] emission typical

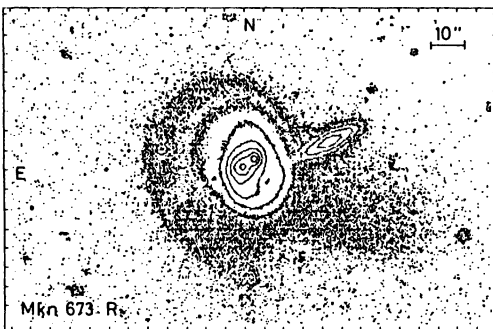


Fig. 1: R-Band image of Mkn 673

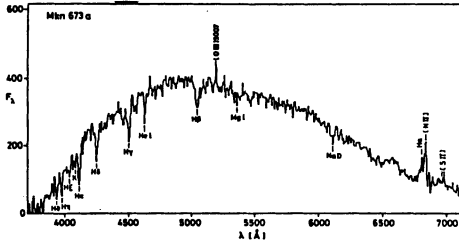


Fig. 2: Optical spectrum of nucleus a

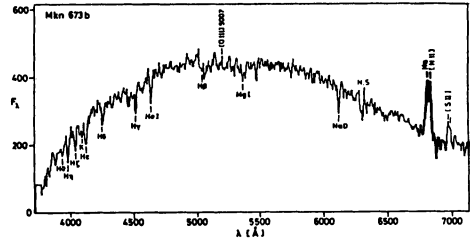


Fig. 3: Optical spectrum of nucleus b

for Seyferts or Liners (e.g. Petrosian et al., 1975). Due to heavy dust obscuration ( $E(B-V) \approx 1.2$ ) the H $\beta$  or [OIII]5007 lines are only barely visible in both nuclei. In accordance with the steep Balmer decrement due to dust obscuration the far-infrared flux is quite strong and the IUE UV-spectra are featureless and weak.

Because of the high  $z$ -values of their cluster galaxies, Dressler and Gunn obtained spectra up to an intrinsic wavelength of  $\sim 5500 \text{ \AA}$  only. Comparison with Mkn 673, however, shows that this is not sufficient to detect heavily reddened emission line activity.

In addition to the spectra the B-V color (0.82) for Mkn 673 is within the definition of "E+A" galaxies.

CCD images obtained with the Calar Alto 2.2m telescope clearly show the double-nucleus structure of Mkn 673 and the strong tidal arms, typical for closely interacting or merging galaxies.

For distant cluster objects it is difficult to discriminate between tidal arms or possible signs of spiral structure (e.g. Thompson, 1988).

The edge-on companion - 25 arcsec to the NW - has a slightly higher redshift than Mkn 673 with weak H $\alpha$  emission. Apart from its dust lane, visible in B-V color maps, this object shows no indication for interaction.

The velocity curves through both nuclei of Mkn 673 (Fig. 4), and perpendicular to this, through nucleus b (Fig. 5) taken with the Calar Alto 3.5m telescope confirm the interaction picture.

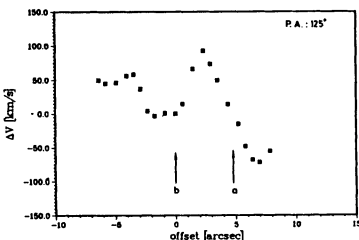


Fig. 4: Velocity curve of Mkn 673 through nuclei a and b (error  $\approx 20 \text{ km/sec}$ ).

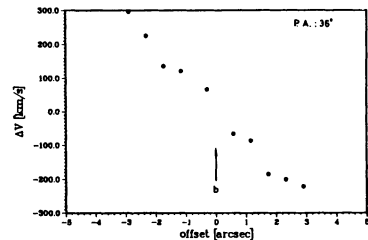


Fig. 5: Velocity curve of nucleus b for Position Angle:  $36^\circ$ .

Mkn 673 is one example that the definition "E+A" galaxies holds for nearby, present day and non cluster objects too. In addition the picture that these galaxies are triggered by interaction or merging with

other galaxies receives support from this object.

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.

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