THE INTERACTION OF THE QUASAR PKS 0812+02 WITH THE SURROUNDING CLUSTER OF GALAXIES

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ABSTRACT. We present the results of long slit spectroscopy and deep imaging of the quasar PKS 0812+02 and its environment, obtained with the ESO 3.6m telescope using the ESO Faint Object Spectrograph and Camera (EFOSC) and the Boller and Chivens spectrograph.

The radio-loud QSO PKS 0812+02 is located near the centre of a z=0.40 rich cluster of galaxies and has been shown to be surrounded by an extended optical nebulosity (5,6). The radio morphology appears as a typical asymmetric double source, with a strong north-western lobe, coincident with an optical non-stellar object of R ~ 22 mag that has been interpreted as its optical counterpart (the brightest ever found) (6). A spectrum along the radio axis has shown a gaseous connection with a steep velocity gradient and VLA observations have revealed a radio jet connecting the QSO with this north-western hot spot (3,4). With new spectroscopic observations of this feature, however, we have found clear evidence for absorption lines typical of an elliptical galaxy and emission lines typical of an active galaxy (1). This object must then be reinterpreted as a bright steep-spectrum radio galaxy, with a total luminosity $L_{5GHz} \sim 5 \cdot 10^{25}$ Watt/Hz (reduced from (6) to the values H_o=100 km$\cdot$s$^{-1}\cdot$Mpc^{-1} and q_o=0.5 used throughout this paper) apparently interacting with the QSO. The spectrum shows a blue-shift of about -1000 km/s with respect to the QSO, and an emission-line gaseous bridge with a continuous velocity gradient is clearly connecting the two objects. There is, furthermore, some evidence that the absorption Balmer lines in the companion galaxy are somewhat stronger than in normal radio ellipticals. The direct images confirm that the QSO is residing in a rich cluster of galaxies: we have counted about 80 non-stellar objects inside a radius of ~ 200 kpc (~ 60 arcsec) (the limiting magnitude of our images is ~ 22.5-23), and the four brightest surrounding objects are all galaxies with a redshift close to that of the central QSO (1). A preliminary deconvolution suggests that the northern extension of the QSO may be another galaxy in very close interaction and shows another object embedded in the QSO's eastern halo. In one of our spectra, we have detected absorption lines (CaII H and K, and the G band) at a distance

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of 2 arcsec (~ 6 kpc) from the nucleus, suggesting the presence of an early-type galaxy hosting the QSO (1).

The spatial profiles of the emission lines are clearly extended, particularly at P.A.=195, and the correlation of their ratios with the distance from the nucleus is consistent with photoionization from the central source. It has been argued (2) that there would be sufficient ionizing flux from a QSO to do this.

The extended gas shows complex kinematics, as is evidenced by the recession velocity displayed by the gas at P.A.=15, but the approaching velocity of the gas extending to the radio galaxy at P.A.=340. This constitutes some evidence that the line-emitting gas is being stripped from the neighbouring galaxies by the interaction with the QSO, and this process could be still at work in the case exemplified by the bridge between the QSO and the radio galaxy. However other mechanisms of gas supply to the central regions of the cluster, such as cooling flows, cannot be excluded a priori.

This may be as clear an example as nature provides of QSO and/or galaxy nuclear activity being fueled by the accretion of material from their neighbours. The ambience provided by a massive galaxy lying in the potential well of a well-populated cluster is certainly an important component of this particular situation.

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