GIANT LUMINOUS ARCS IN CLUSTERS OF GALAXIES

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During a program of study of surface brightness of elliptical galaxies in large redshift clusters in 1976 by a video camera at the KPNO 4-meter telescope, we in colaboration with Alan Sandage discovered filamentary and arc-like features in three clusters of galaxies. More recently, the same clusters (Abell 370, Abell 2218, and Cl2244-02) were observed by three different CCD's at the same telescope. These new observations confirm ouir old observations,and being of higher quality,show that the features in two of the clusters (Abell 370 and Cl 2244) form well defined continuous arcs with the following properties:

1) Large nearly circular features (length and radius of curvature $\sim$100 Kpc) with the center of curvature located near the center of gravity of the cluster.

2) Large optical luminosity ($\simeq 10^{11} L_{\odot}$).

3) Bluer than the elliptical galaxies with unexpectedly high ultraviolet emission for Abell 370 giving rise to an unusual spectrum(see figure 1).

4) Nearly uniform width along the arc with almost abrupt termination points, indicating a one dimensional structure rather than projection of a portion of a spherical shell.

5) The arcs are nearly resolved perpendicular to their length with widths of $\leq 1''$ ($\leq$ 6 Kpc).

i) In case of Abell 370 the surface brightness is very uniform but the width varies with wavelength, becoming wider toward blue and ultraviolet.

ii) In case of Cl 2244 there is considerable variation of surface brightness along the arc. We have no information on the variation of the width with wavelength.

6) Our data does not show any other unusual features associated with the clusters as a whole or with the giant cD galaxies. These clusters may, however, be unusual in that they seem to have two distinct centers of gravity. this is especially true for Abell 370 which has two almost identical giant cD galaxies instead of the usual clusters dominated by one centrally located cD galaxy.

7) Polarization observations show that the arcs are not highly polarized (polarization $<$ 20%).

8) From a short exposure spectral observation of Cl2244 we can only deduce absence of very strong emission lines.

The following table summarizes some of our observations.

J. Audouze et al. (eds.), Large Scale Structures of the Universe, 467–469.

Abell 370 $\alpha = 02\,37\,20.4 \quad \delta = -01\,47\,51 \quad z = 0.373$

Scale 4″.3 per cm

Length 21″ (143 Kpc); Radius of Curv. 15″ (103 Kpc); Width 0″.9 (4.7 Kpc)

	U	B	V	R	I	"J"
Arc						
Magnitude	19.7	21.1	20.0	19.2	18.3	18.2
Width/kpc	10.3	7.5	4.7	3.5	2.7	–
cD galaxies	21.3	21.1	19.5	18.2	17.4	17.4

Mean visual surface brightness $\approx 23 - 10\log(1+z) = 21.6$ mag/sq.arcsec. Bolometric luminosity $\simeq 10^{11} L_{\odot}$.

CL 2244 $\alpha = 22\,44\,38.3 \quad \delta = -02\,21\,30 \quad z = 0.328$

Scale 4″.3 per cm

Length 19″(114 Kpc); Radius of Curv. 11″ (64 Kpc); Width < 1″

	B	V	R	I
Arc	21.0	20.1	19.4	19.2
cD galaxy	21.1	19.3	18.1	17.1

Figure 1. Spectrum of Abell 370 arc and the nearby cD galaxy. The inset shows the spectrum in the optical range. Filled circle for the arc, G for the galaxy. The larger scale spectrum shows how two power law fits to the optical data when extended to the x-ray and radio bands compare with observed upper limits there.

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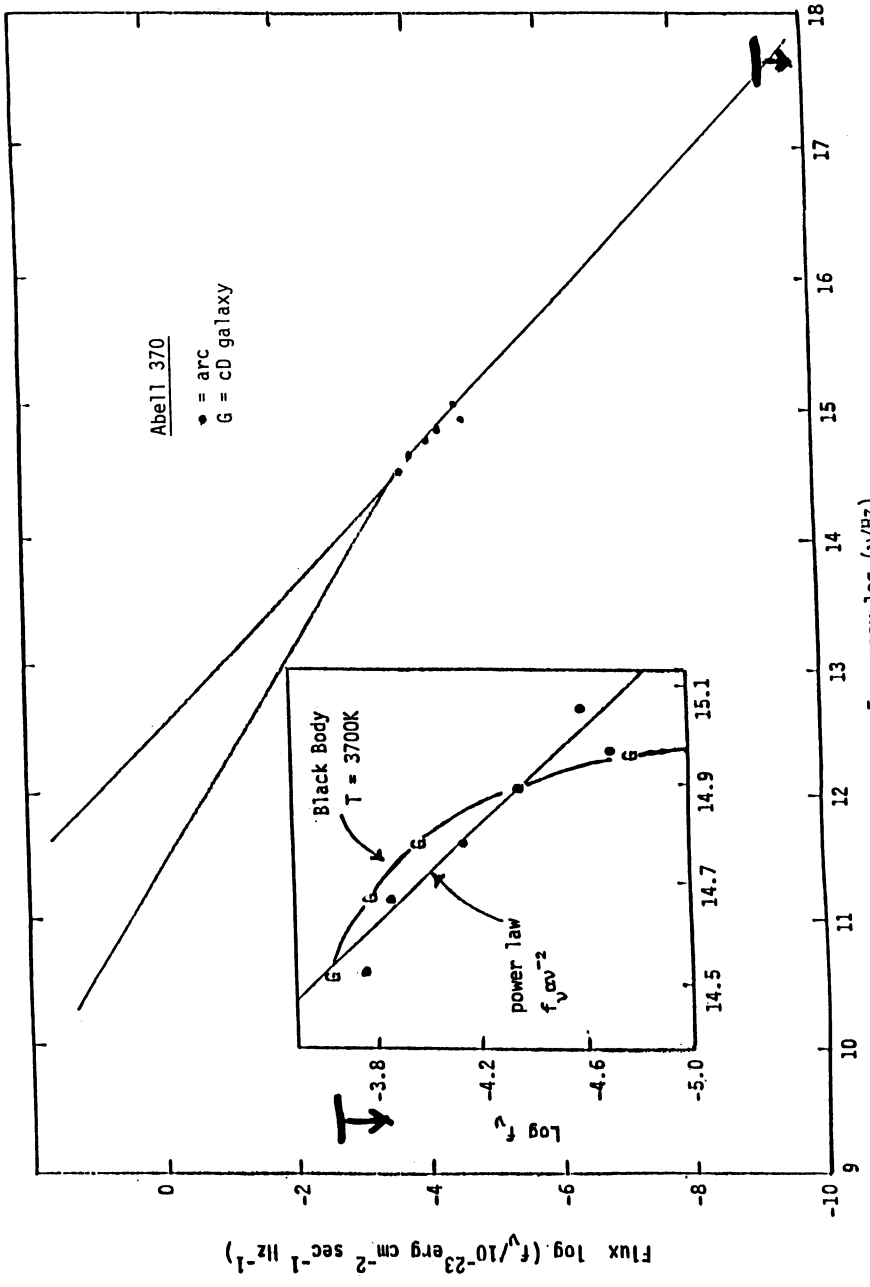

Figure 1