A LUMINOUS ARC IN A Z=0.042 CLUSTER OF GALAXIES

The nearest gravitational arc known?

LUIS E. CAMPUSANO
Departamento de Astronomía, Universidad de Chile
Casilla 36-D, Santiago, Chile

AND

EDUARDO HARDY
Departamento de Astronomía, Universidad de Chile and
Département de Physique, Université Laval, Québec, Canada

Abstract. We report the discovery of a bright, arc-like feature with a redshift of z= 0.073 associated with the nearby cluster of galaxies ACO3408, at z = 0.042. The redshift, position, and geometry of the arc with respect to the central cD galaxy of the cluster strongly suggest that this is by far the nearest case known of gravitational lensing of a faint background galaxy.

1. A Nearby Arc-like Feature

The serendipitous discovery took place on 6/7 February 1995 during a run with the CTIO 0.9m telescope, while performing direct imaging of clusters of galaxies for a program conducted in collaboration with Giovanelli and Haynes (Cornell). On 1 April 1995, the spectroscopy of the arc was obtained with the CTIO 4m telescope, revealing that its redshift was nearly twice that of the galaxy cluster.

The observed photometric properties of the arc are as follows: R=18.60, R-I = 0.42, and B-R =0.79. The mean BRI surface brightnesses are 24.23, 23.44, and 23.02 mag/sq.arcsec, respectively. Its length is $\sim$ 11 arcsec, corresponding to a linear size of 22 h_{50}^{-1} kpc These parameters are consistent with, for example, a lensed image of a faint BCD galaxy at z=0.07. Could the arc be instead an edge-on unlensed spiral? Its size is compatible with a medium-size one. But the object exhibits emission lines all along its body (within our resolution of $\sim$1.5"). There is some velocity structure along the arc, but with a small amplitude, more reminiscent of an irregular galaxy

C. S. Kochanek and J. N. Hewitt (eds), Astrophysical Applications of Gravitational Lensing, 125–126.

Figure 1. CTIO B-image showing the arc and the central cD galaxy of ACO3048

of the Magellanic type. The size however is too large by far for the arc to be an unlensed Irregular. Notice that the direct calculation of the absolute magnitude of the arc gives M_B = -18.9, a value expected for a small spiral such as M33, or for an irregular, such as the LMC, which have sizes of only a few kpc.

The "gravitational radius" of the arc is $\sim$ 47" (i.e.$\sim$54 h_{50}^{-1} kpc), although this value remains somewhat uncertain for no counter-arc is observed. Under the hypothesis of a singular isothermal sphere (SIS; see Blandford & Narayan 1992 and Fort & Mellier 1994) we derive the following cluster parameters: Velocity dispersion $\sigma_v \sim$ 2000 km/s, a mass interior to the arc $\sim$2 x $10^{14} h_{50}^{-1}$ solar masses, and a (M/L) ratio $\sim 740 h_{50}$. Although these parameters might be overestimated due to simplified hypotheses (SIS), their very large values invite caution. The crucial test to confirm the lensing nature of the arc presented here would be the observation of shear in the fainter images of far-away background galaxies near the central cD galaxy of ACO3048. This test is ideally suited for the Hubble Space Telescope.

Acknowledgments: LEC and EH acknowledge the financial support of Fundación Andes(Chile).

References

Blandford, R.D. & Narayan, R., 1992, ARA&A, 30, 311
Fort, B. & Mellier, Y., 1994, A&A Review, 5, 239