COLOR MAPS OF A 1795 and A 2597 - COOLING FLOW CLUSTER CENTRAL GALAXIES with ACTIVE NUCLEI

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The subject of cooling flows in clusters of galaxies remains a controversial one, primarily because many clusters which have large x-ray derived mass inflow rates do not show any optical manifestation of the inflow or of the final fate of the gas. However, a handful of cooling flow clusters do show extended blue continuum regions indicative of current star formation which may be caused by the cooling flows (Romanishin 1987, Romanishin and Hintzen 1988), while another group show spectral evidence of star formation (O'Connell and McNamara 1988). Most of the cluster galaxies which show evidence of star formation also show nuclear activity, in the form of radio emission.

In a continuing program of multi- color imaging of cooling flow clusters, we have been looking for extended blue continuum light which would indicate recent star formation. By taking into account the background light from the old galaxy presumed to lie "underneath" the cooling flow induced star formation, we can make a quantitative estimate of the amount of "excess" blue light associated with the ongoing star formation , and, after assuming an IMF, estimate the total star formation rate implied by the excess light. With this information we can study the possible role of starlight in providing ionization for the emission line filaments seen in many cooling flow clusters and the relation of the star formation rates and the mass inflow rates derived from x-ray observations. Detailed *images of the excess light* , such as discussed here, allow spatial correlation of the sites of presumed star formation and structures as radio emission and optical line emission.

The optical imaging observations were designed to measure the *continuum* light from stars over a large color baseline, while avoiding emission lines which are strong in cooling flows. In particular, the standard B filter was not used, because it is contaminated by the [O II] 3727 line. Instead, a filter avoiding [O II] (referred to as b_{45}) was used (λ_0= 4506 Å, FWHM of 355 Å). The red filter was similar to a standard Cousins I filter, with λ_0 = 8200 Å, FWHM = 2000 Å.

In this short paper, we will discuss in detail only the imaging of A 1795, and mention A 2597. The central galaxy in A 1795 is a radio source (4C 26.42), with extended emission line gas (van Breugel, Heckman, and Miley 1984; vBHM). Figure 1a shows the red (I band) image of the A 1795 central galaxy. Figure 1b shows the excess b_{45} light. This image was derived from the observed b_{45} image by subtraction of the "old population" galaxy derived by scaling the I image, assumed to be unaffected by the young stars. The b_{45} image shows a structure similar in outline to the radio maps shown by vBHM. Preliminary calculations show the continuum luminosity must be starlight, as it is too bright to be nebular

D. E. Osterbrock and J. S. Miller (eds.), Active Galactic Nuclei, 460–461.

https://doi.org/10.1017/S0074180900141646 Published online by Cambridge University Press

continuum emission. One interpretation of this structure is that the radio source is interacting with the cool gas from the cooling flow and causing star formation. Clearly, further study of the spatial distribution of excess blue light in clusters will help elucidate the relation between cooling flows, radio sources, star formation, and nuclear activity.

The central galaxy in A 2597, a cluster with a cooling flow with an x-ray $\dot{M}$ of $\sim$300 $M_\odot$ yr^{-1} (Arnaud, private communication), shows a blue excess light region $\sim$6$''$ across, without significant structure. This blue light region is similar in extent to the radio map of A 2597 shown by Antonucci (1985). Like other cooling flow clusters studied, the SFR rate (for an assumed disk IMF) implied by the excess blue light is only a few percent of the x-ray $\dot{M}$.

For five cooling flow clusters with high L(Hα) studied so far (NGC 1275, A 1795, A 2597, PKS 0745−191 , 2A 0335+096), there is an approximately linear relation between the amount of excess blue light and L(Hα) . Except for NGC 1275, there is no evidence for any optical point source in these central galaxies. These two facts argue strongly that the extended emission line gas in these systems is ionized by extended star formation regions, rather than by nuclear point sources. If we ASSUME that some portion of the accreting gas forms stars with a normal disk IMF, and ignore the rest (Johnstone, Fabian, and Nulsen 1987), we can show that the extrapolated UV contiuum from the hot stars producing the excess blue light seen will also ionize the emission line filaments.

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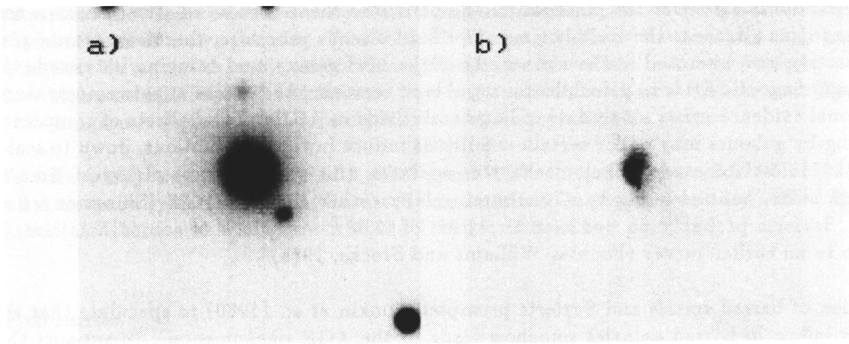

Figure 1. a) Broadband I image of A 1795 central galaxy b) Image of "excess" blue light derived by subtracting the blue light expected from the old population from the observed b_{45} image. Each image is 60$''$ on a side.

https://doi.org/10.1017/S0074180900141646 Published online by Cambridge University Press