PROPERTIES OF THE X-RAY EMITTING GAS IN EARLY TYPE GALAXIES

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We have studied a sample of 81 E and SO galaxies (taken mostly from the literature) that were observed with the *Einstein* Observatory. Fifty-five galaxies are detected in X-rays, most of which come from a hot interstellar medium. It is possible that discrete sources make a significant contribution to the X-ray emission for 21 of the detected galaxies with the lowest X-ray luminosity, L_X, for a given optical luminosity, L_B. We examine the L_X vs. L_B distribution (see Figure 1), and derive approximate values of the central electron density, central cooling time and total mass in gas for the sample. Typical values are $\sim 0.1\text{cm}^{-3}, \sim 5 \times 10^6$ yr and $5 \times 10^9 M_\odot$, respectively. The short cooling times suggest the presence of cooling flows, and we consider heating by supernovae and by gravitational processes. Supernovae at the accepted rate would overproduce the observed X-ray luminosity: either the true rate is many times lower or the supernova energy is not well coupled to the hot gas. There are also difficulties in explaining the suppression of a strong galactic wind if supernova heating dominates, unless an external pressure confines the gas. Gravitational heating gives $L_X \propto L_B\sigma^2$, where σ is the line-of-sight velocity dispersion in the galaxy, and we find that this is roughly the case. Gravitational heating exceeds the mean observed L_x by a factor of $\sim 3 - 4$ if one uses the accepted rate of stellar mass loss and assumes that the gas falls all the way to the center of the galaxy. This could be reconciled if the mass injection rate were lower or if matter drops out of the flow at all radii. The sample properties provide no additional information about the presence or absence of heavy halos in early type galaxies.

A full report of this work is given in *Astroph. J.*, **312**, 503.

T. de Zeeuw (ed.), Structure and Dynamics of Elliptical Galaxies, 431–432.

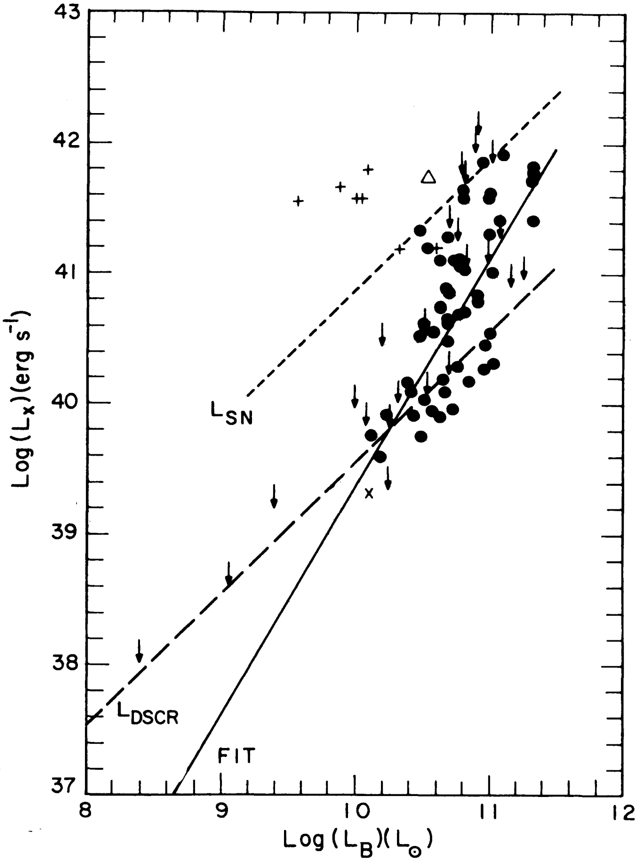

Figure 1. X–ray vs. optical (blue) luminosity of early type galaxies. The filled circles are detections, and the downward arrows are upper limits. The possibly active galaxy NGC 3998 is shown as a triangle, and NGC 5128 (Cen A) is shown as an "X". The plus signs are for galaxies in A1367 identified by Bechtold *et al.* (1983, *Astroph. J.*, **265**, 26); these are not included in our sample because we believe their emission may not be from hot, galactic gas. The dashed line gives L_{dscr}, the estimate of the possible X–ray luminosity from discrete sources. The solid line is the mean L_X vs. L_B fit to the full sample, and the dotted line shows L_{SN}, the luminosity expected from heating by supernovae at the accepted rate, assuming 10^{51} ergs per supernova, and that all the energy emerges as X–rays:

$$L_{SN} = 7.1 \times 10^{41} (R_{SN}/0.22)(L_B/10^{11}) \, \text{erg s}^{-1},$$

where R_{SN} is the supernova rate per $(10^{10} L_B 100 \text{ yr})$.

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