Discovery of an X-Ray Outburst in an Optically Non-Active Galaxy

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Abstract. The main X-ray and optical properties of a very luminous X-ray outburst source are summarized. The results are: large variability in X-ray emission (count rate rise of a factor of 10 within 7 days), soft X-ray spectrum (photon index = –3.8), giant peak X-ray luminosity (10^{44} erg/s), previously unknown non-active optical counterpart (redshift = 0.05).

1 Introduction

Galaxies typically show constant X-ray emission. Variable X-ray emission is common among AGN, typically about a factor of 2–3. Outbursts exceeding a factor of ~ 10 are rare even among AGN. It was therefore quite surprising when recently large UV/X-ray outbursts from optically 'normal' galaxies were discovered (Renzini et al. 1995 [1]; Bade et al. 1996 [2]; Komossa & Greiner 1999 [3]; Grupe et al. 1999 [4]). Exciting possible outburst scenarios have been discussed, including the tidal disruption of a star by a supermassive black hole, based on suggestions of Rees (1988) [5]. However, it is always difficult to safely indentify an optical counterpart. Because of the intriguing possible implications of these observations one would certainly rather rely on a larger number of objects. Here we report the discovery of another soft X-ray outburst in an optically non-active galaxy, thereby fortifying further that this phenomenon deserves a detailed theoretical understanding.

2 Observations

X-ray observations: The outburst source was discovered during analysis of 5 archival ROSAT PSPC pointed observations of the galaxy cluster Abell 3560, where the source appeared only in 2 observations. Applying the source detection algorithm incorporated in the EXSAS package (Zimmermann et al. 1998 [6]) yields a source position R.A.: 13H31M57.6S, Dec.: –32D43M20S (J2000). Within 7 days the source count rate rises about a factor of 10. Six months before and after the burst no emission is detected. A power law fit to the spectrum yields a photon index -3.8 ± 0.6. Using the *peak* count rate ($\sim 0.1\,\mathrm{cts/s}$) yields a giant luminosity $L_{\mathrm{X}}(0.1 - 2.4\,\mathrm{keV}) \sim 10^{44}\, h_{50}^{-2}\mathrm{erg/s}$.

Optical observations: An optical image taken at the Danish 1.5m telescope, ESO/La Silla, 6 years after the burst shows only one bright object within the ROSAT PSPC error circle. The spectrum of this anonymous galaxy does not show any emission lines typical for AGN. Absorption lines yield a redshift $z = 0.051$, similar to the redshift of Abell 3560.

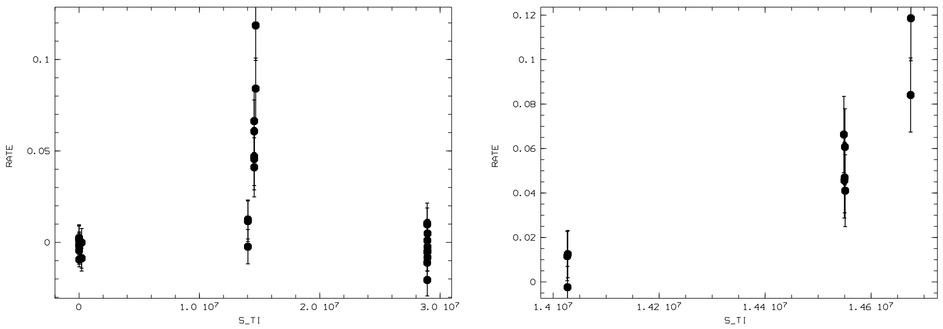

Fig. 1. Source light curve (cts/s over s) of the 5 PSPC observations and blow-up.

3 Conclusions

Our discovery brings the number of detected UV/soft X-ray outbursts from optically non-active galaxies to 5. Even though these objects differ in their properties, like X-ray spectrum, light curve and peak luminosity (for the latter, however, only lower limits can be derived from the data), they have in common that a large amount of energy is released in a relatively short time period from an otherwise boring looking galaxy. Several outburst scenarios have been discussed by Komossa & Bade (1999) [7] and Komossa & Greiner (1999) [3], who found that all successful models involve the presence of a supermassive black hole. Explicitly the tidal disruption of a star is favored, which may also explain the observations presented here.

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Images, spectra, light curves etc. of this source can be found at:
http://www.xray.mpe.mpg.de/~reiprich/act/publi.html

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