Chandra X-ray Sources in M101

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Abstract

A deep (98.2 ks) *Chandra* Cycle-1 observation has revealed a wealth of discrete X-ray sources as well as diffuse emission in the nearby face-on spiral galaxy M101. From this rich dataset we have created a catalog of the 110 sources from the S3 chip detected with a significance of $> 3\sigma$. This detection threshold corresponds to a flux of $\sim 10^{-16}$ ergs cm^{-2} s^{-1} and a luminosity of $\sim 10^{36}$ ergs s^{-1} for a distance to M101 of 7.2 Mpc. The sources display a distinct correlation with the spiral arms of M101 and include a variety of X-ray binaries, supersoft sources, supernova remnants, and other objects of which only ~ 27 are likely to be background sources. There are only a few sources in the interarm regions, and most of these have X-ray colors consistent with that of background AGNs. The derived $\log N - \log S$ relation for the sources in M101 (background subtracted) has a slope of -0.80 ± 0.05 over the range of $10^{36} - 10^{38}$ ergs s^{-1}. The nucleus is resolved into 2 nearly identical X-ray sources, each with a 0.5 – 2.0 keV flux of 4×10^{37} ergs s^{-1}. One of these sources coincides with the optical nucleus, and the other coincides with a cluster of stars 110 pc to the south. The field includes 54 optically identified SNR, of which 12 are detected by *Chandra*. Two of the SNR sources are variable and hence must be compact objects. In total, 8 of the X-ray sources show evidence for short term temporal variation during this observation. Two of these variable sources are now brighter than the *ROSAT* detection threshold, but they were not detected in the previous *ROSAT* observations taken in 1992 and 1996. There are also 2 variable sources previously seen with *ROSAT* that apparently have faded below the *Chandra* detection threshold. The brightest source in the field shows extreme long-term and short-term temporal variability. At it's peak brightness it has a super-Eddington luminosity $> 10^{39}$ ergs s^{-1}. There are 10 Supersoft sources (SSS) in the field which can be divided into 2 distinct subclasses: the brighter class (3 objects) has a luminosity of $\sim 10^{38}$ ergs s^{-1} and a blackbody temperature of ~ 70 eV whereas the other class (7 objects) is an order of magnitude fainter and has a blackbody temperature of only ~ 50 eV.

CATEGORY: NORMAL GALAXIES