A Chandra Observation of the Nearby Sd Spiral Galaxy NGC 45

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***Abstract:** We present the results of our Chandra observations of the nearby face-on Sd spiral galaxy NGC 45. We have observed this galaxy as part our study of supernova remnants (SNRs) in a sample of nearby spiral and irregular galaxies. The effective total exposure time of the observations (from three different epochs) was 65522 seconds: approximately eighteen discrete sources were detected (at a minimum of a 3s level) on the ACIS-S3 chip which sampled the optical extent of the galaxy, corresponding to an unabsorbed limiting luminosity of ~4´1036 ergs sec-1 over the energy range of 0.2-10.0 keV. We are searching for counterparts to the detected X-ray sources at multiple wavelengths: our search includes comparisons with positions of known young star clusters and HII regions associated with the galaxy, foreground Galactic stars and background galaxies seen through the disk of NGC 45. We have also analyzed the properties of a newly-discovered extended source CXOU J001358.0-231353: a fit to the extracted spectrum of this source using a thermal model yields a best-fit temperature of 6 keV, consistent with a classification of a background cluster of galaxies. Initial results of this work will be presented and discussed.*

Introduction and Motivation

- *While over 230 supernova remnants (SNRs) are now known to exist in the Galaxy (Green 2004), observations and analyses of these sources are hindered by significant absorption along Galactic lines of sight and considerable distance uncertainties.*
- *To help remedy this situation we are conducting a survey of SNRs in nearby (D < 8 Mpc) face-on (i≤66°) spiral galaxies using radio, optical and X-ray observations: the high angular resolution capabilities of Chandra are essential for obtaining matching resolution for our complementary radio and optical observations.*
- *The goals of this work include performing statistically-robust analyses of the properties of the entire sample of extragalactic SNRs and to investigate wavelength-dependent selection effects identified in prior searches (e.g., NGC 300-- Pannuti et al. 2000, NGC 2403 -- Schlegel & Pannuti 2003, NGC 6946 -- Lacey & Duric 2001, NGC 7793 --Pannuti et al. 2002, 2005).*

NGC 45

- *Once suspected to be a member of the Sculptor Group of Galaxies (de Vaucouleurs 1959) but now believed to lie just beyond the Group (Puche & Carignan 1988)*
- *Nearly face-on orientiation (i=47°; Tully 1988); located at a distance of 4.35 Mpc (Puche & Carignan 1985); Major and minor axes: 8.5×5.9 arcmin (NED); column density N_H~2.20×10^{20}cm^{-2}*
- *One of the closest and lowest surface brightness galaxies known (e.g., Ryder & Dopita 1993): NGC 45 is so faint and possesses such a low dust that background galaxies can be clearly seen through the disk of the galaxy*
- *No prior pointed X-ray observations have been made of NGC 45; no prior surveys have been conducted at any wavelength (optical or radio) for resident SNRs in this galaxy*

References

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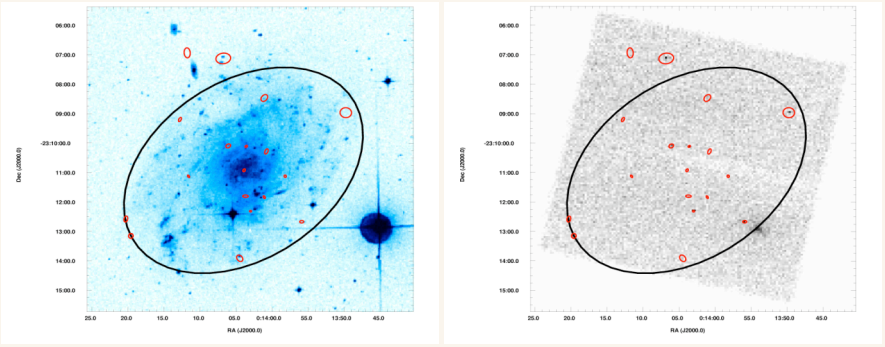
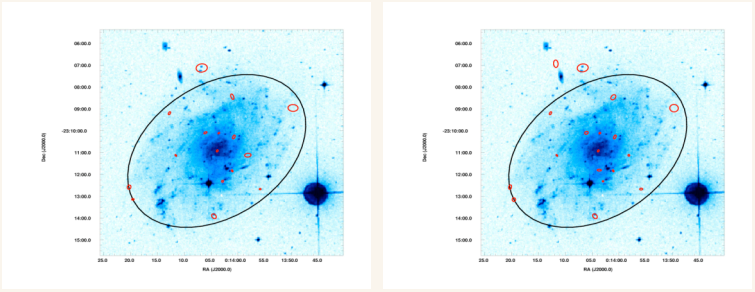
Observations and Results -- A Chandra View of NGC 45



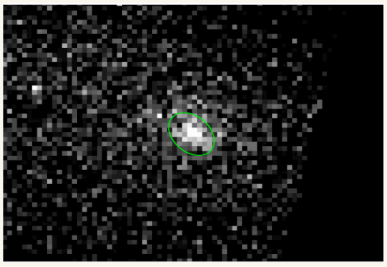
- *ACIS-S3 was used to sample the galaxy; three pointed observations made in VERY FAINT mode with effective exposure times of 34851 sec+24649 sec+6022 sec=65522 sec*
- *Using the "wavdetect" algorithm (Freeman et al. 2002), eighteen discrete sources detected at the ≥3σ level (corresponding to an unabsorbed luminosity of ~4×10^{36}ergs/sec from 0.2-10.0 keV)*
- *Detected sources: a nuclear source, an X-ray counterpart to a young stellar cluster (Larsen 1999); remaining sources are most likely X-ray binaries and background galaxies as well as SNRs*

Searching for Time-Variability from Detected X-ray Sources in NGC 45



ObsID 4690 **ObsID 6184**

- *Two sources are clearly variable (detected in ObsID 6184 but not ObsID 4690); one appears to be associated with a background galaxy while the other appears to be associated with NGC 45*
- *Are other detected sources (including the nuclear source) variable as well?*



CXOU J001358.0-231353: A New Background X-ray Cluster of Galaxies?

- *Extended source (approximately 20'' ×15'' in extent) seen just beyond southwestern edge of NGC 45*
- *Spectrum extracted and fit with a thermal model (APEC) with the column density frozen to 2.2×10^{20}cm^{-2}: derived temperature of kT~6 keV*
- *Morphology and spectral properties consistent with a previously unknown background cluster of galaxies -- optical observations are needed to identify the member galaxies of the cluster (presence of bright foreground star has hindered previous detection of cluster?)*

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