M31 in the Chandra Era
A High Definition Movie of a Nearby Galaxy
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M31 in the Chandra Era:
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M31 in the Pre-Chandra Era

- First X-ray detection: 0.5-5 keV with a rocket-borne proportional counter in 1973 (Bowyer et al. 1974).
- Einstein (van Speybroeck et al. 1979)
- Ginga (Makishima et al. 1989)
- ROSAT (Primini et al. 1993; Supper et al. 1997, 2001)
- EXOSAT (Garcia et al. 1997)
- BeppoSAX (Trinchueri et al. 1999)
- ASCA (Takahashi et al. 2001)
- RXTE (XTE All-Sky Slew Survey Catalog)
M31 in the Chandra Era

- 52 ACIS-I observations (294 ks)
- 4 ACIS-S observations (55 ks)
- 40 HRC-I observations (590 ks)
- Total: 939 ks (M31 core only)

- XMM-Newton (670 ks), Suzaku (100 ks), Swift (130 ks), Integral (400 ks)
First Chandra Observation of M31

Garcia+ 2000, 537, L23

XMM

Chandra ACIS

CXOOGMP J004247.0+411628
CXOOGMP J004244.2+411609
CXOOGMP J004242.0+411608
(Transient)
CXOOGMP J004244.2+411608
(Nucleus)
Chandra HRC-I

Bo375
Di Stefano+ 2002
Yang+ 2009

Williams+ 2004; Kaaret 2002 (center only)
X-ray Luminosity Functions of M31

Kong+ 2003
See also Voss & Gilfanov 2007
Diffuse X-ray Emission of M31

- 0.3 keV circumnuclear hot gas: Type Ia SN
- A large amount of faint sources (accreting WDs and active binaries)
- Extended along the minor axis => outflow

Li & Wang 2007
Bogdan & Gilfanov 2008
Li + 2009
The first X-ray resolved SNR in M31

Raymond-Smith model:
nH=4.6e21, kT=0.18 keV
L_x=5e36 erg/s

Kong+ 2002

Red: 0.5-0.8 keV
Green: 0.8-1.2 keV
Blue: 1.2-4 keV

Fe L/Ne K
O VIII

Counts/sec/keV
Residuals

Energy (keV)
The First X-ray/radio/optical Resolved SNR in M31

Kong+ 2003
See also Williams+ 2004
Supersoft and Quasi-soft X-ray Sources

- **SSS**: $kT < 100$ eV, $L_x \sim 10^{35-38}$ erg/s
- First discovered by Einstein and identified as a class of sources by ROSAT
- Accreting WDs, Type Ia SN progenitors
- **QSS**: $kT=150-350$ eV
- Over 50 SSSs and QSSs in M31 (Di Stefano+ 2004)
- SSSs and QSSs are found in GCs (Henze+)

See Poster 10.5, 10.13
1.4x10^8 M_{\odot} Supermassive BH: M31*

See also Li+ 2009

Garcia+ 2005, 2009

2x10^{36} \text{ erg/s}

P1

0.5"

P3 = M31*

See also Li+ 2009
G1: a giant GC in M31

HST/WFPC2

Palomar Observatory Sky Survey
Globular Cluster G1 in M31
A 20,000 solar mass black hole?

Noyola+ 2008

[Graph showing velocity dispersion vs. log(mass)]
HST/WFPC2 (F814W)

Kong+ in preparation

Ulvestad+ 2007

Chandra 95% (0.28 arcsec)
Core radius (0.21 arcsec)

VLA 2sigma

Ulvestad+ 2007
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