

M31 in the Chandra Era

A High Definition Movie of a Nearby Galaxy

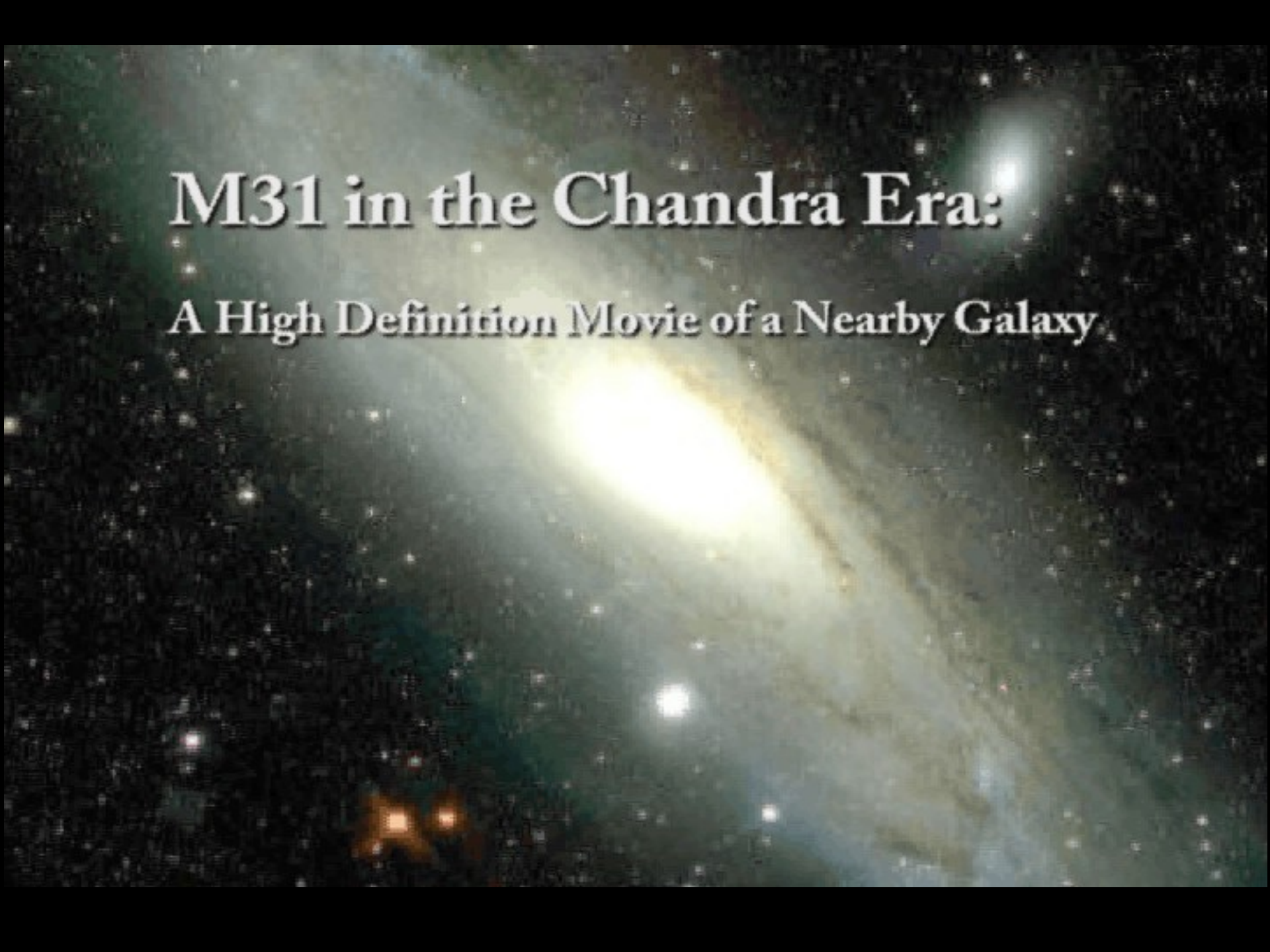
Albert Kong

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With **Rosanne Di Stefano**, Mike Garcia, Frank Primini, Ben Williams, Steve Murray
Movie Director: Phyllis Yen

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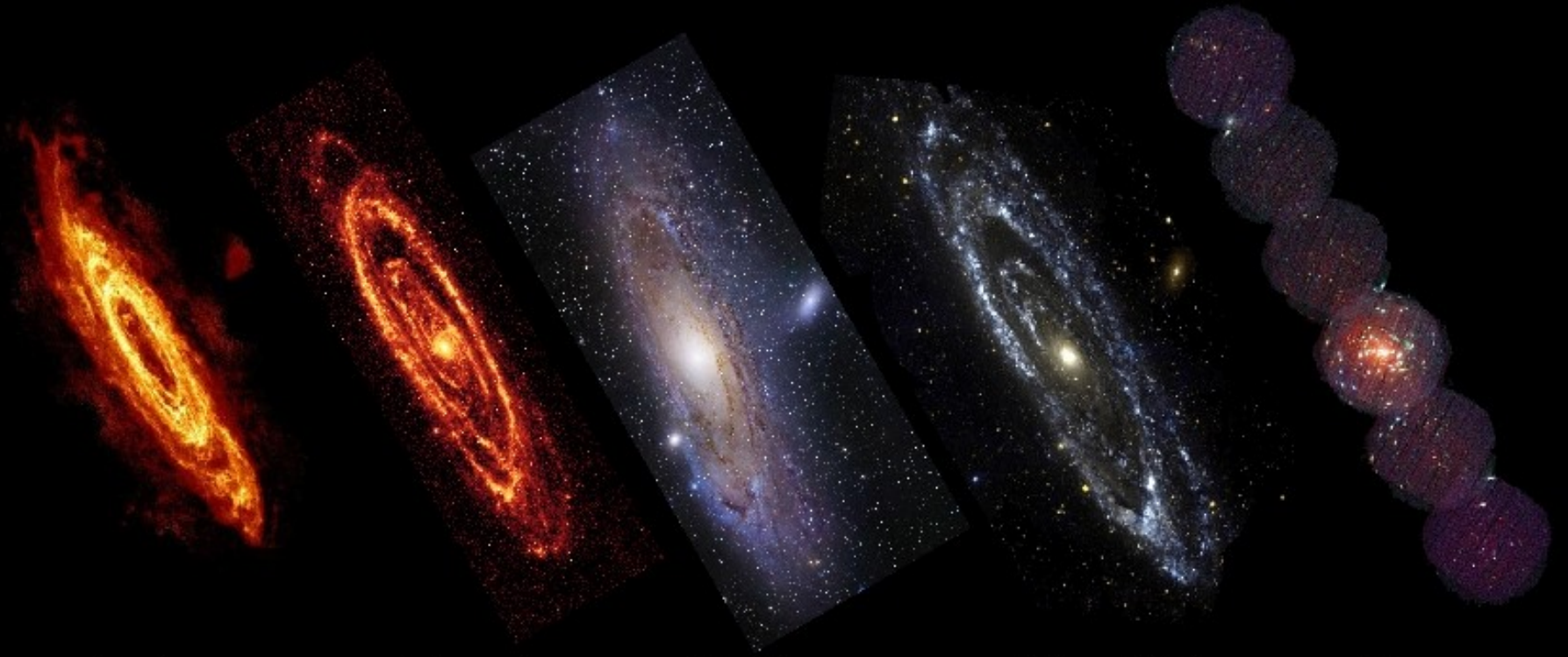
M31 in the Pre-Chandra Era

- First X-ray detection: 0.5-5 keV with a rocket-borne proportional counter in 1973 (Bowyer+ 1974).
- Einstein (van Speybroeck+ 1979)
- Ginga (Makishima+ 1989)
- ROSAT (Primini+ 1993; Supper+ 1997,2001)
- EXOSAT (Garcia+ 1997)
- BeppoSAX (Trinchueri+ 1999)
- ASCA (Takahashi+ 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)~~



Radio

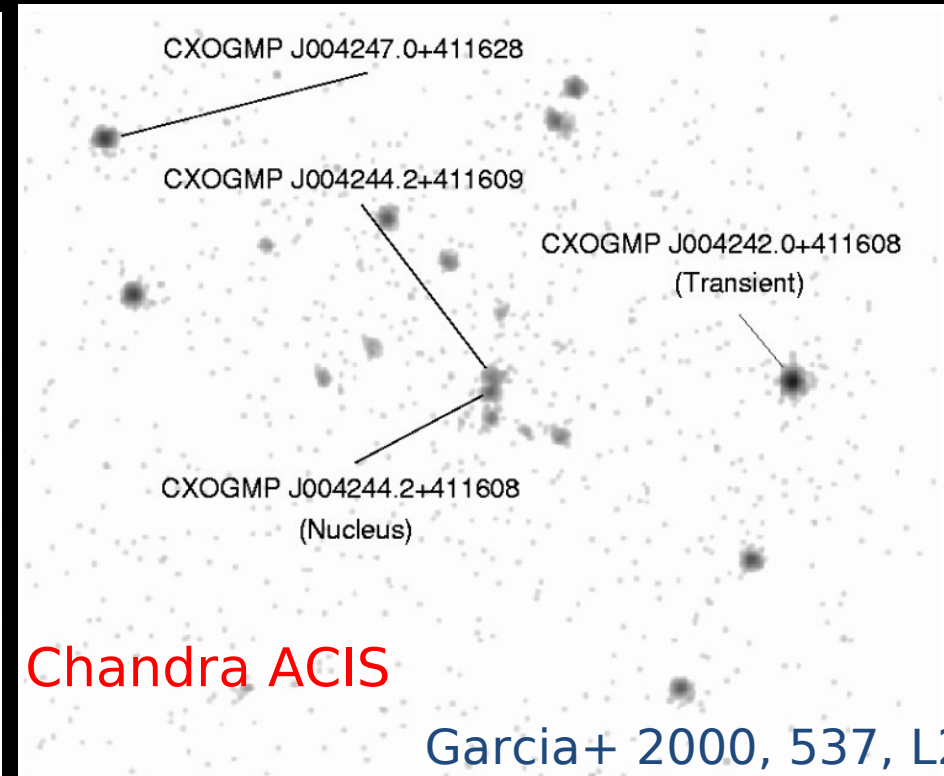
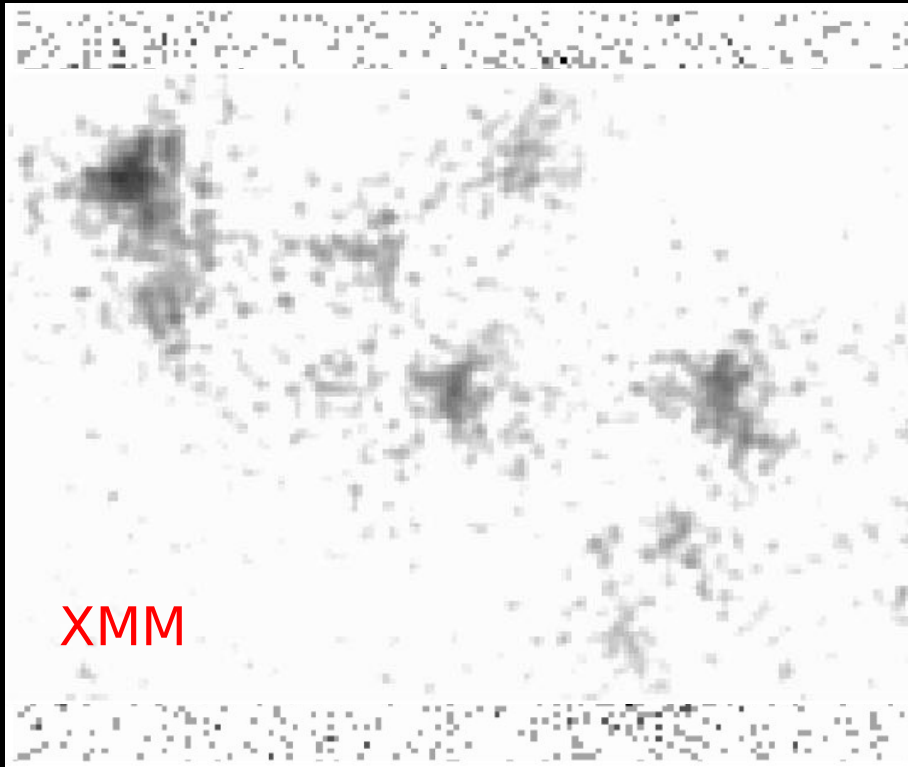
Infrared

Visible

Ultra-violet

X-ray

First Chandra Observation of M31



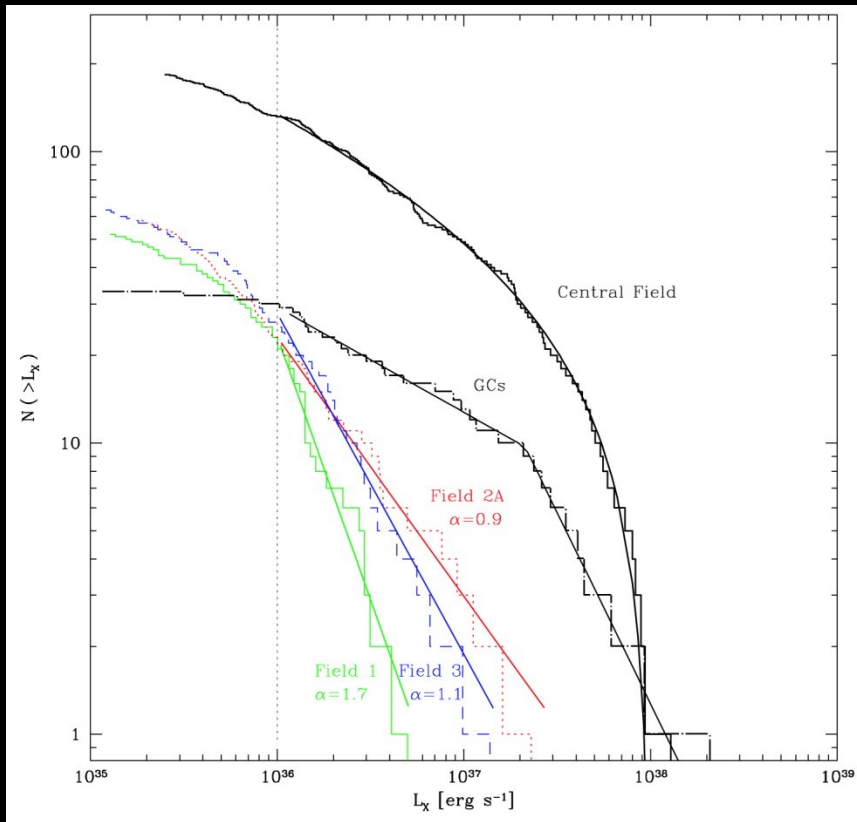
Chandra HRC-I



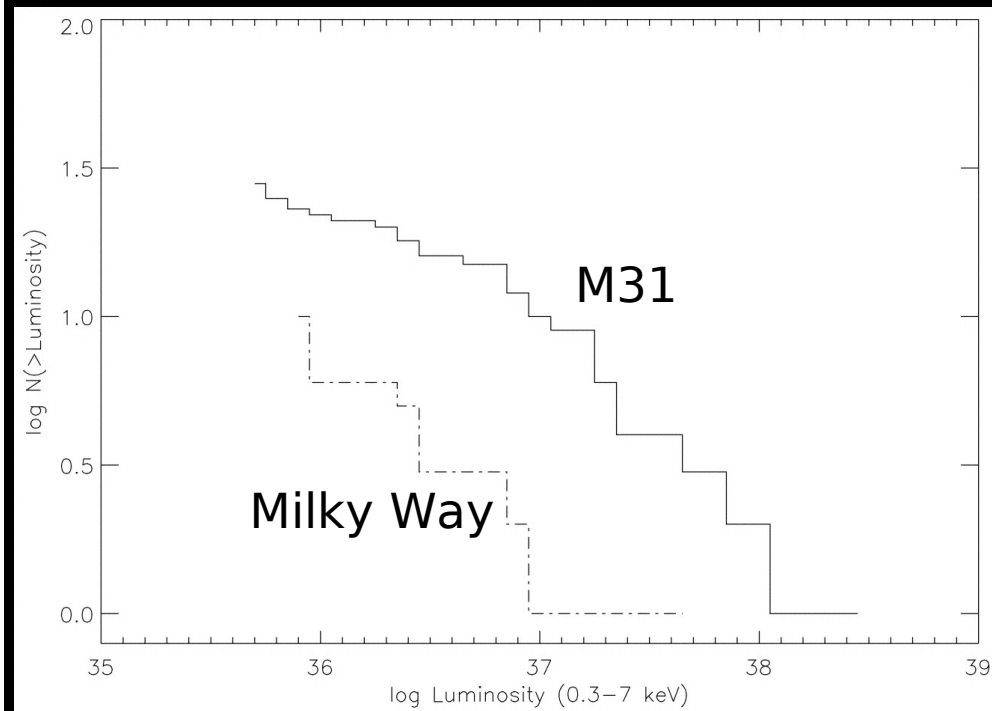
Bo375
Di Stefano+
2002
Yang+ 2009

Williams+ 2004; Kaaret 2002 (center only)

X-ray Luminosity Functions of M31



Kong+ 2003
See also Voss & Gilfanov
2007



Di Stefano+ 2003

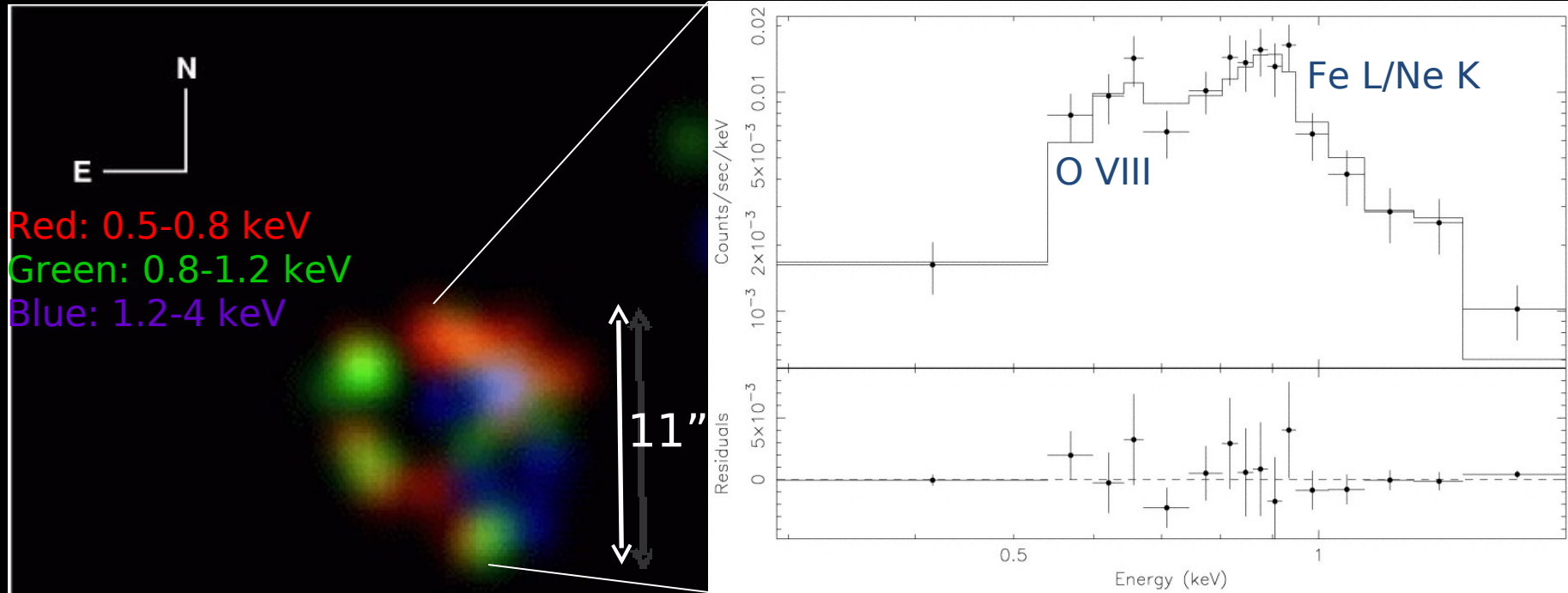
Diffuse X-ray Emission of M31

- 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 2000

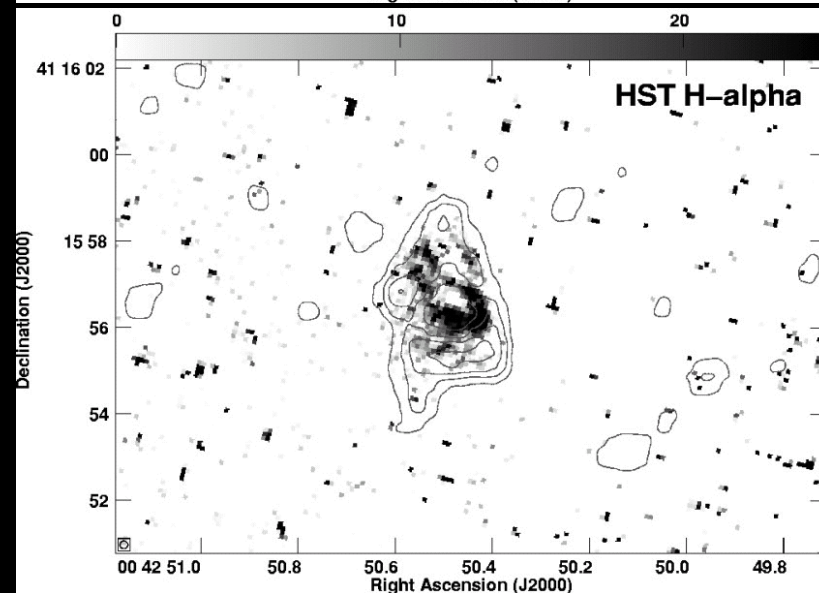
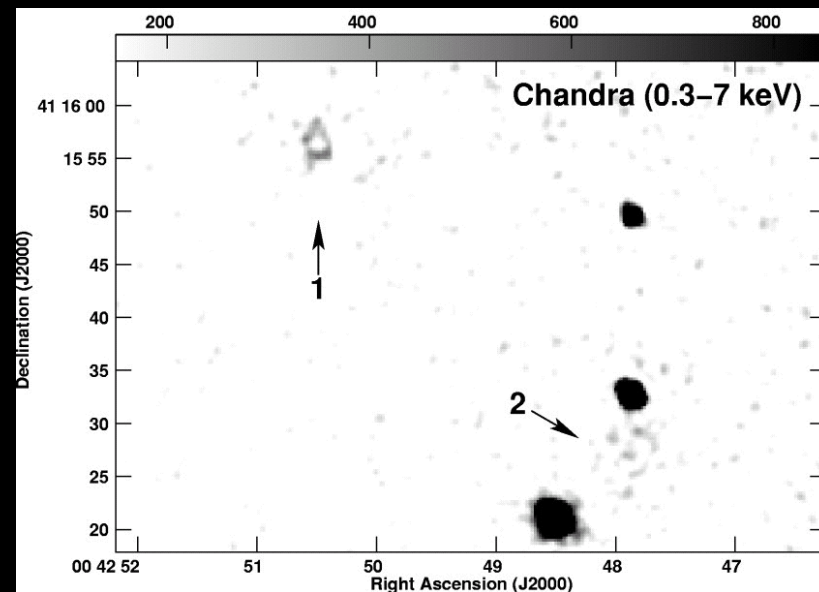
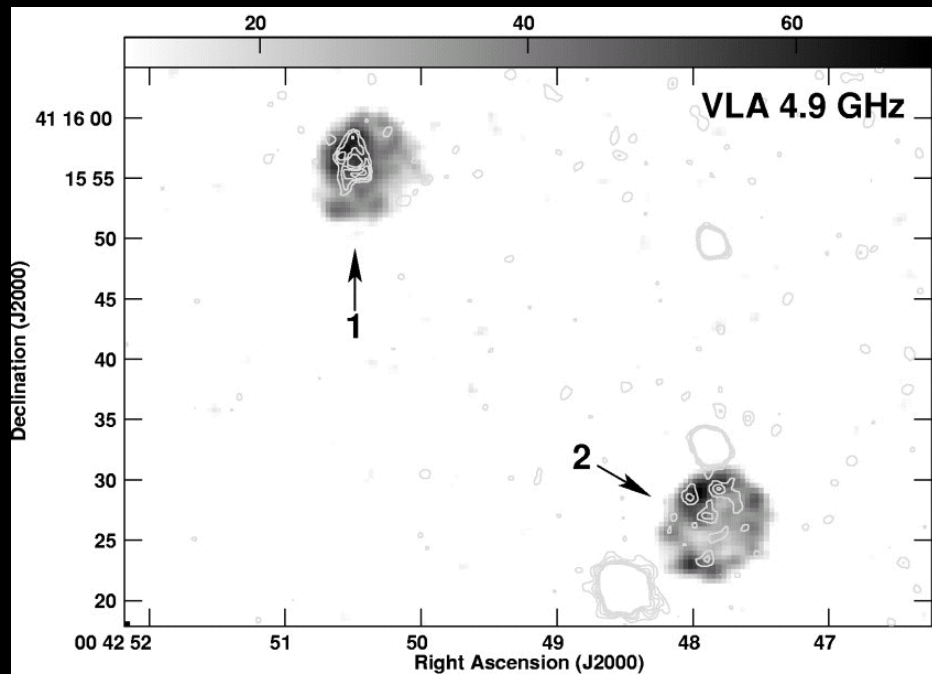
The first X-ray resolved SNR in M31



Kong+ 2002

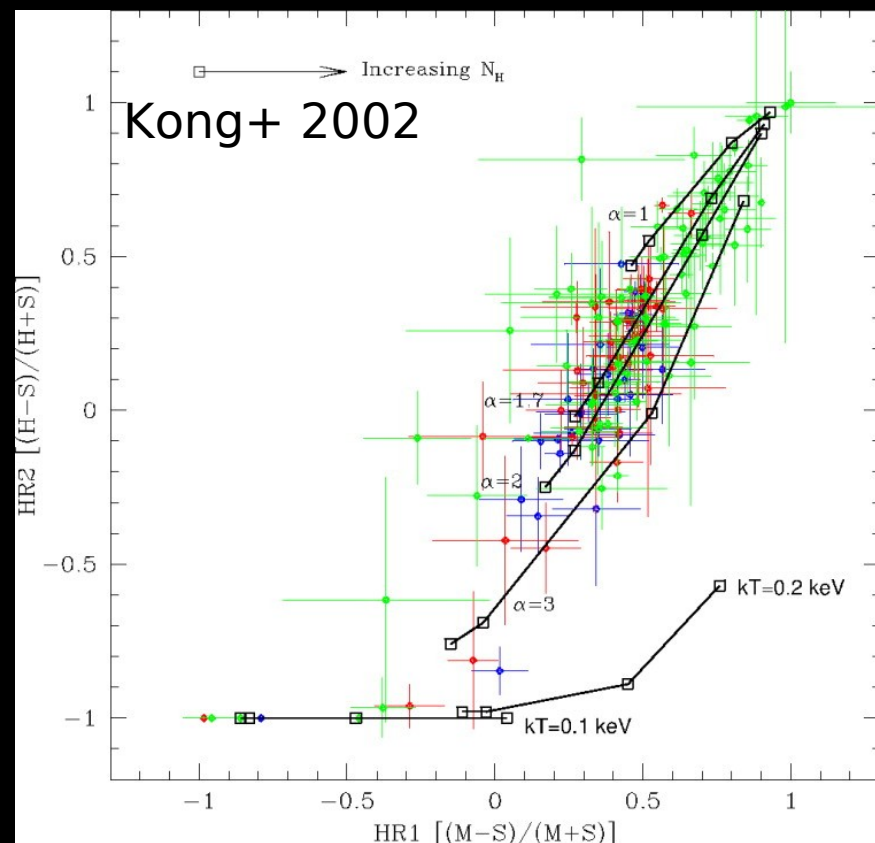
Raymond-Smith
model:
 $nH=4.6e21$,
 $kT=0.18$ keV
 $L_x=5e36$ erg/s

The First X-ray/radio/optical Resolved SNR in M31



Kong+ 2003
See also Williams+
2004

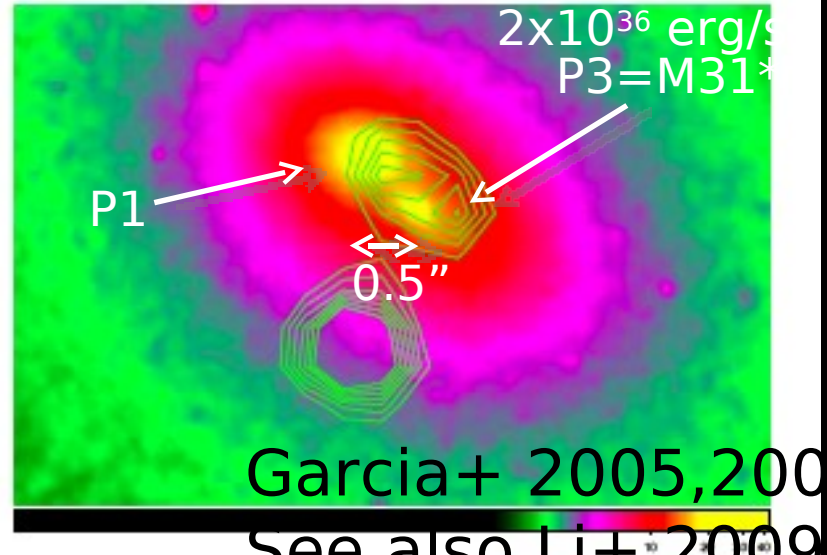
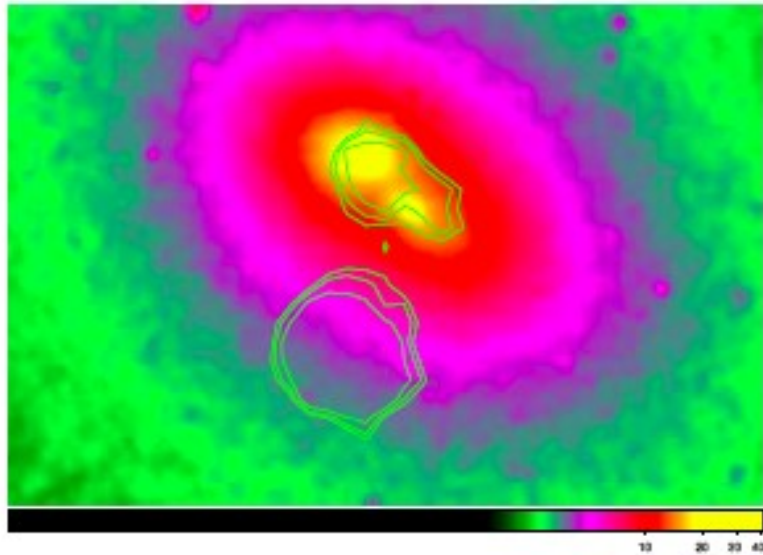
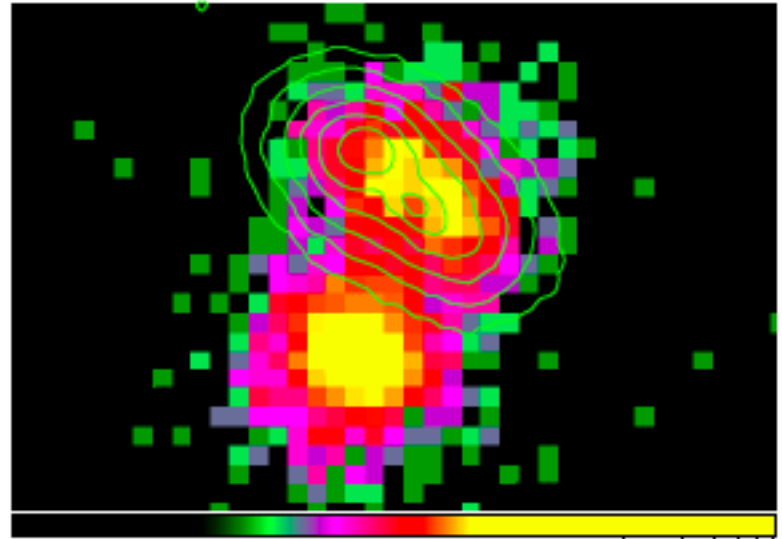
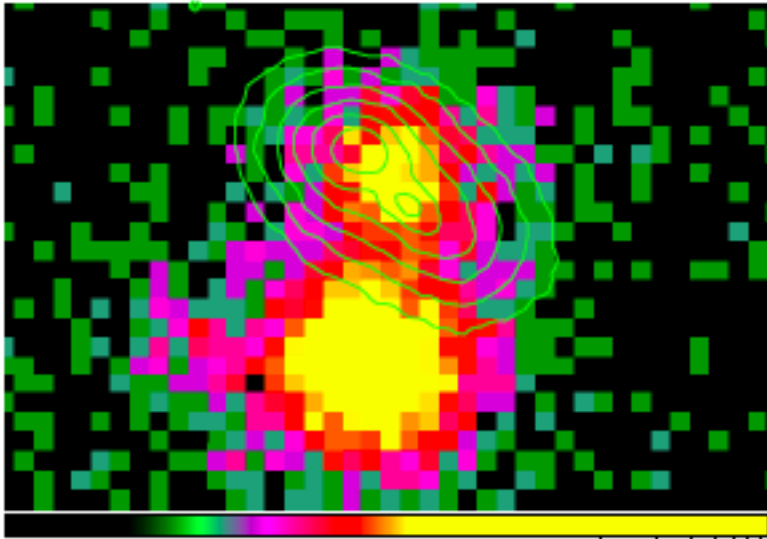
Supersoft and Quasi-soft X-ray Sources



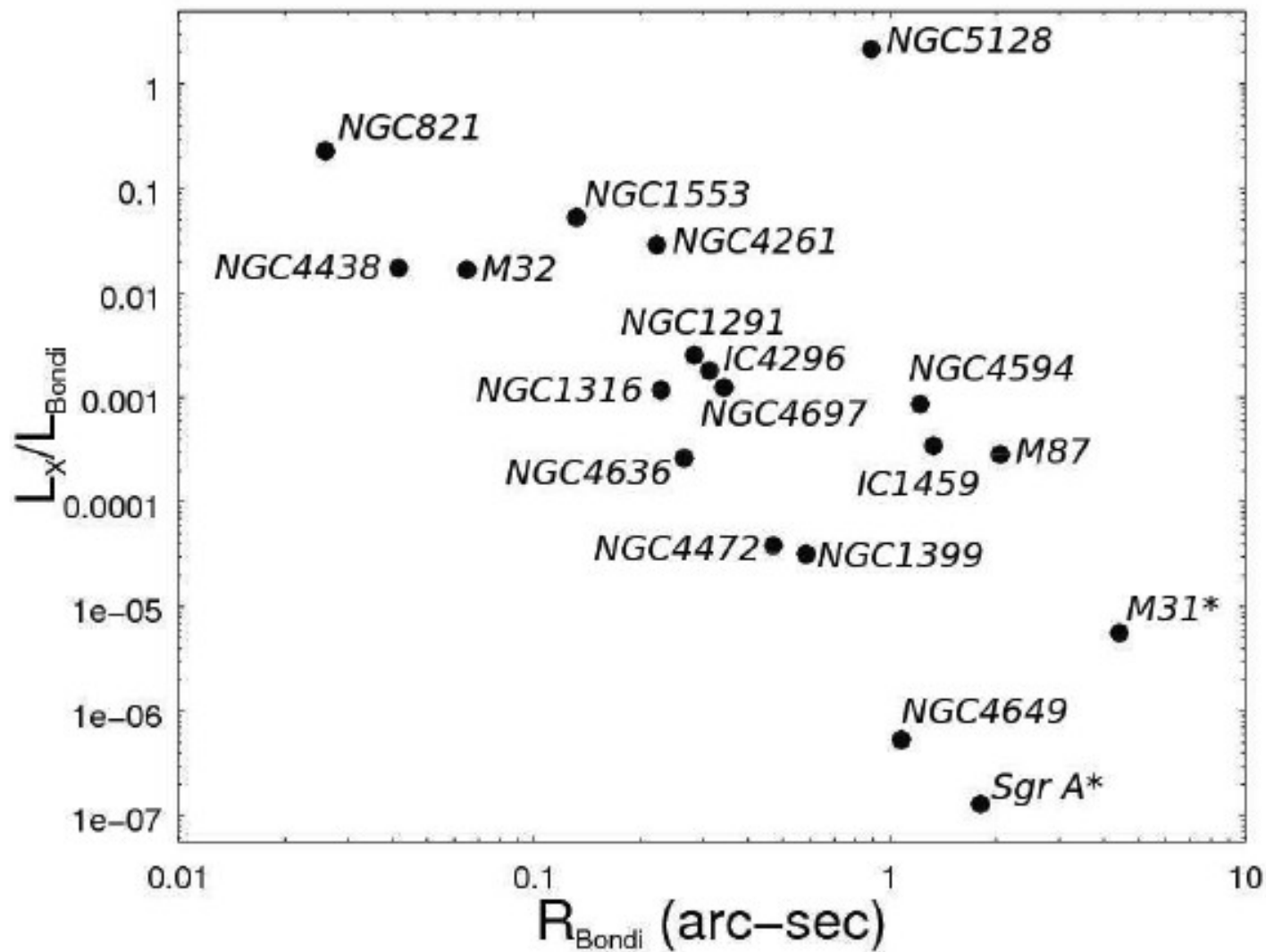
Poster 10.5, 10.13

- 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+

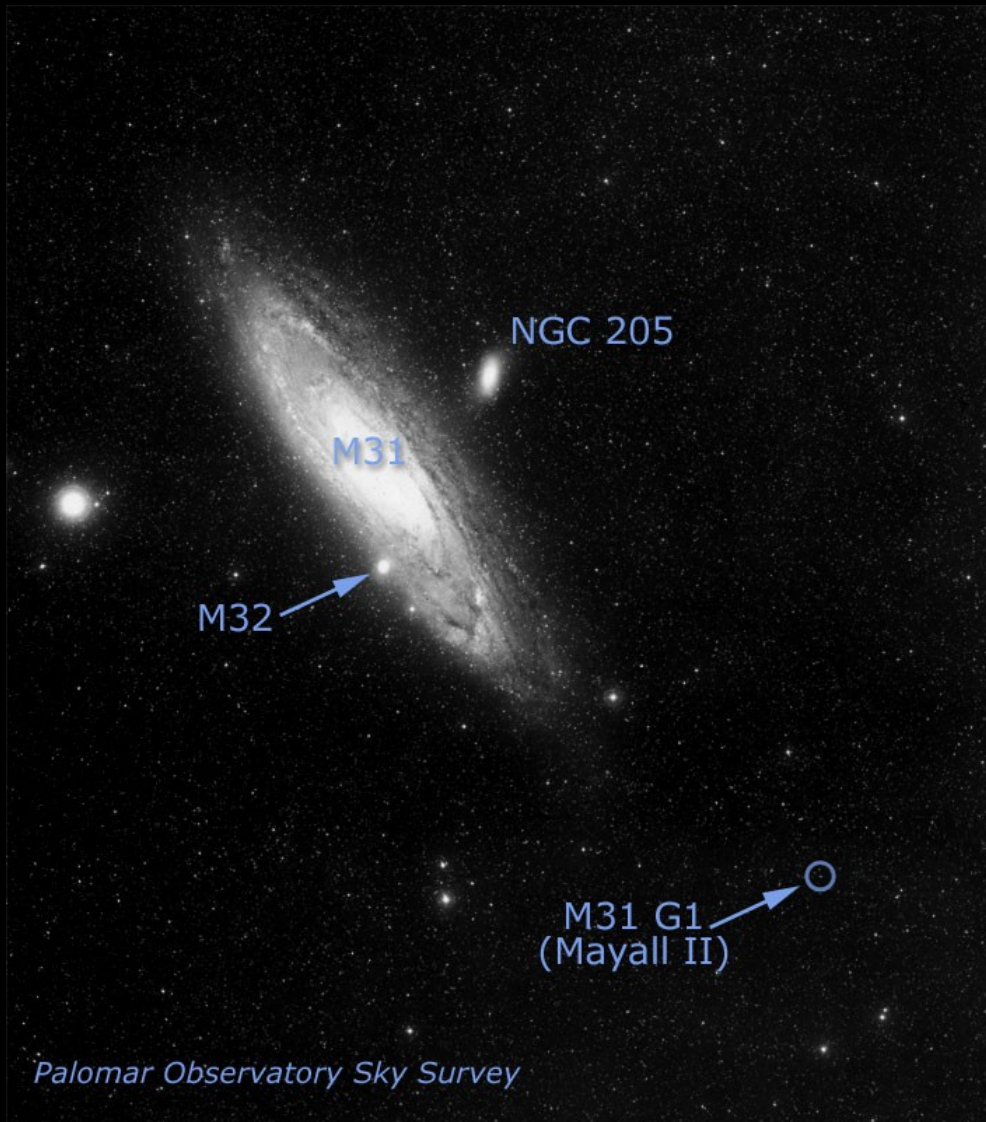
$1.4 \times 10^8 M_{\odot}$ Supermassive BH: M31*



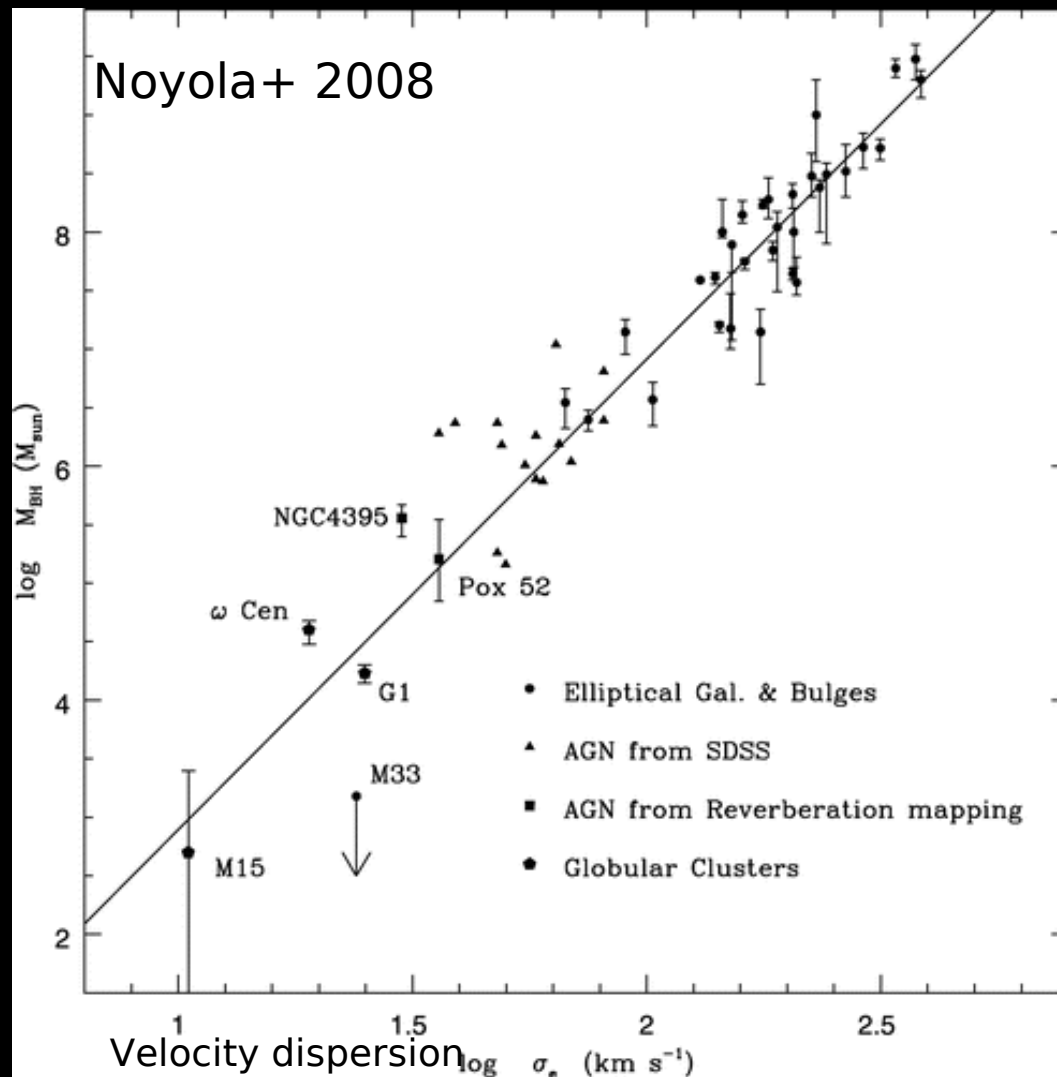
Garcia+ 2005, 2009
See also Li+ 2009



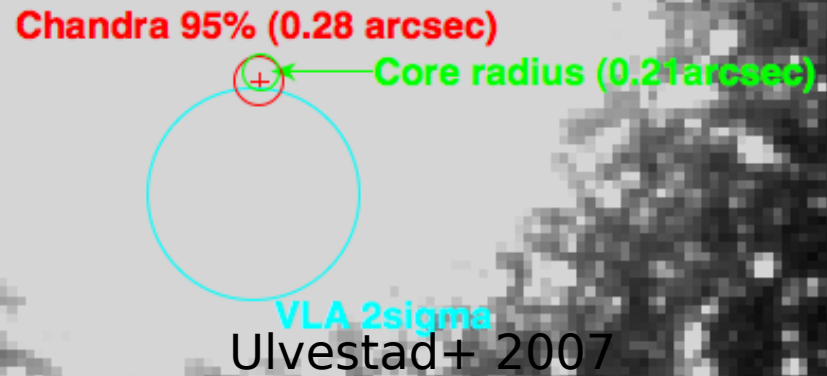
G1: a giant GC in M31



Globular Cluster G1 in M31 A 20,000 solar mass black hole?



HST/WFPC2 (F814W)



Kong+ in preparation

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