Highlights on Starburst Activity in Galaxies from XMM-Newton

Maria Santos-Lleo

Some XMM-Newton published results

M82

Read and Stevens 2002, MNRAS, 335, L36

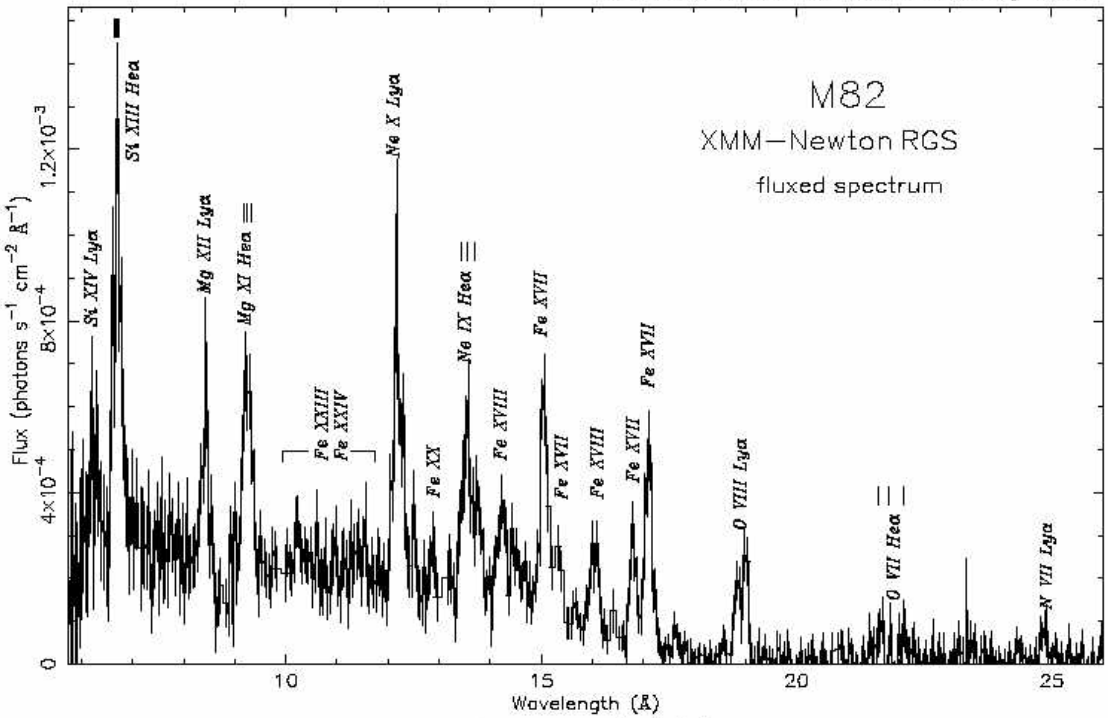
Integrated core: 1'.3-2'

Fe-L --> 'thermometer':

0.2<T<1.6 keV, peak 0.7keV

Abundances:

- **Mg 2.3-5.2**
- **Si > 4.6**
- **N < 3**
- **Ne > 1.4**
- **O 0.5-0.9**
- **Fe 0.8-14**



gure 1. The fluxed RGS spectrum (RGS 1 & 2, order 1) in counts cm^{-2} s^{-1} Å^{-1} of the nuclear M82 starburst. The identifications bright emission lines are indicated (see text for details). Resonance-intercombination-forbidden triples of the He-like species are also dicated (vertical lines).

XMM-Newton, results (2)

NGC 253

Pietsch et al. 2001, A&A 365, L174

Pietsch 2002

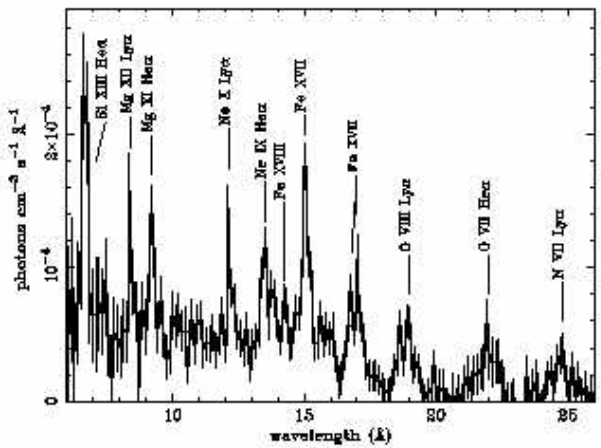


Figure 10. RGS spectrum of the bright nuclear area of NGC 253 covering nucleus and plume. Bright emission lines are identified.

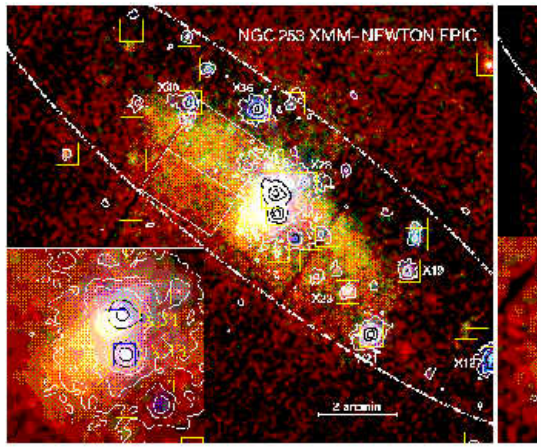


Figure 7. XMM-Newton EPIC low background images of the NGC energy bands (red: 0.2 0.5 keV, green: 0.5 0.9 keV, blue: 0.9 2.0 ke contours. The white ellipse indicates the optical D_{25} diameter of the et al. 2001), combining all EPIC instruments. ROSAT sources from extraction regions are indicated. (Right) SSC GT observation from

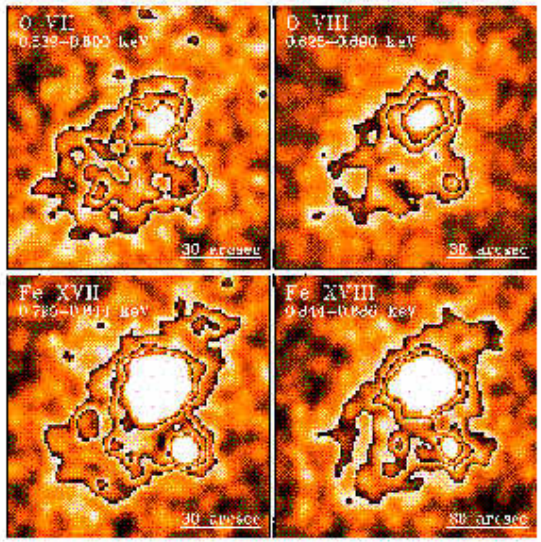


Fig. 7. XMM-Newton EPIC PN images of the NGC 253 clear area in the energy bands of four O and Fe emission li formed from low background times of both exposures us singles and doubles: **(upper left)** O VII (20.7 23.0 Å), **(upp right)** O VIII (18.0 19.6 Å), **(lower left)** Fe XVII (14.7 15.6 **(lower right)** Fe XVIII (14.0 14.7 Å)

Thermal plasma, 0.6, 0.9 and 6 keV, increasing N_H

~ Solar abundances

XMM-Newton, results (3)

NGC 1068

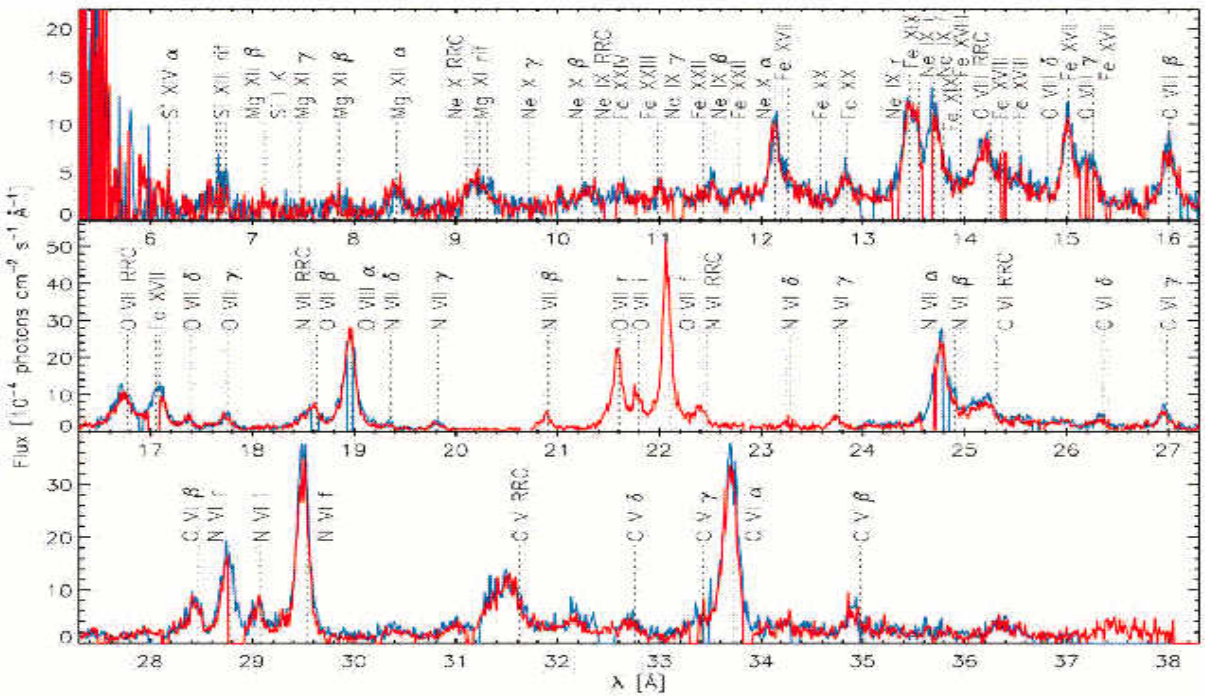


FIG. 1.—Effective area–corrected, first-order RGS 1 (*red*) and RGS 2 (*blue*) spectra of NGC 1068 shifted to its rest frame ($z = 0.00379$). The spectral discontinuities are due to chip gaps in the CCD arrays, bad pixels, and the previous inflight loss of one CCD for RGS 2 ($\lambda \sim 20$–24 Å). Line labeling indicates the final state ion. All H-like (α) and He-like (r, i, and f) principal order lines are labeled for each ion with the corresponding RRC edges indicated as well. Additionally, resonance transitions ($np \rightarrow 1s$) are labeled as β through δ (short for Lyβ–Lyδ and Heβ–Heδ). Several Fe L-shell transitions are listed as well. Unlabeled features at longer wavelengths (e.g., $\lambda = 27.45$, 27.92, 30.4, 31.0, 34.0–34.6, and 36.38 Å) are likely due to L-shell transitions in mid-Z elements. Line blueshifts are especially noticeable at longer wavelength.

Kinkhabwala, et al. 2002, ApJ 575, 732

XMM-Newton, results (4)

M81

T: 0.18, 0.64, 1.7 keV

~ solar abundances

Page et al. 2003, astro-ph 0301027

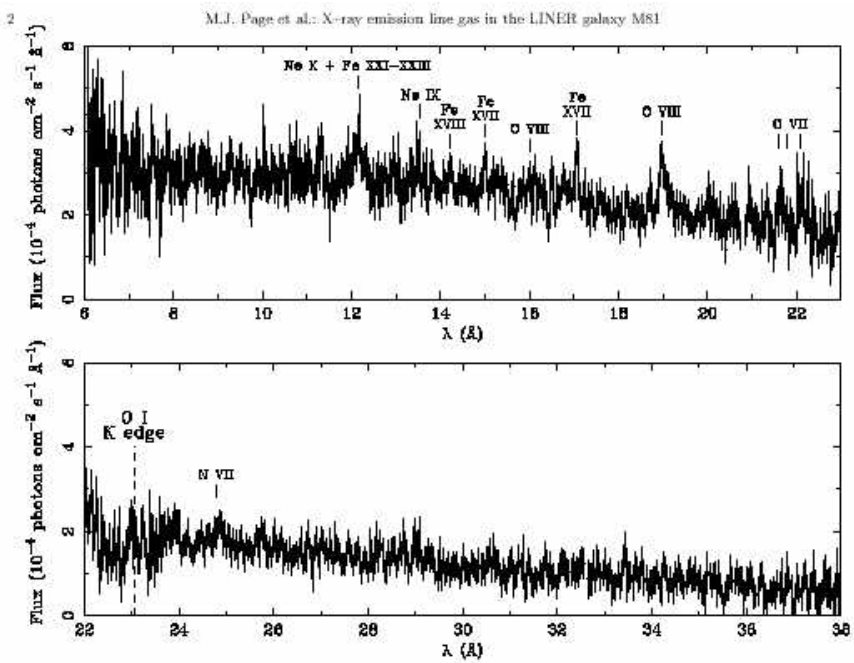


Fig. 1. The combined RGS spectrum with some prominent emission lines marked.

NGC 3079

Pietsch 2002

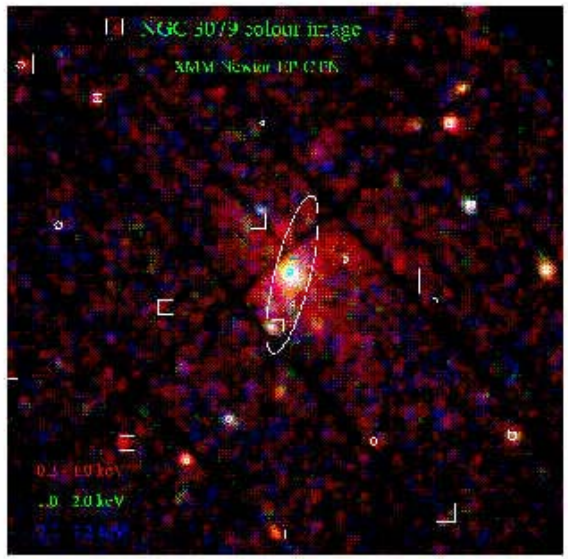


Figure 6. EPIC PN low background image for the NGC 3079 field. The colours represent X-ray intensities in different energy bands (red: 0.2 - 1.0 keV, green: 1.0 - 2.0 keV, blue: 2.0 - 7.2 keV). The white ellipse indicates the optical D_{25} diameter of the galaxy. ROSAT PSPC sources from Pietsch et al. (1998) are indicated by squares, HRI sources by circles. The symbol size represents the 90% confidence positional error. The position of SN 2001ei is indicated by the blue cross north of the galaxy center.

XMM-Newton, results (5)

M33

Pietsch 2002

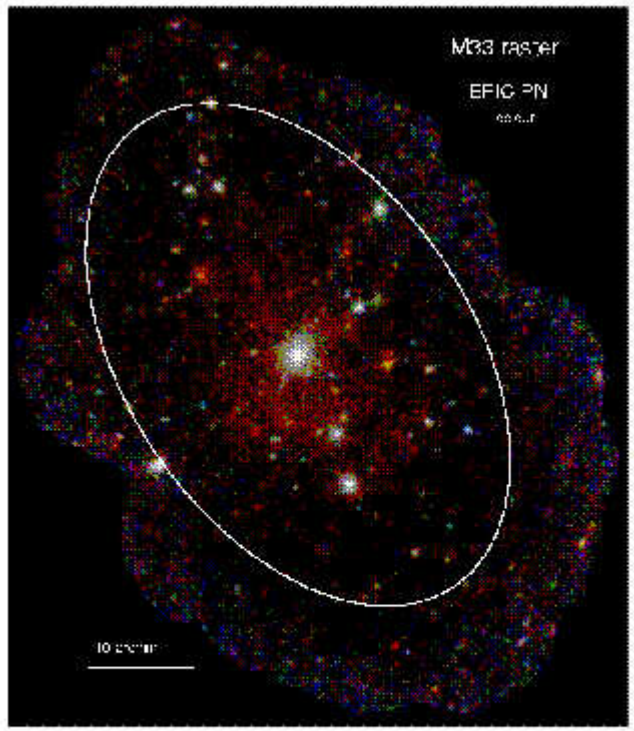


Figure 5. EPIC PN low background image of the 18 M33 raster observations. The colours represent X-ray intensities in different energy bands (red: 0.2 1.0 keV, green: 1.0 2.0 keV, blue: 2.0 7.2 keV). The white ellipse indicates the optical D_{25} diameter of the galaxy.

XMM-Newton

Instrumento	EPIC-MOS	EPIC-PN	RGS	OM
Banda de energía	0.15-12 k	0.15-15 k	0.35-2.5 keV	160-600 nm
Campo de visión	Diametro =30□	Diametro= 30□	5□	17□x17□
PSF(*FWHM*)	5”	6”	-	1”
Resolución espectral (1 keV)	70 eV	80 eV	0.04/0.025 Å	0.5/1.0 nm
Resolución temporal	1.5 ms	0.03 ms	16 ms	500 ms

XMM-Newton more data ?

- **Archive**:

http://xmm.vilspa.esa.es/xsa

already public data on M31, M33, NGC 253, NGC 1569, NGC 4649, NGC 4636 and many others

Galactic plane surveys

- **Next Call for proposals**

March 17- April 30

- **We offer help and collaboration at Vilspa:**

helpdesk

visitors

SAS workshop

Matthias Ehle (mehle@xmm.vilspa.esa.es) !!!

X-rays from the central regions of Galaxies with Starburst and a weak AGN

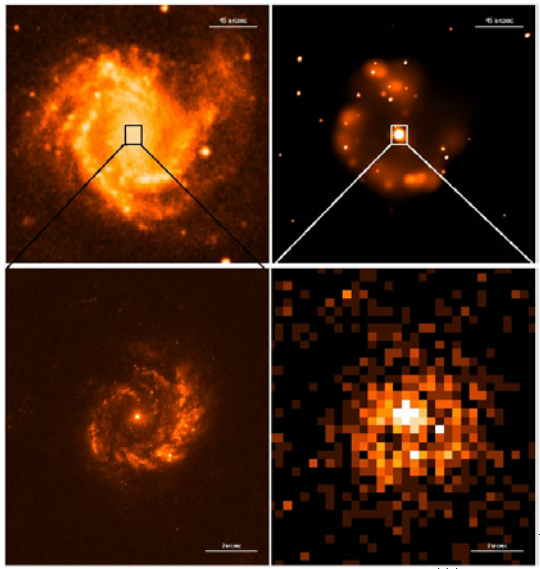
Elena Jimenez-Bailon

Maria Santos-Lleo

Miguel Mas-Hesse

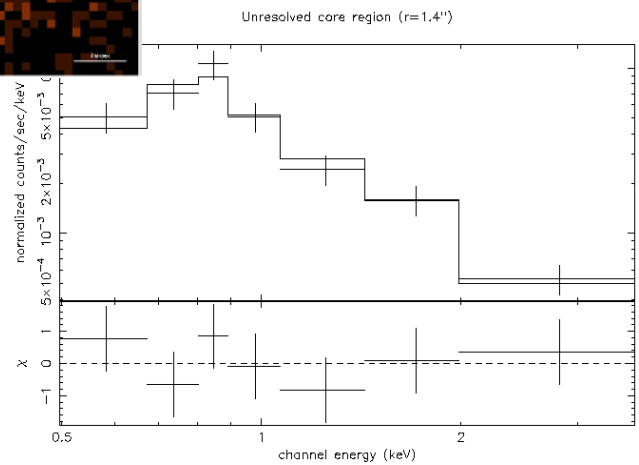
(collaborators: M.Dahlem, M.Ehle, M.Guainazzi, M. Cervino, L. Colina, R. Gonzalez-Delgado)

NGC 4303: Weak Seyfert 2 and Starburst



- The central soft X-ray emission of NGC 4303 traces a nuclear ultraviolet spiral structure and also the inner nuclear star-forming spiral.
- X-ray (*Chandra*) and UV (*HST*) data show the co-existence of an intermediate mass or supermassive BH with a young SSC within the 3 central pc.
- The core X-ray spectrum, r~110 pc, can be explained by a thermal componet, kT=0.6±0.3 keV, and a power law, Γ=1.2 ±0.6. The luminosities obtained are:

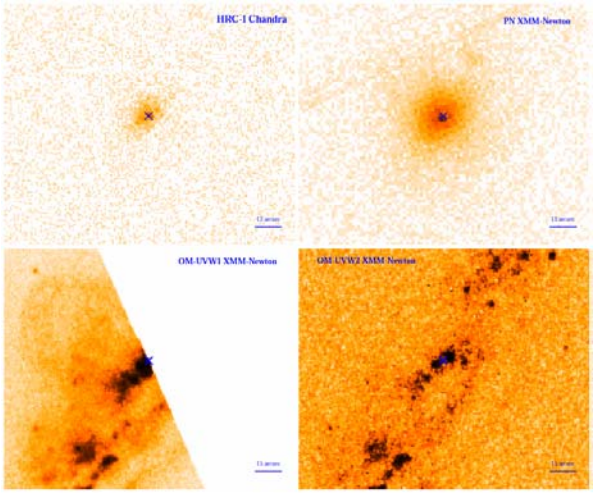
$L_{0.23\text{-}2keV}=6 \pm 3 \times 10^{38}$ ergs^{-1} $L_{2\text{-}10keV}=1.3 \pm 0.7 \times 10^{39}$ ergs^{-1}



(Jimenez-Bailón et al. 2003, ApJ submitted)

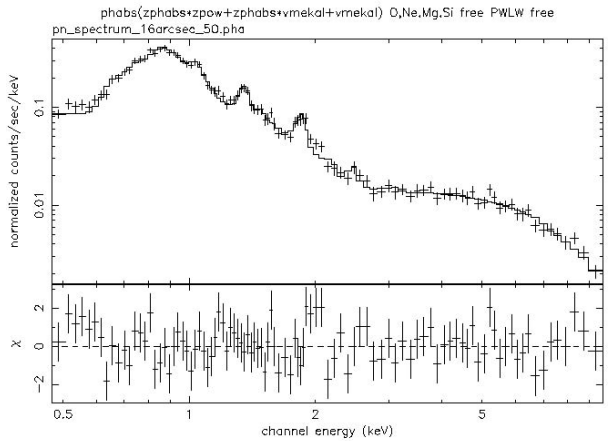
- The soft X-ray emission in the central region is associated to massive star-formation episodes. The young massive stellar cluster identified within the core region in the UV band account for the thermal core component. The hard X-ray luminosity, dominated by the power law component, cannot be explained by the massive stellar cluster contribution.

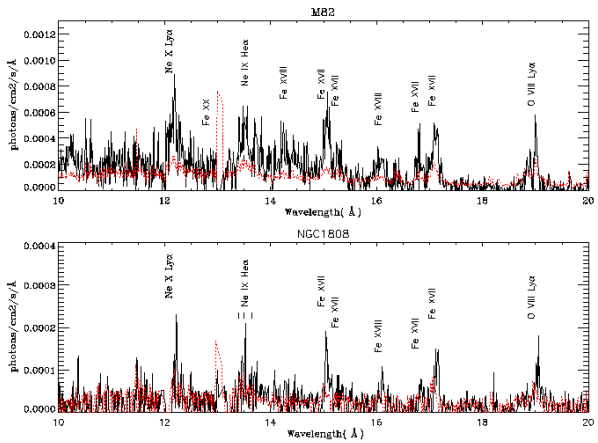
NGC 1808: Seyfert 2 vs. Starburst



- X-ray (*XMM-Newton* and *Chandra*) and UV (*XMM-Newton*) images of NGC 1808 are consistent: the location of the maximun luminosity correspond to an unresolved point-like source and coincides in both spectral ranges.
  - The bulk X-ray --> from the nuclear region.
  - *EPIC-pn* spectrum (central 850pc):
    - two thermal components which account for the main part of the soft X-ray emission,
    - a power law is required to explain the hard tail. Luminosity:

$$L_{2\text{-}10keV}=2\times10^{40}\ ergs^{-1}$$





- The *RGS* data --> no continuum emission larger than the noise, but exhibit emission lines. Wavelengths and relative ratios similar to the strongest features identified in the RGS data from the prototypical starburst galaxy M 82. --> the soft X-ray spectrum in NGC 1808 is best explained as in M 82, I.e. dominated by thermal emission from a starburst

Jimenez-Bailon et al. 2002, in MSSL High resolution X-ray spectroscopy