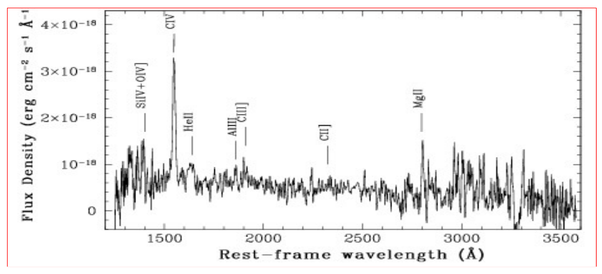
SPITZER observations of luminous obscured Quasars

E. Bellocchi[1], F. Pozzi[2], J. Fritz[2], C. Vignali[1,2], A. Comastri[2], M. Mignoli[2], on behalf of the HELLAS2XMM collaboration

(1) Dipartimento di Astronomia, Universita` di Bologna, Italy; (2) INAF-Osservatorio Astronomico di Bologna, Italy

We present Spitzer IRAC+MIPS observations of a sample of 8 luminous obscured AGNs selected in the 2-10 keV band from the 1.4 sq. deg. HELLAS2XMM survey. They are "certified" Type 2 quasars, with high-excitation narrow emission lines in their optical-UV spectra, high X-ray-to-optical flux ratios (X/O≥1), and with faint counterparts in R band (21.8<R<24.0). The Spitzer data allow us to compute the spectral energy distributions (SEDs) of these AGNs, hence an estimate of their bolometric luminosities.

The sample



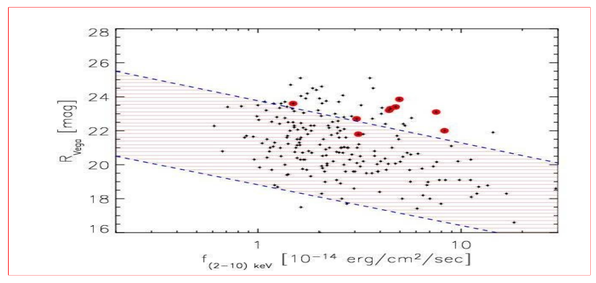
8 Type 2 QSOs (z=0.7-2.0)

High-ionization narrow emission-lines AGNs

Pks 0537#043 (Fiore et al. 2003; Vignali & Mignoli 2006)

$z = 1.797$, $L_X = 6.3 \times 10^{44}$ erg/s, $N_H = 1.1 \times 10^{23}$ cm^{-2}

R magnitude to X-ray flux (2-10 keV) relation

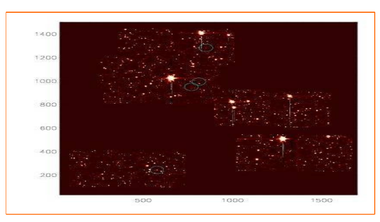


In this figure we report the whole HELLAS2XMM sample on which the 8 sources are marked in red. The upper dashed line represents the place where X/O = 1, the lower one corrisponds to X/O = -1. The 8 AGNs show a **X/O** ratio **≥ 1**.

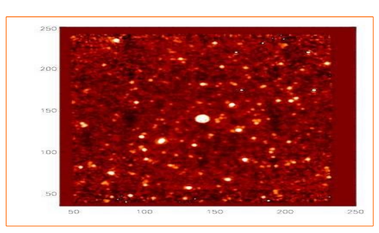
$$X/O = \log(F_X/F_R) = \log F_X + R/2.5 + 5.5$$

They are likely associated with LUMINOUS, OBSCURED AGNs at HIGH REDSHIFTS

Spitzer observations



IRAC 1 image (3.6 μm) FOV 5.2'x5.2'

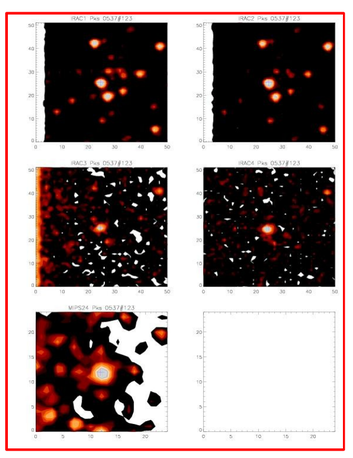


MIPS image (24 μm) FOV 5.4'x5.4'

SPITZER data (PI:Comastri)

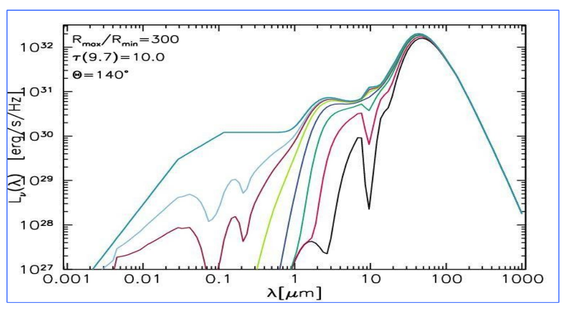
- ✓ IRAC (3.6, 4.5, 5.8, 8.0 micron)
- ✓ MIPS (24 micron)

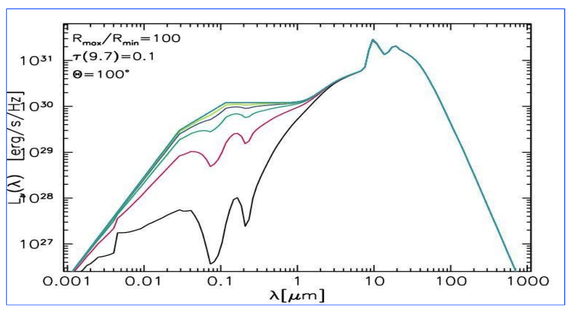
Spitzer data analised with an IDL procedure (all sources but 2 detected in all bands)



Spectral Energy Distributions Analisys

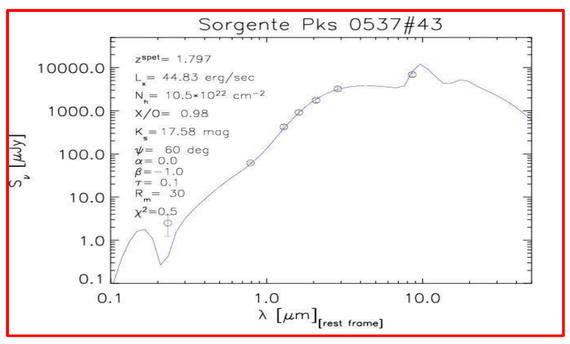
"Matching" the IR SEDs with Fritz et al. (2006) models

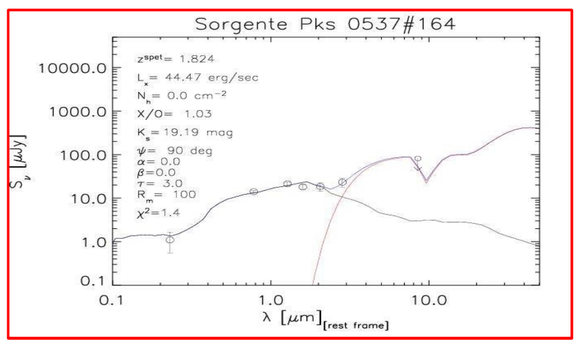




The broad band SEDs were fitted with the torus model of Fritz et al. (2006). Examples in Figures show the emission spectra for different model parameters (optical depth τ_{eq}, torus opening angle **Θ**, radius max/min ratio **R**) and for 10 different line-of-sight inclinations (from 0° to 90°).

RESULTS





For all sources but 2 the optical and IR SEDs are accounted for by the torus model of Fritz et al. (2006); for the remaining 2 the best fit is obtained adding an elliptical galaxy template to the torus model.

The following parameters (optical depth τ_{eq}**(9.7μm)** , angle of view **Ψ**, covering factor **f**, column density N_H) are computed:

2. For 6 sources $\tau_{eq}(9.7\ \mu m) = 0.1 \approx A_V \sim 2.1\text{-}2.3$

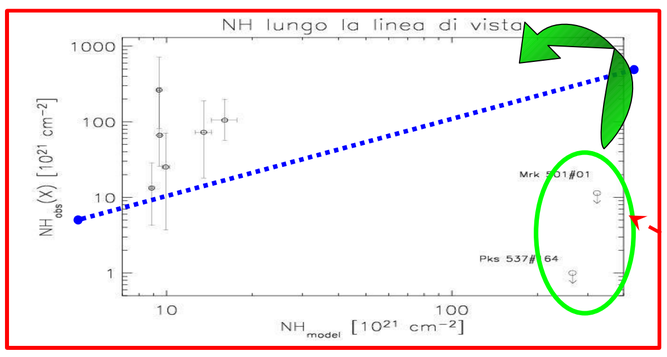
   For 2 sources $\tau_{eq}(9.7\ \mu m) = 3.0 \approx A_V \sim 60$

   (with galaxy)

5. Angle of view $\Psi \approx 0°\text{-}30°$

   (0° ≡ equatorial plane)

7. Covering factor f ≈ 0.1-0.6



The N_H measured from the X-ray spectra is 1-10 times higher than that estimated with the torus model!!!

- ✓ The 2 sources with high dust absorption might be also **heavily obscured in X-ray (*Compton thick*)**
- ✓ **Gas-to-Dust ratio > Galactic ratio**

Last results & future prospects

Using the Spitzer data to estimate the bolometric luminosity

Our sample has been compared with another sample selected in the same way from HELLAS2XMM

-Pozzi et al. (2007)-

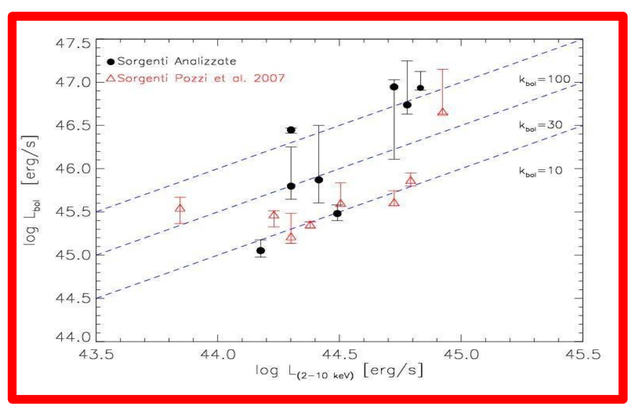
Bolometric luminosity $L_{bol} = L_{IR} \cdot 1/f + L_{(0.5\text{-}500)\ keV}$

Bolometric correction

$K_{bol,2\text{-}10\ keV} = L_{bol} / L_{(2\text{-}10)\ keV}$

$\langle K_{bol,2\text{-}10\ keV} \rangle \approx 90$ (min 8÷ max 145)

... LARGE SPREAD !!!



Future prospectives:

- ✓ Consider the **70** and **160** micron data
- ✓ And the **X-ray** data in the SEDs to PARTIALLY ***ELIMINATE*** the degeneracy in the fitting

REFERENCES: *Fiore F. et al. 2003, A&A, 409, 79; Pozzi et al. 2007, A&A, 468,603, Fritz et al. 2006, MNRAS, 366, 767; Vignali C., Mignoli M., 2006, Adv. Sp. Res., in press (astro-ph/0504278)