IRAS 13197-1627: a composite AGN-starburst galaxy (I)

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GM et al 2006 MNRAS submitted
IRAS 13197-1627 is a nearby (z=0.16) Luminous IR galaxy

with $L_{\text{IR}} (80-1000\mu\text{m}) = 1.7 \times 10^{11} \ L_{\odot} = 6.7 \times 10^{44} \text{ erg s}^{-1}$

It was initially classified as a Seyfert 2 but later became Seyfert 1.8

Radio is moderately extended with $L_{1.4\text{GHz}} = 1.6 \times 10^{30} \text{ erg s}^{-1} \text{ Hz}^{-1}$

It was observed in X-rays by ASCA in 95 (Ueno 97)
SAX in 98 (Risaliti 02; Dadina & Cappi 05)

ASCA: $\Gamma \sim 3.0$ and $N_H \sim 7 \times 10^{23} \text{ cm}^{-2}$
SAX: $\Gamma \sim 2.5$ and $N_H \sim 4 \times 10^{23} \text{ cm}^{-2}$

+ The SAX spectrum is complex (PC or RD) and implies $L_{2-10} \geq 10^{44} \text{ erg s}^{-1}$
First look: absorbed AGN (Fe edge and Fe K line plus low-E cutoff) structured "soft excess" below 2-3 keV

Variability: soft is consistent with no variability
            hard is (slightly) more variable
IRAS 13197-1627 with XMM-Newton

2-12 keV band: an absorbed Compton-thin ($4 \times 10^{23}$ cm$^{-2}$) AGN, but

Fe K is resolved ($\sigma \sim 100$ eV)

transmitted Fe K EW and Fe edge suggest Fe is 1.5-2 x Solar

6.8 keV absorption line (rest-frame)

Positive residuals $> 10$ keV and in 5-6 keV band
the 6.8 keV absorption is significant and confirmed in the MOS data

most likely Fe XXV resonant absorption (6.697 keV) blue-shifted by 5000 km/s with a Fe XXV column of $10^{19}$ cm$^{-2}$

Outflow? Maybe … but notice that $zc = 4959$ km/s … (local hot bubbles?)

see McKernan et al 05
the final fit is very good but **SAX does not like it very much ...**
a reflection component from the disc improves the stats (99% level)
the hard spectrum is reflection-dominated (e.g. GM & Fabian 04 see Ponti’s talk)
the narrow component of the Fe K is now truly unresolved
$L_{2-10}\ (XMM) \sim 4-5 \times 10^{43}\ erg\ s^{-1}$ and $L_{2-10}\ (SAX) \sim 1-2 \times 10^{44}\ erg\ s^{-1}$

IRAS 13197-1627 is a local borderline type 2 Seyfert/QSO
long-term variability is negligible

literature data were used to infer $N_H$ variability ([Risaliti et al 03])

but we do not confirm it

the absorber can be placed arbitrarily far away from the nucleus in agreement with the unresolved Fe K line in the final (RD) fit
IRAS 13197-1627 with XMM-Newton

The soft band is dominated by emission lines from BOTH PHOTOIONIZED GAS and COLLISIONAL PLASMA.
IRAS 13197-1627 is a composite galaxy

the hard X-rays are dominated by a reflection-dominated luminous AGN (Seyfert/QSO borderline)

the soft X-rays are dominated by emission from AGN-ionized gas and by star-forming regions

\[
\text{SFR}_X \sim 2.2 \times 10^{-40} L_{\text{thermal}} \sim 33 \, M_{\text{Sun}} \, \text{yr}^{-1}
\]

\[
\text{SFR}_R \sim 2.5 \times 10^{-29} L_{1.4 \, \text{GHz}} \sim 30 \, M_{\text{Sun}} \, \text{yr}^{-1}
\]

\[
\text{SFR}_{IR} \sim 1.66 \times 10^{-44} L_{\text{IR}} \sim 37 \, M_{\text{Sun}} \, \text{yr}^{-1}
\]

(Kennicut 98 and Ranalli et al 03)
MCG-03-34-63 ULX-1:
the most luminous ULX detected so far?

GM et al 2006 in prep
The central region

X-ray contours

IRAS 13197-1627

MCG-03-34-63
The central region

\( N_H \sim 3.8 \times 10^{22} \text{ cm}^{-2} \)

\( \Gamma \sim 2.3 \)

and from the Fe K detection

\( z = 0.16 \pm 0.06 \) giving

\( L_{2-10} \sim 1-2 \times 10^{43} \text{ erg s}^{-1} \)
The central region

MCG-03-34-63

IRAS 13197-1627

X-ray contours
MCG-03-34-63: VLA+DSS +MOS

VLA (21cm)
DSS (4680 A)
MOS (0.3-10 keV)
X-ray data analysis

an absorbed power law fit is good with $\Gamma = 1.9$

we measure excess absorption of $2.3 \times 10^{21}$ cm$^{-2}$ making it highly unlikely that we are looking at a foreground X-ray source
A background AGN or a ULX?

By assuming the observed logN-logS (e.g. COSMOS, Brusa’s talk)

\[ N_{\text{XRB}} \sim 100 \times (S_{0.5-2}/10^{-14})^{-1/4} \times \text{Area} \]

we expect < 0.02 sources in D_{25}

it is most likely within the galaxy at z = 0.021 and thus

\[ L_{1.2-10} \sim 7.4 \times 10^{40} \text{ erg s}^{-1} \]

or by extending the model \[ L_{0.2-100} \sim 2.3 \times 10^{41} \text{ erg s}^{-1} \]

if taken at face value it would imply an IMBH with \[ M_{\text{BH}} \sim 1800 \, M_{\text{Sun}} \]
HST 500s observation

MCG-03-34-63

IRAS 13197-1627
HST 500s observation
Possible Optical counterpart(s)

Chandra is required (and multi-\(\lambda\) follow-up)

grazie