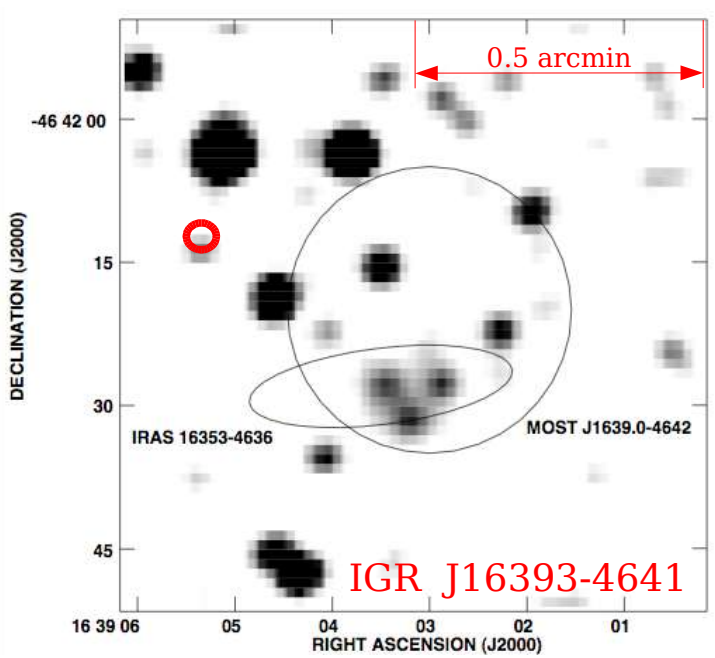

INTEGRAL brings
the most obscured sources of the galaxy
to light

Unidentified Source

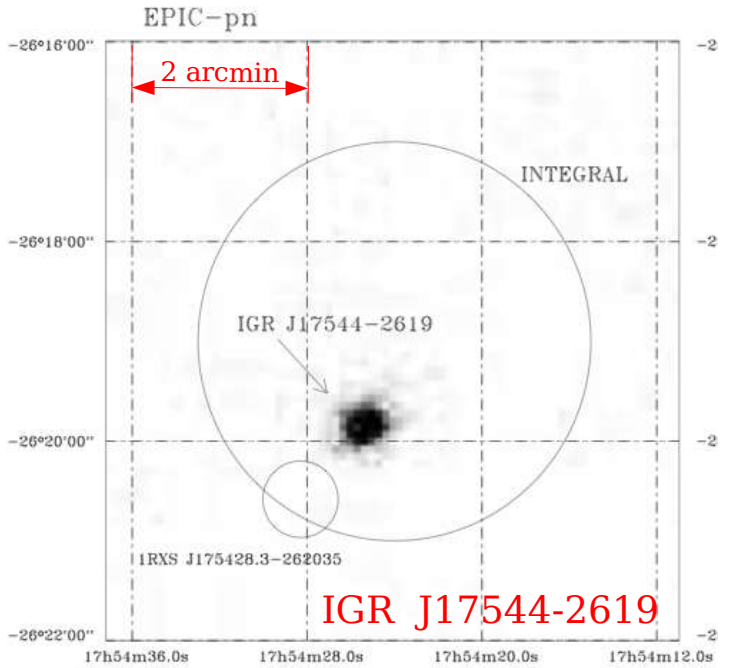
Among 43 IGR sources:

- 4 were known ASCA faint sources (Sugizaki)
- 1 was a known RXTE source
- 25% of the INTEGRAL sources have possible ROSAT counterpart (50% of the INTEGRAL detected sources have ROSAT counterpart) (Stephen et al)
- 2-5 are probably AGNs (Bassani et al)

ISGRI positions are not good enough to find counterpart:

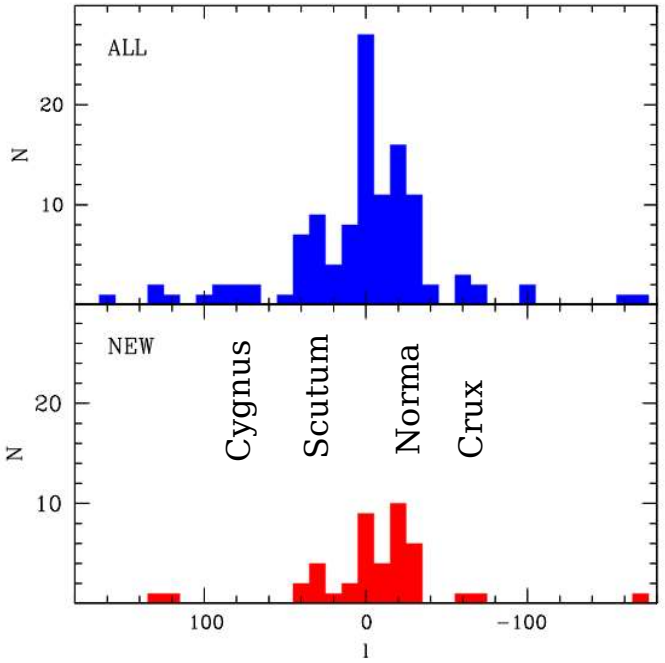


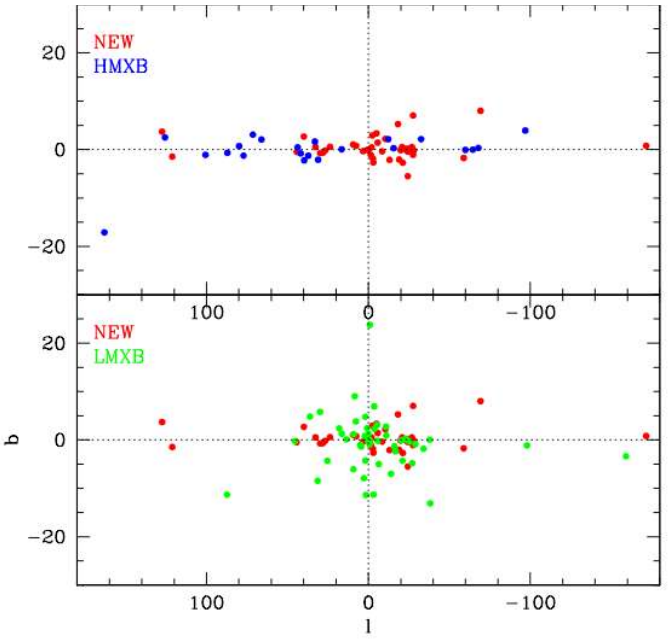
Combi et al, 2004

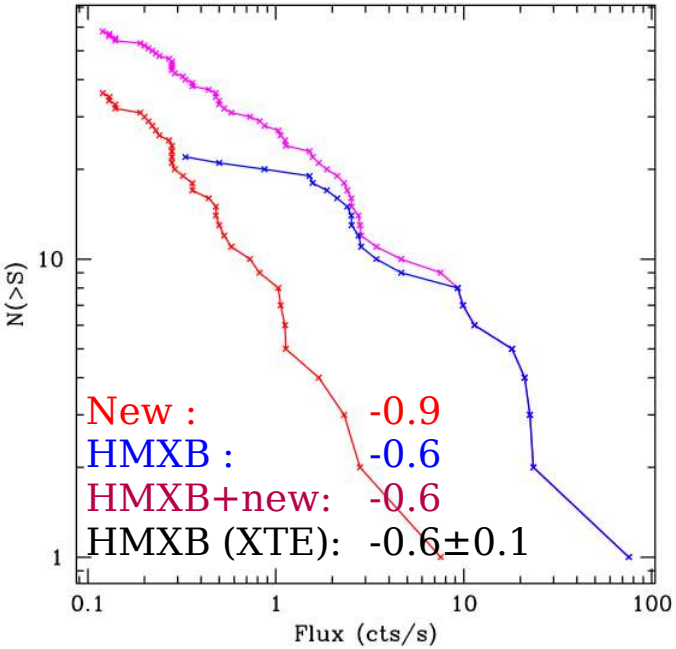


Gonzales-Riestra et al, 2004

IGR source galactic distribution

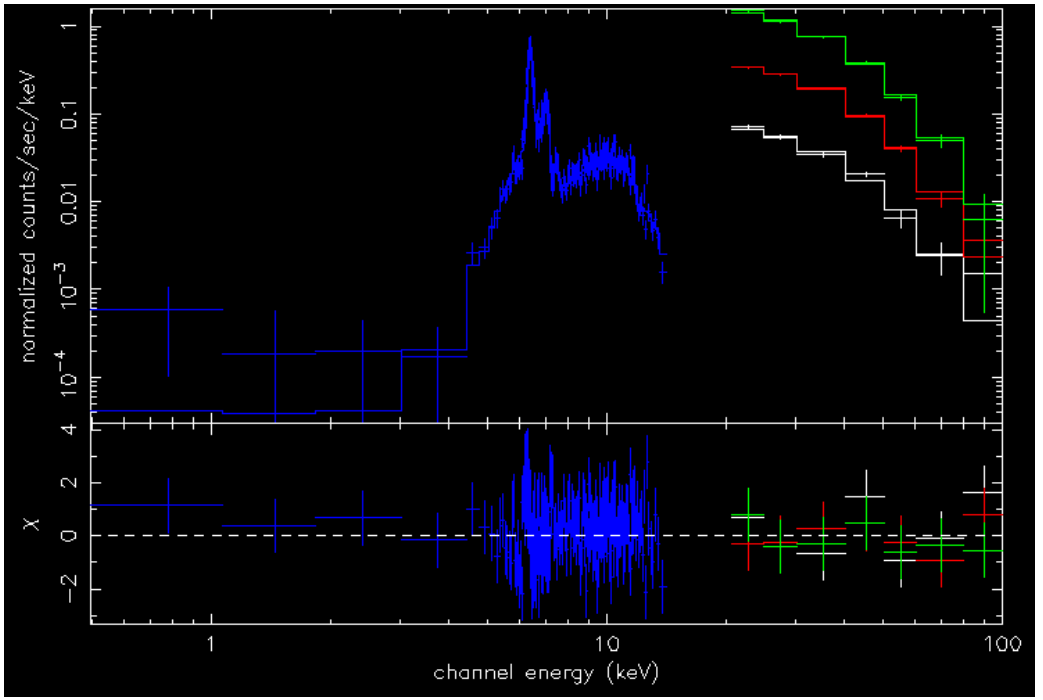






- IGR source over-density in the Norma arm tangent region (5–8kpc)
- A good fraction of the new INTEGRAL sources should be HMXB

IGR J16318-4848



Comptonized spectrum:

N_H	=	184±6	10^{22}cm^{-2}
kT	=	9±0.5	keV
τ	=	4.3±0.4	

+ narrow Fe Kα, Kβ and Ni Kα lines

Unabsorbed fluxes:

$F_{20\text{-}100\ keV}$	=	4-80	10^{-10} erg/s/cm^2
L_{5kpc}	=	1-20	10^{36} erg/s

Transmission geometry (Matt & Guainazzi, 2003)

Counterpart:

- sgB[e] star (HMXB)
  cold and hot stellar wind components
- several kpc away
- dusty circumstellar envelope
  E(B-V)=6, 100 times smaller than N_H

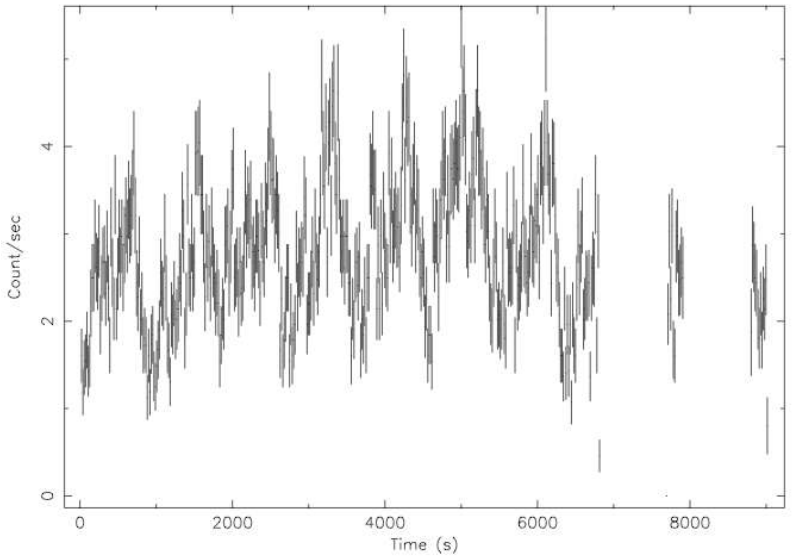
Filliatre & Chaty, 2004

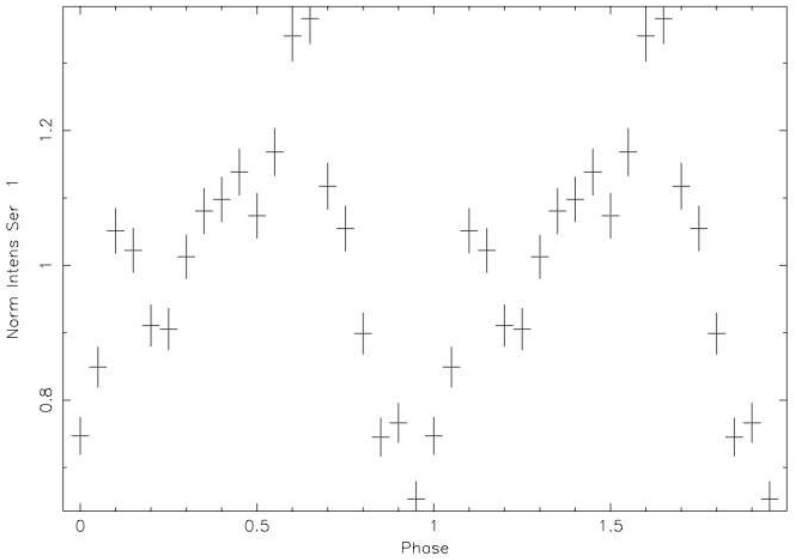
Variability:

- N_H not related to flux
- Reprocessing region ≈ 10^{13} cm
- Flux is highly variable (factor of 20)
- 10 hours between flares
- 2-3 days of inactivity are also observed

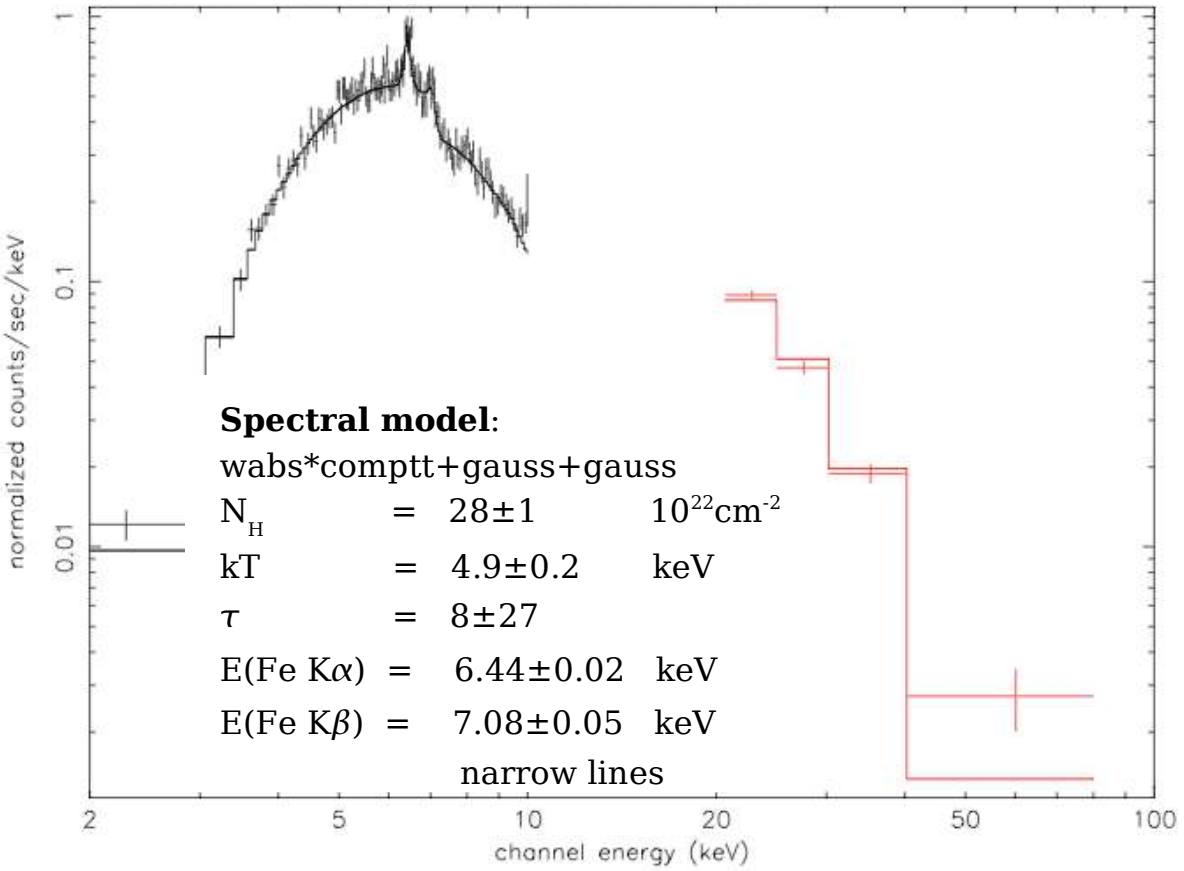
IGR J16393–4641

INTEGRAL and XMM results





XMM/EPIC/PN INTEGRAL/IBIS/ISGRI



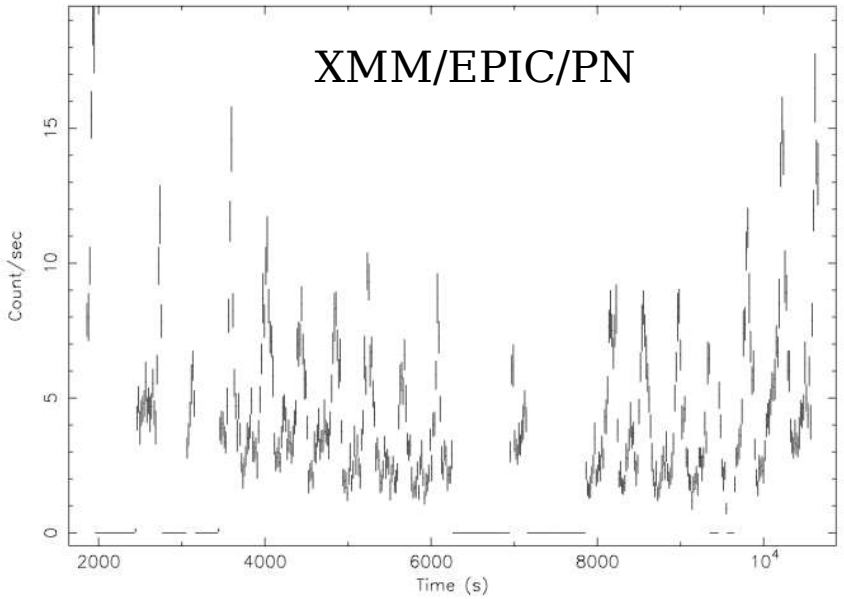
Spectral model:
wabs*comptt+gauss+gauss

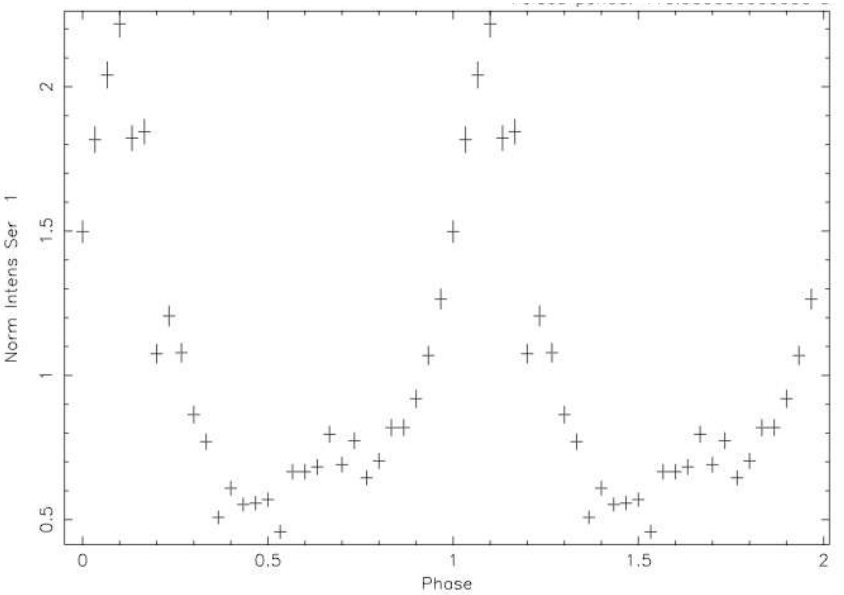
N_H	=	28±1	$10^{22}cm^{-2}$
kT	=	4.9±0.2	keV
τ	=	8±27	
E(Fe Kα)	=	6.44±0.02	keV
E(Fe Kβ)	=	7.08±0.05	keV

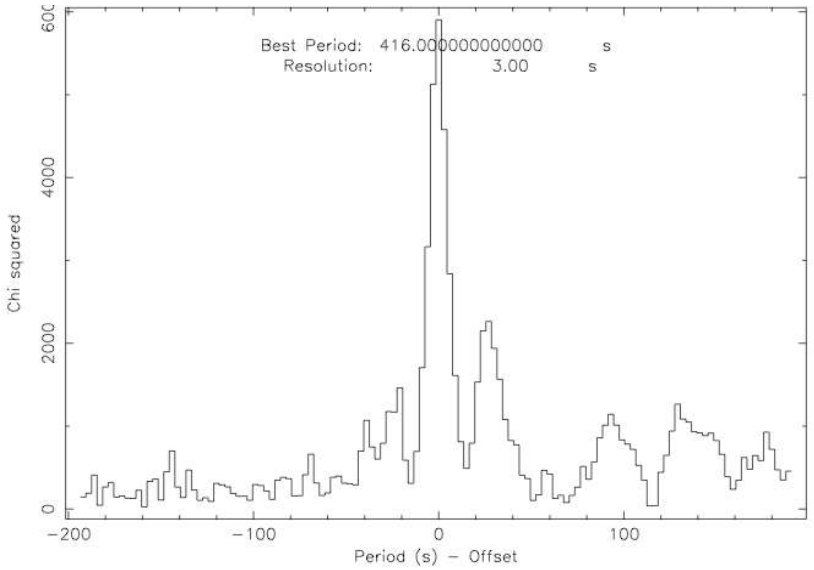
narrow lines

- Persistent source
- New X-ray pulsar, period: 903 sec
  (not a μQSO as proposed by Combi et al)
- No bright infrared counterpart

IGR J17255-3617 (=EXO 1722-363)





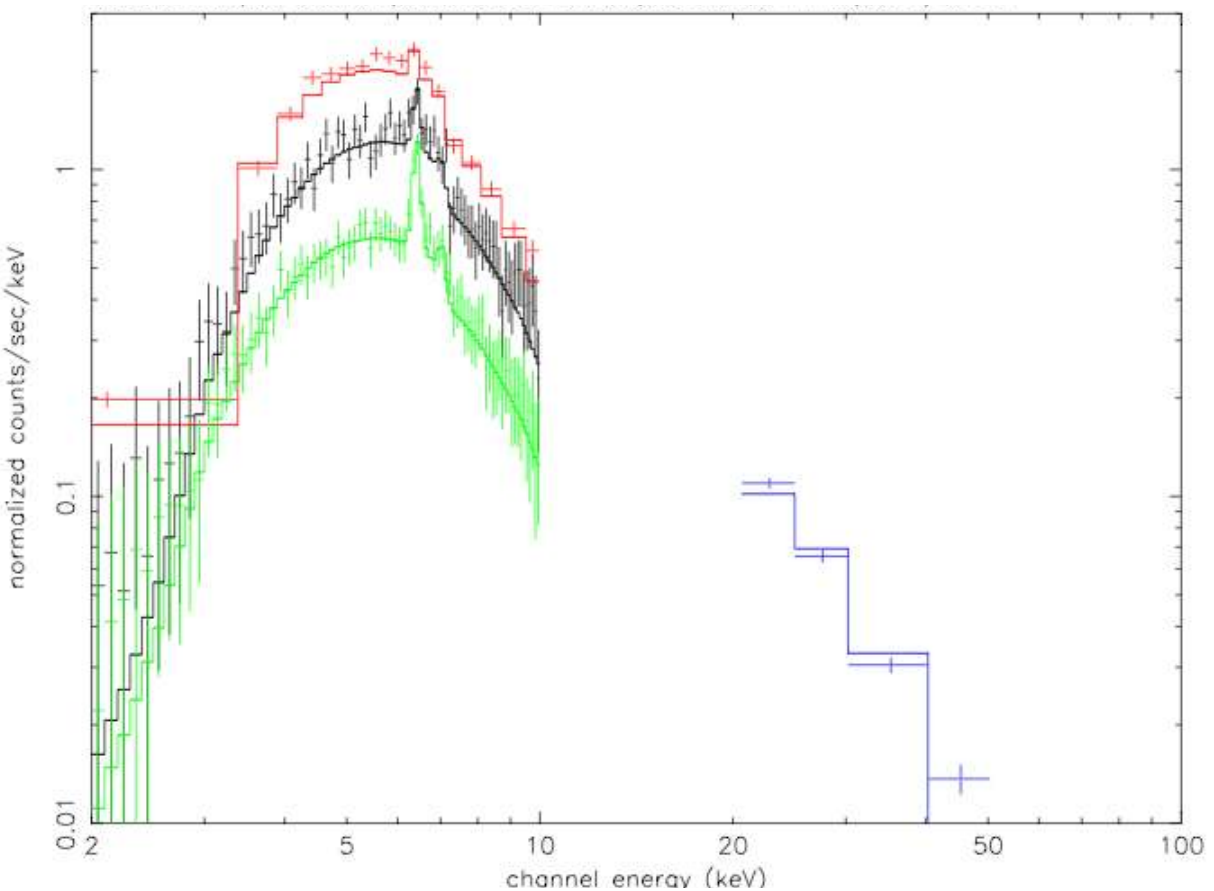


- Persistent source
- New X-ray pulsar, period: 416 sec
- Infrared counterpart

  K=10.6 $N_H(E_{B-V}) < 4.5\ 10^{22}cm^{-2}$

IGR J17255–3617

XMM/EPIC/PN INTEGRAL/IBIS/ISGRI



Reprocessing/absorbing region:

- Ø > 3 10^{12} cm
- cannot completely cover the companion star
- orbital period of 9.3 days (XTE)

Best spectral model:

wabs*comptt+gauss+gauss

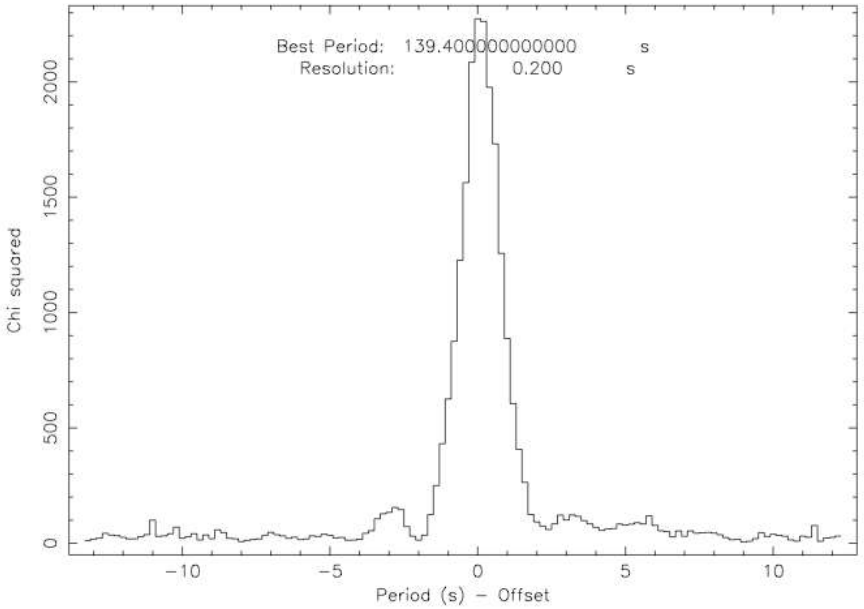
N_H	=	20±1	10^{22}cm^{-2}
kT	=	6.1±0.2	keV
τ	=	6.3±0.3	
E(Fe Kα)	=	6.40±0.01	keV
E(Fe Kβ)	=	7.04±0.05	keV
		narrow lines	

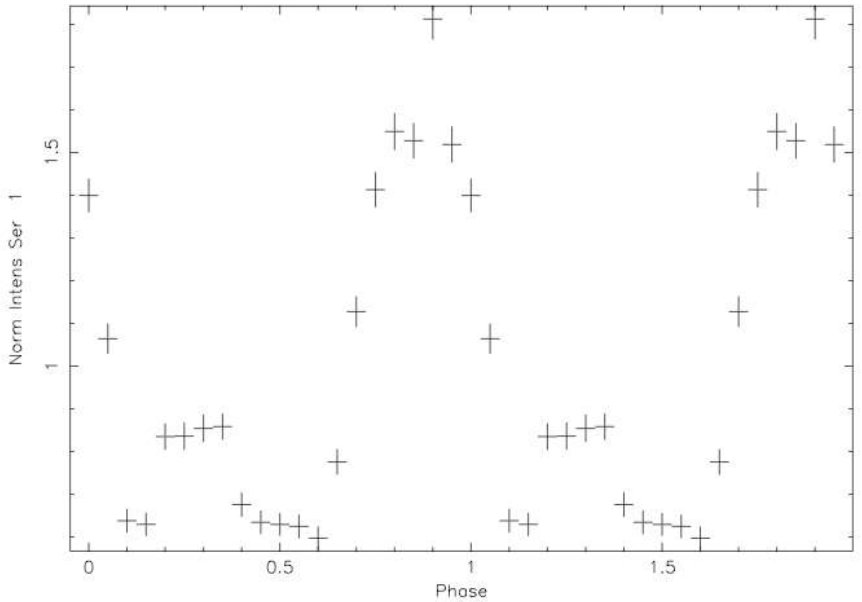
	Low	Medium	High
Flux	0.9	1.8	2.7
NH	18.8±1.0	20.8±1.0	18.5±0.5
F6.4keV	1.8±0.4	1.4±0.6	2.0±0.7

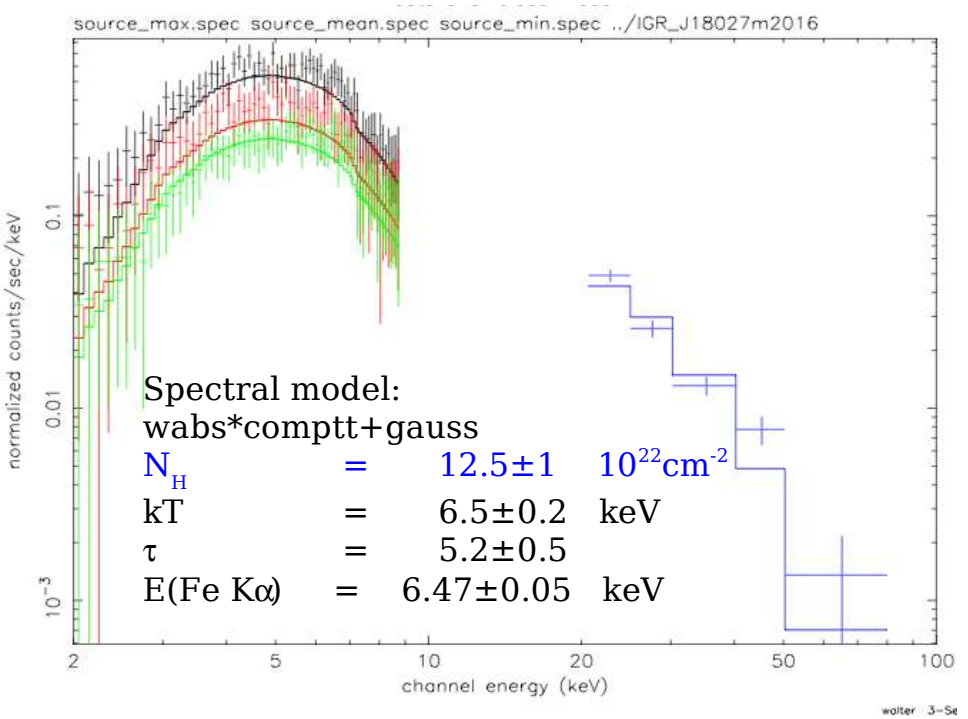
IGR J18028–2017 (=SAXJ 1802.7-2017)

INTEGRAL and XMM results

XMM/EPIC/PN INTEGRAL/IBIS/ISGRI







- Persistent source (INTEGRAL)
- X-ray pulsar, period: 139.4 sec
- SAX detected a period of 139.7 sec (Augello et al, 2003), orbit 4.6 days
- $N_H = 12.5\ 10^{22}\ cm^{-2}$
- Infrared counterpart
  K=11.4 $N_H(E_{B-V}) < 1.8\ 10^{22}\ cm^{-2}$

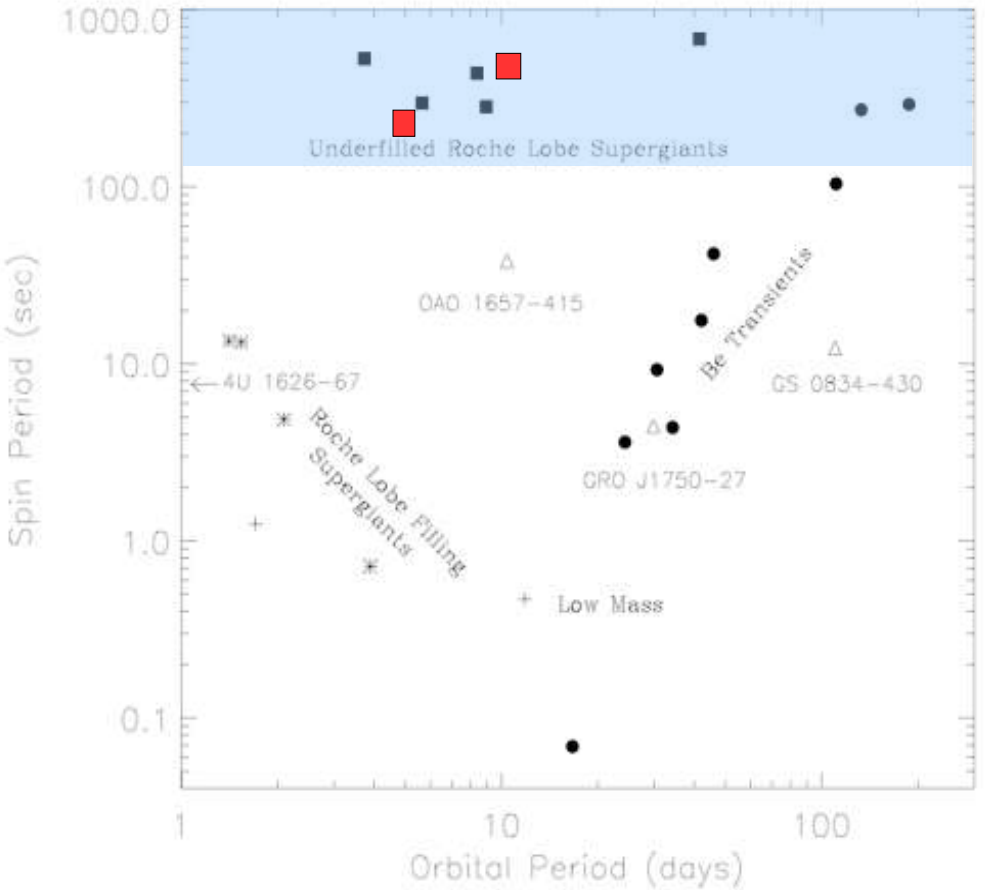
Nature of the systems

- 7 out of 9 sources show X-ray pulsations
- In all sources, the continuum spectral parameters are similar to those found in neutron stars
- No radio emission
- High absorbing column densities
- IGR J16318–4848 identified with a sgB[e]
- Long spin periods, position in Corbet diagran
- |b|< 1°

9 persistent are supergiant HMXB (3 for sure)

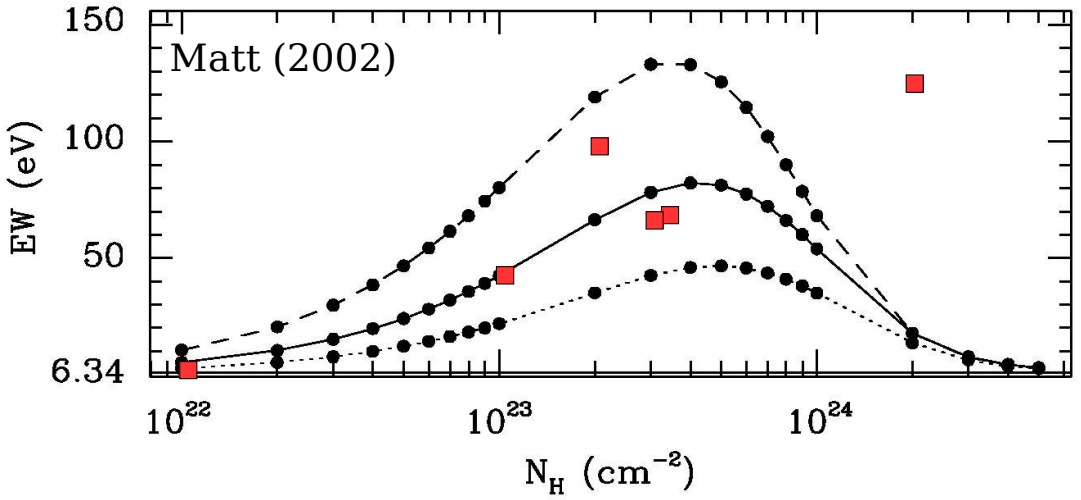
2 of the 3 transients are supergiant systems

It looks like that INTEGRAL has doubled the number of known sg HMXB in the galaxy



Absorbing matter

- In 85% of the observed sources: $N_H > 10^{23}$ cm^{-2}
- Fluorescence lines are detected when $N_H > 2\ 10^{23}$ cm^{-2}



- Link between absorbing matter and amount of fluorescence.
- Fluorescence unlikely to originate on the companion surface.
- Spherical geometry is possible excepting for IGR J 16318-4848, where an excess of absorption is found on the line of sight.

- X-ray absorption >> Infrared reddening => absorbing matter local to NS
- No sign of N_H variation on short periods => not related to the accretion column

Possible Geometries

- Persistent huge column density => special wind configuration
- Number of sources is important => geometry favors accretion

1) NS orbits within dense equatorial wind

Equatorial wind:

- density $10^{11–12}\,\mathrm{cm}^{-3}$
- disk thickness $10^{12–13}\,\mathrm{cm}$
- disk radius $10^{13–14}\,\mathrm{cm}$

2) NS start spiralling within the stellar envelope

It is essential to obtain the orbital periods of those systems..

Conclusions

- 30% of the sources detected by INTEGRAL/IBIS were not previously known (this will increase). A large fraction of those sources are located close to the galactic plane and should be HMXB.
- 85% of the sources that have been investigated with XMM/Chandra are strongly absorbed. 80% of those are X-ray pulsars.
- INTEGRAL already doubled the population of known supergiant HMXB in the galaxy.
- Those sources will provide hints on the geometry/evolution of supergiant HMXB