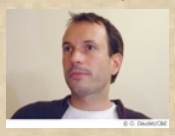
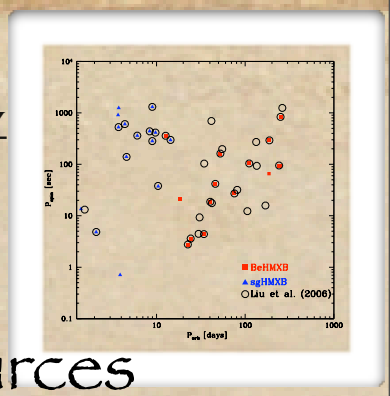
Multi-wavelength observations revealing the most obscured sources of our Galaxy

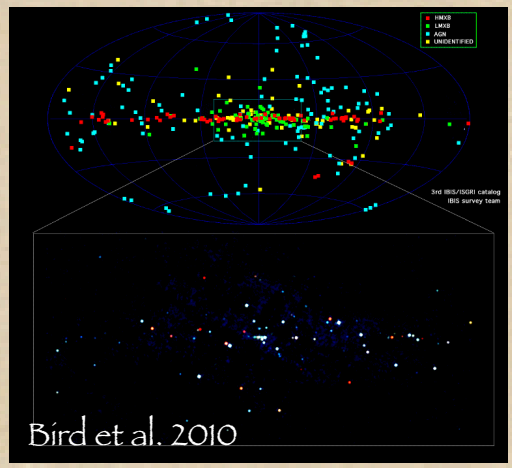
Sylvain Chaty et al. (University Paris Diderot & CEA Saclay)



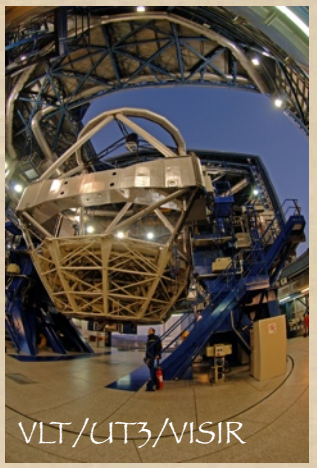


The INTEGRAL observatory

ESA satellite launched on 17/10/2002 by PROTON Rocket:
2 coded-mask γ-ray telescopes
10 keV-10 MeV, 12' resolution, 19' field-of-view



Bird et al. 2010


VLT/UT3/VISIR

Multi-wavelength Study

Discovery in X/γ (INTEGRAL)
Localisation in X-rays (XMM/Swift/Chandra)
Identification of the nature in opt./IR (ESO La Silla NTT)
Study of the environment in MIR (ESO Paranal VLT/VISIR)

References

Multi-wavelength study of ~30 sources:

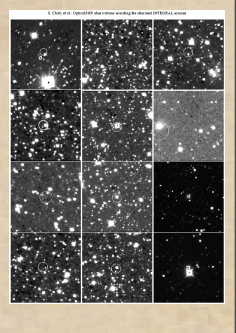
Butler, Tomsick, Chaty et al. 2009, ApJ, 698, 502
Chaty, 2008, ChJA&A, 8, 197; Chaty & Rahoui 2006
Chaty & Filliatre, 2005, A&SS, 297, 235 / ChJA&A, 5, 104
Chaty, Rahoui, Foellmi et al., A&A, 484, 783
Combi, Ribo, Marti, Chaty, 2006, A&A, 458, 761
Filliatre & Chaty, 2004, ApJ, 616, 469 / 2006, ASR, 38, 1365
Liu, Chaty, Yan, 2010, ApJ subm.
Paizis, Nowak, Chaty et al., 2007, ApJ, 657, L109
Pellizza, Chaty, Negueruela, 2006, A&A, 455, 653 / 2006, RMA&A, 27, 225
Pellizza, Chaty, Chisari, 2010, A&A subm.
Rahoui, Chaty, Lagage, Pantin, 2008, A&A, 484, 801
Rahoui & Chaty, 2008, A&A,492, 163
Zurita Heras & Chaty, 2008, A&A, 489, 657
Zurita Heras & Chaty 2009, A&A, 493, L1
Zurita Heras, Chaty, Tomsick, 2009, A&A, 502, 787

Localization of ~55 IGRs by Chandra & Swift

Bodaghee, Tomsick, Rodriguez, Chaty et al., 2010, ApJ subm.
Rodriguez, Tomsick, Chaty, A&A 2008, A&A, 482, 731
Rodriguez, Tomsick, Chaty, A&A 2009, A&A, 494, 417
Rodriguez, Tomsick, Bodaghee, Chaty et al. 2009, A&A, 508, 889
Tomsick, Chaty, Rodriguez et al., 2006, ApJ, 647, 1309
Tomsick, Chaty, Rodriguez et al., 2008, ApJ, 685, 1143
Tomsick, Chaty, Rodriguez et al. 2009, ApJ, 694, 344
Tomsick, Chaty, Rodriguez et al. 2009, ApJ, 701, 811

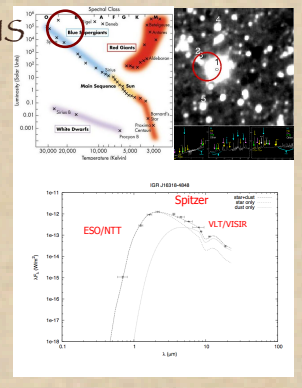
Study of INTEGRAL sources

Sample of ~30 sources, most X-ray pulsars:
Pspin 139-5880s, Porb 4-14d
Wind-accreting sgHMXBs (Corbet Diagramme)
Astrometry, Photometry, Spectroscopy
Results: 20 HMXBs (among them: 15 supergiants)
3 with MIR excess: Td=1000K; Rd=10R*



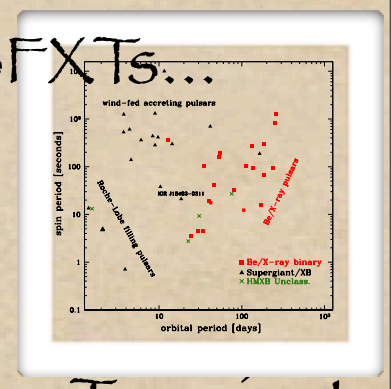
From «classical» obscured sources...

IGR J16318-4848 : 1st source discovered by INTEGRAL/IBIS
Discovery of the optical counterpart
Unusual absorption of 17 mag, 100 times > Interstellar
Unusual NIR spectrum: stratified circumstellar envelope
HMXB with luminous supergiant star sgB[e]:
10^6 L$_\odot$, 20 M$_\odot$, 22200 K, 20 R$_\odot$=0.1 a.u.;
Discovery of cocoon of dust/cold gas enshrouding the whole binary system: Td=1100 K, Rd=12 R$_\odot$=1 a.u.



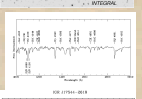
...through Intermediate SFXTs...

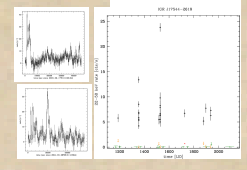
IGR J18483-0311:
HMXB: NS + supergiant star (B0.5I) at 3-4 kpc
Porb: 18.52 days, long flares, lower Lmax/Lmin ratio
Intermediate SFXT with small and excentric orbit
Intermediate position in Corbet diagramme



...to Supergiant Fast X-ray Transients

IGR J17544-2619: INTEGRAL (2')->XMM (4")->Chandra (0.6")
HMXB: NS + blue supergiant star (25 M$_\odot$, 31000 K)
X-ray study: very short and complex X-ray flares
Accretion from clumpy stellar winds?
(Negueruela et al. 2006, Walter & Zurita Heras 2007)





The sgHMXB connection

Continuum of sgHMXBs from «classical» obscured sources to SFXTs: difference in NS-supergiant star orbital distance, eccentricity of orbits
Intermediate SFXTs represent the missing link

How IXO will help...

High resolution spectroscopy 0.3-10 keV of sgHMXBs
Evolution of Nh along the orbit
Characterization of various types of sgHMXBs