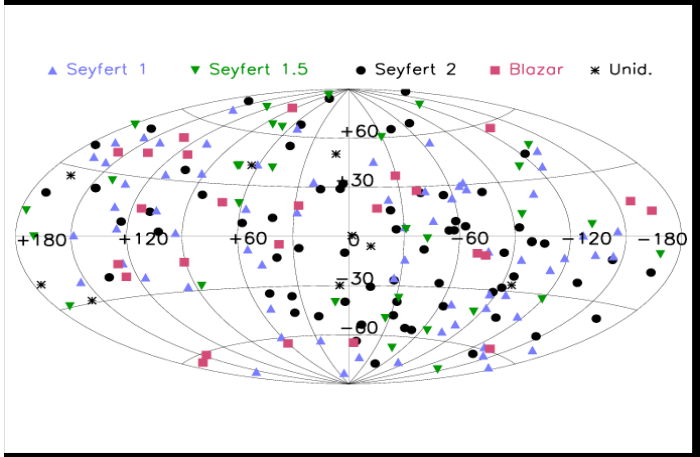
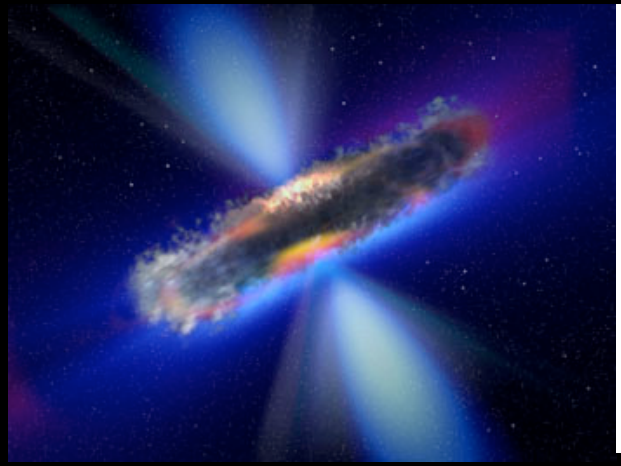
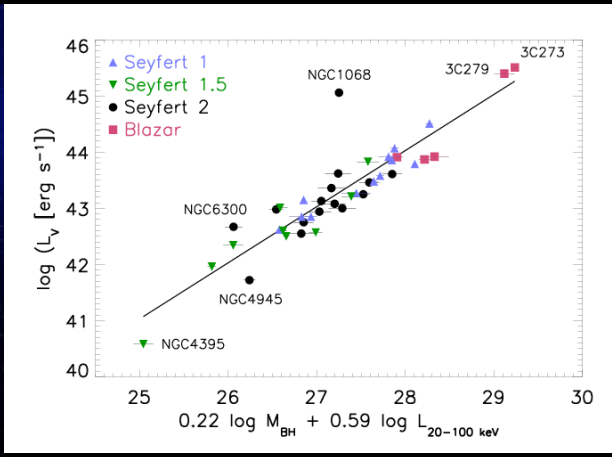
The Unified Scheme seen with INTEGRAL detected AGN







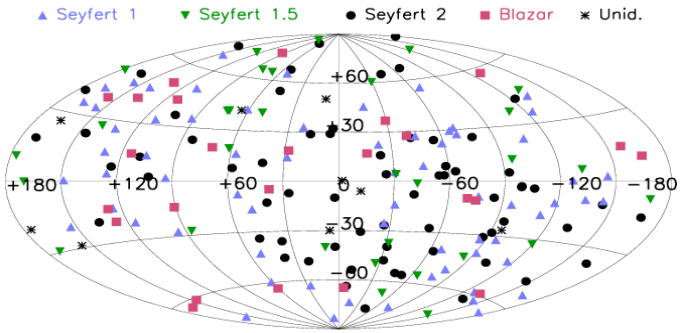
Volker Beckmann
APC Université Paris 7 - Denis Diderot
& Soldi, Ricci, Alfonso-Garzón, Courvoisier,
Domingo, Gehrels, Lubinski, Mas-Hesse, Zdziarski

X-ray Astronomy 2009, September 10th

UNIVERSITÉ PARIS 7 - DENIS DIDEROT

Overview

- The different Seyfert types -- are they intrinsically the same, i.e. is it just a question of the point of view?
- 2nd INTEGRAL AGN catalogue
- Results from spectral and correlation analysis
- A fundamental plane in AGN: Lv, Lx, M_{BH}
- Unified scheme at work: same underlying continuum spectrum under different viewing angle and absorption
- A&A in press, arXiv:0907.0654

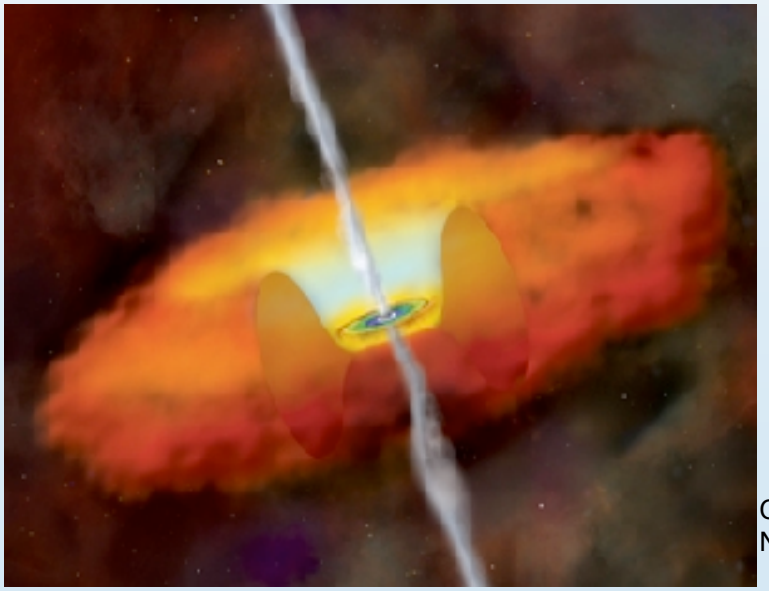


V. Beckmann, INTEGRAL AGN and the unified scheme

Unified scheme

- If there is a unified scheme (e.g. Antonucci 1993) , objects should look the same objects in hard X-rays
- Absorption can be neglected (unless objects are Compton thick)
- Underlying continuum should be the same (when reflection is considered).
- But: several observations in the past indicated different spectral slopes for Seyfert 1 and 2

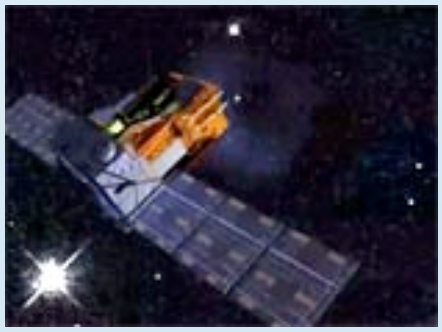
(e.g. Zdziarski et al. 1995, Gondek et al. 1996, Deluit & Courvoisier 2003, Beckmann et al. 2006 ...)

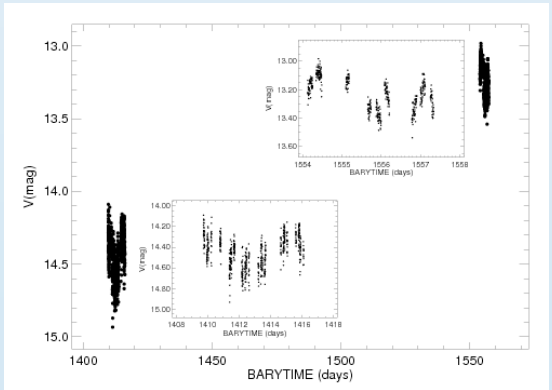


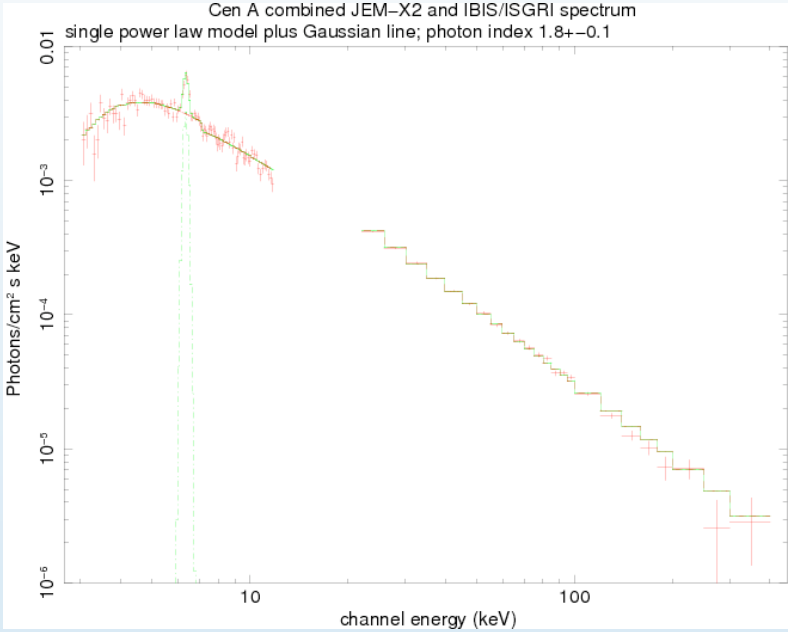
Credits: NASA/CXO

INTEGRAL AGN Catalogue

- Extract ISGRI (20 - 400 keV) / JEM-X (3-30 keV) / OMC (V-band) data for all 199 AGN reported so far (187 detected here)
- 148 significant ISGRI spectra
- 23 JEM-X detections >5 sigma
- 57 OMC V-band lightcurves
- Swift/XRT, XMM-Newton to determine intrinsic absorption



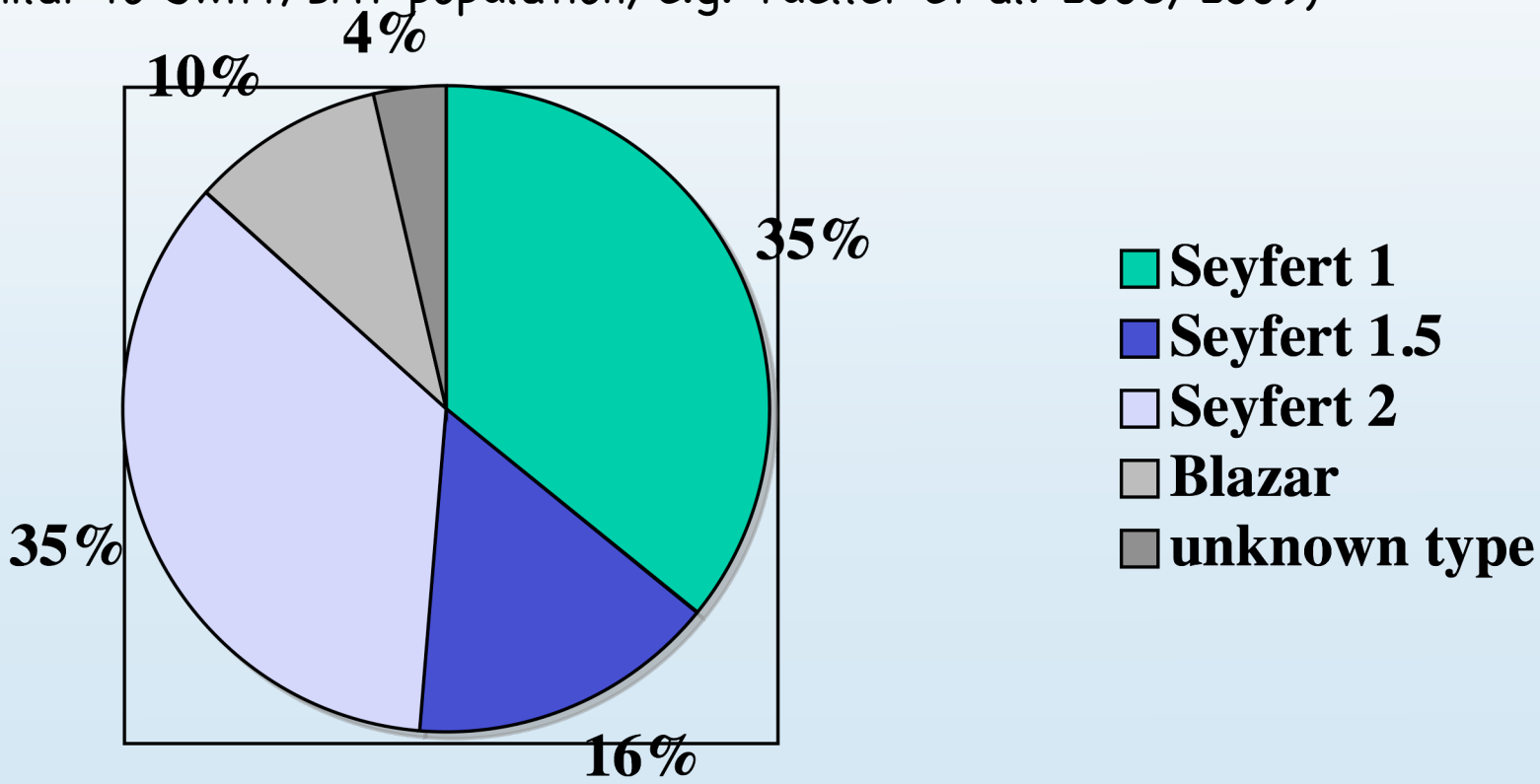




INTEGRAL AGN

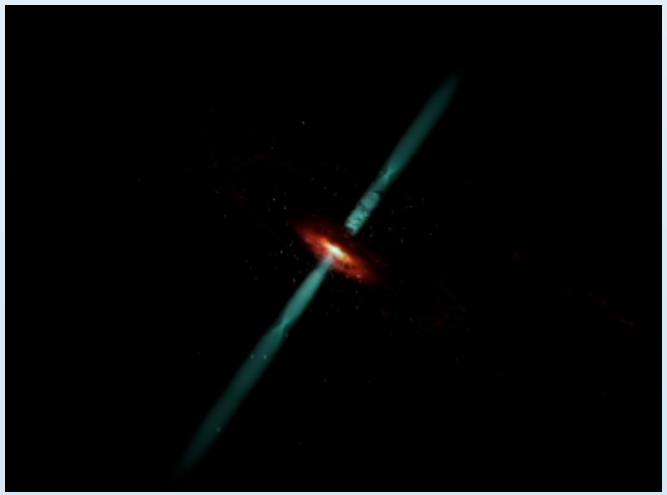
- 162 Seyfert galaxies (67 Sy1, 66 Sy2, 29 Sy 1.5), 18 blazars, 7 AGN of unknown type
- 60 absorbed, 74 unabsorbed Sy, 5 Compton thick (4%)

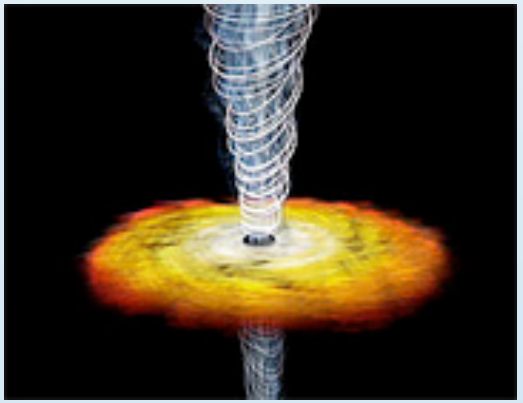
(similar to Swift/BAT population, e.g. Tueller et al. 2008, 2009)



INTEGRAL Blazars

- 18 Blazars mainly seen in outburst
- E.g. 0716+714, 0836+710 (Pian et al. 2005), 3C 454.3 (Pian et al. 2006), Mrk 421 (Lichti et al. 2008) ...
- Γ = 1.55 +- 0.04, Lx = 1e46 erg/sec
- 11 INTEGRAL blazars are also Fermi/LAT bright sources:
- 1ES 0033+595, PKS 0528+134, QSO B0716+714, Mrk 421, 3C 273, 3C 279, Mrk 501, PKS 1830-211, 1ES 1959+650, BL Lac, 3C 454.3

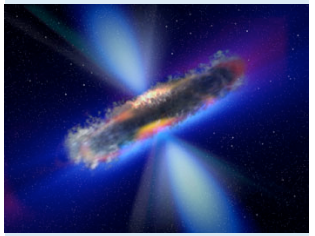




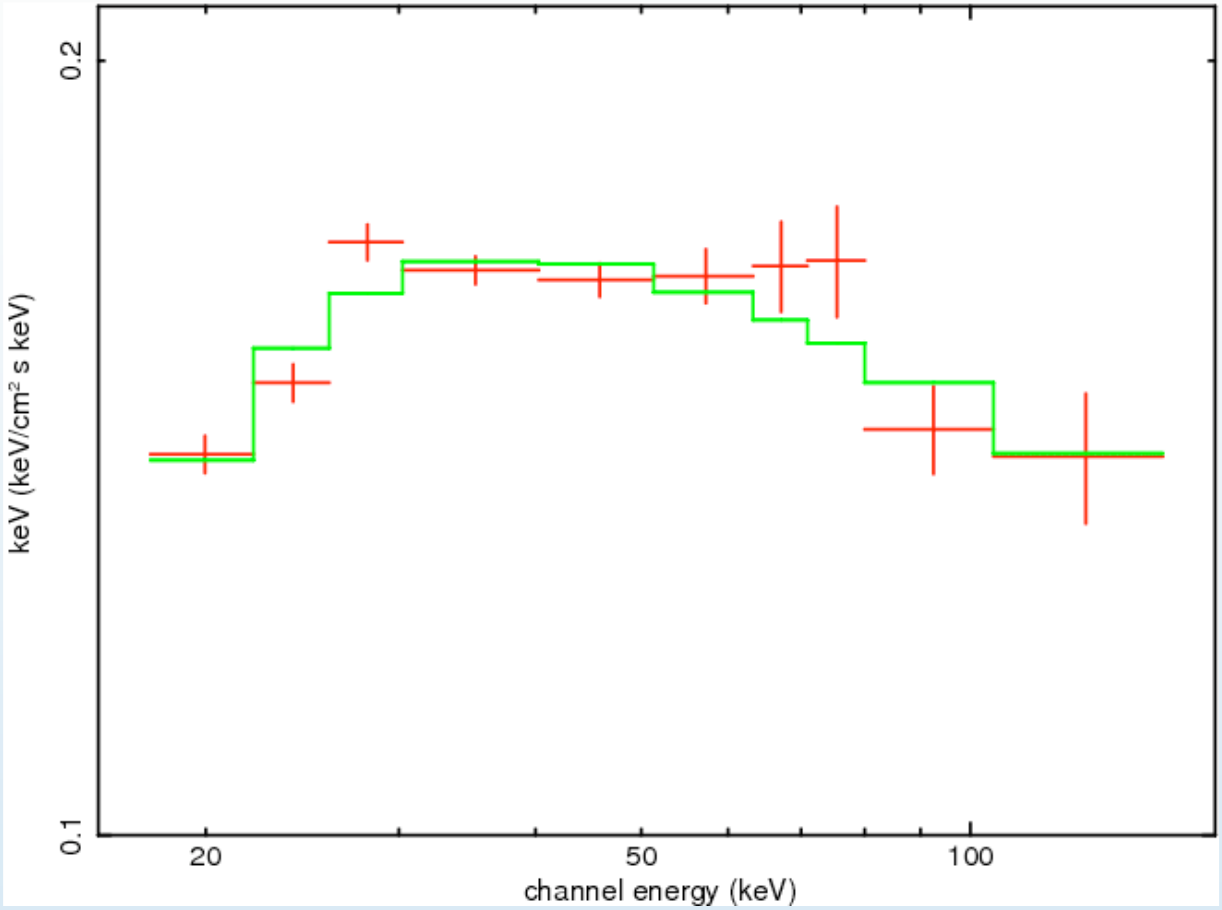
Credits: A. Marscher / Cosmovision

Seyfert Properties

	Seyfert 1	Seyfert 1.5	Seyfert 2
$\langle z \rangle$	0.03 (63)	0.014 (24)	0.02 (57)
$\langle \Gamma \rangle$	1.92 ± 0.02 (55)	2.02 ± 0.03 (20)	1.88 ± 0.02 (44)
$\langle \log N_{\rm H} \rangle$	21.2 (61)	21.7 (23)	22.9 (51)
$\langle \log L_{20-100\,{\rm keV}} \rangle$	44.0 (63)	43.3 (24)	43.4 (57)
$\langle \log M_{\rm BH} \rangle$	7.8 (30)	7.2 (14)	7.7 (27)
$\langle \lambda \rangle$	0.064 (30)	0.015 (14)	0.02 (27)
	Unabs	Absorbed	all Sey
$\langle z \rangle$	0.03 (74)	0.014 (60)	0.02 (144)
$\langle \Gamma \rangle$	1.94 ± 0.02 (66)	1.91 ± 0.02 (44)	1.93 ± 0.01 (119)
$\langle \log N_{\rm H} \rangle$	21.0 (75)	23.1 (60)	21.9 (135)
$\langle \log L_{20-100\,{\rm keV}} \rangle$	43.8 (74)	43.4 (60)	43.6 (144)
$\langle \log M_{\rm BH} \rangle$	7.6 (37)	7.7 (34)	7.6 (71)
$\langle \lambda \rangle$	0.06 (37)	0.015 (34)	0.03 (71)



Seyfert Properties



ISGRI stacked spectrum of sources >5σ (CT excluded)

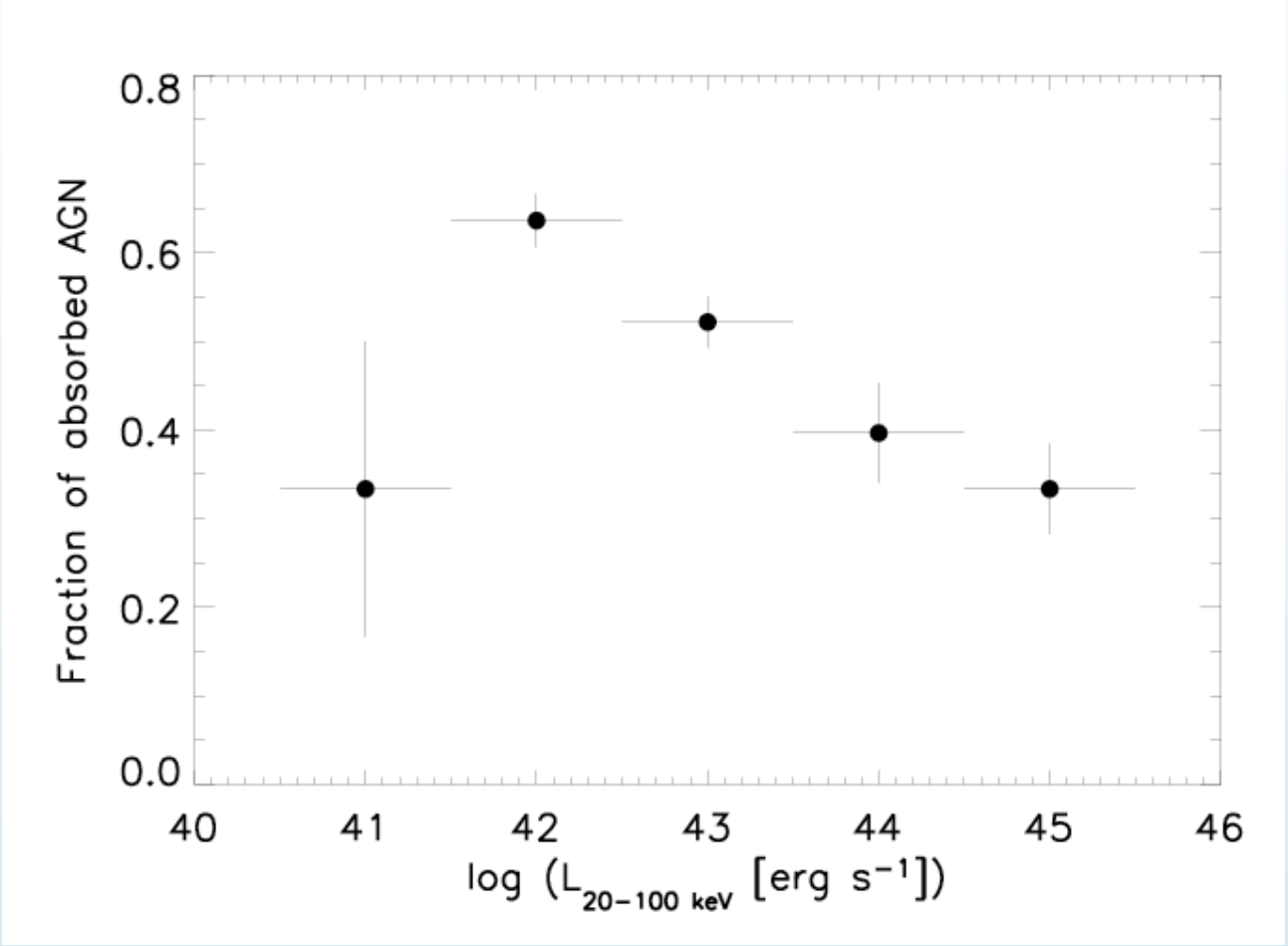
Stacked spectra of different Sy types can be modelled by a Compton reflection model, just varying the inclination angle: R ≈ 1, Γ=1.95 (see also e.g. Dadina 2007)

Reflection

CXB at 30 keV can be explained by:

- A fraction of ~20% Compton thick AGN
- A strong reflection component (R >> 1)
- Evolution of absorption
- A mix of the above
- Treister & Urry (2008) [see also Ezequiel later this session]:
- Assume (constant) Compton thick fraction of INTEGRAL AGN study (Beckmann et al. 2006): ~10%
- How much reflection is needed to model the CXB?
- R ~ 1
- R is the relative amount of reflection compared to the directly viewed primary spectrum

Seyfert Properties



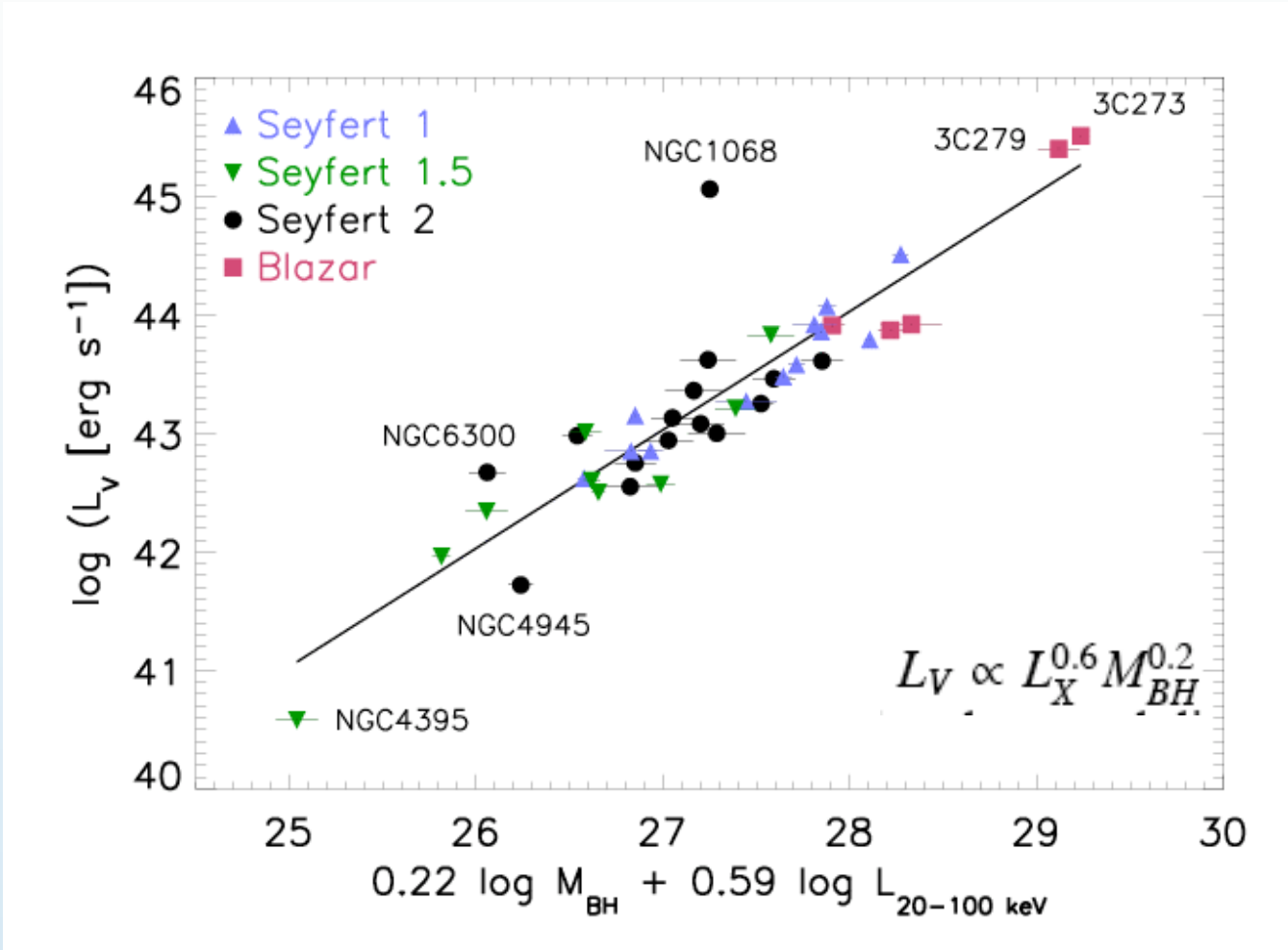
The fraction of absorbed sources increases toward low luminosity AGN (note that there are only 3 objects in the lowest Lx bin). See also Sazonov et al. '04, '07

Seyfert Properties

	M_{BH}	Γ	L_X	Edd. ratio λ	L_V
N_H	no	no	no	no	no
M_{BH}	–	no	> 99.99%	intrinsic	> 99.99%
Γ		–	no	no	no
L_X			–	intrinsic	> 99.99%
λ				–	no

Correlation matrix for INTEGRAL detected Seyfert galaxies. M_{BH}, optical and X-ray luminosity seem to be linked.

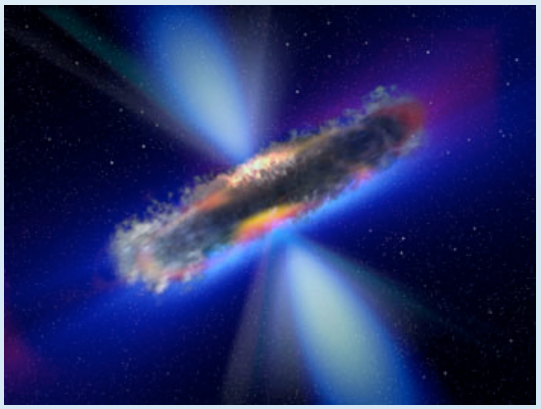
Fundamental plane of AGN



$L_{\rm radio} \propto L_X^{0.6} M_{\rm BH}^{0.8}$ (e.g. Merloni et al. 2003)

Summary

- 200 AGN detected by INTEGRAL
- Seyfert: intrinsic spectrum has Γ = 1.95, R~1
- Fraction of absorbed AGN increases toward low Lx
- Seyfert 1 / unabsorbed AGN show higher Lx and Eddingtion ratio
- Black hole mass similar in different Seyfert classes
- Unified scheme supported by fundamental plane of Lx, Lv, and black home mass M_{BH} : $L_V \propto L_X^{0.6} M_{BH}^{0.2}$
- arXiv:0907.0654



V. Beckmann, INTEGRAL AGN and the unified scheme