AGN structure from the BH to the host galaxy

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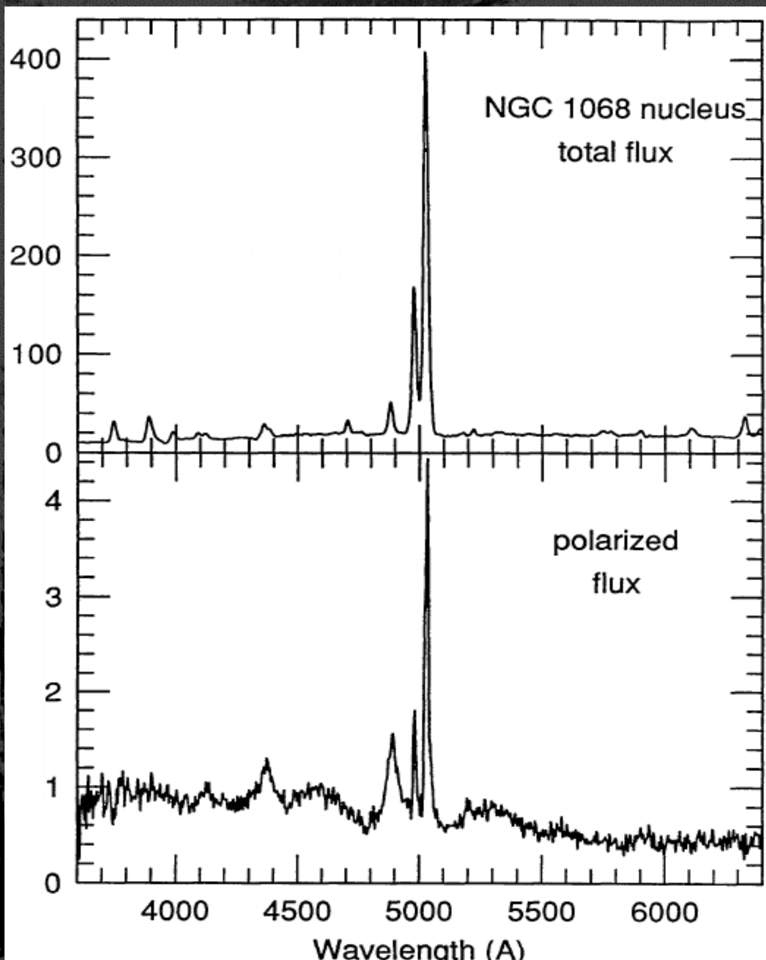
ROMA TRE
UNIVERSITÀ DEGLI STUDI

The first unification attempts have been focussed on polarization measurements: Antonucci (1984) found a perpendicular alignment of optical polarization relative to the radio axis in a sample of radio galaxies, which was interpreted as due to scattering of photons originally emitted in the 'vertical' direction



Annu. Rev. Astron. Astrophys. 1993. 31: 473–521

UNIFIED MODELS FOR ACTIVE GALACTIC NUCLEI AND QUASARS

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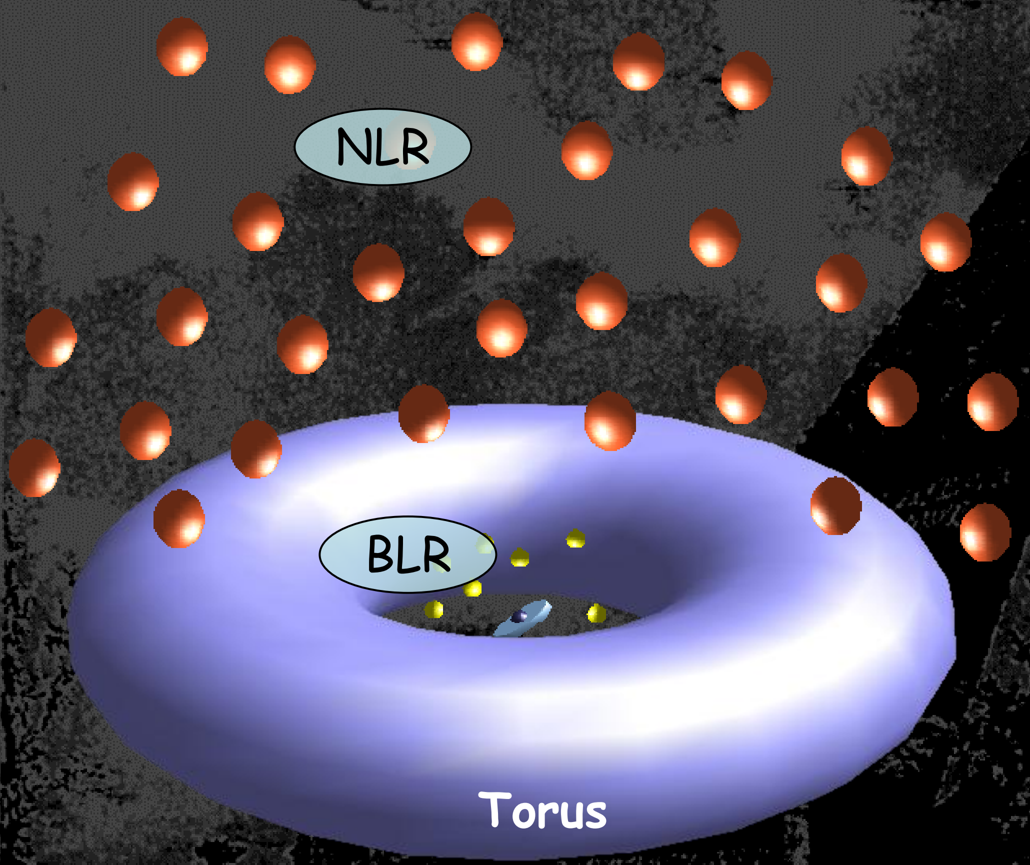
KEY WORDS: radio galaxies, Seyfert galaxies, BL Lac objects, blazars, OVV quasars

1. INTRODUCTION

Because the critical central regions of Active Galactic Nuclei (AGN) and quasars are strongly nonspherical but spatially unresolved, orientation effects have been the source of much confusion. In fact, it now appears that much of the variety in AGN types is just the result of varying orientation relative to the line of sight.

The detection of broad optical lines in the polarized spectrum of the archetypical Seyfert 2, NGC 1068, led Antonucci (1993) to postulate <u>**the equivalence between Type 1 and Type 2 AGN, any observational difference due to obscuration along the line-of-sight to the source**</u>

The absorber:
The Unification Model view



If the absorber were a simple cloud along the line of sight, reflection should come from all directions: the total polarization should be zero. **<u>In order to break the symmetry of the polarization angles the absorber should prevent the nuclear light to be scattered in a significant range of angles, and a "torus" is the most natural configuration that can achieve this effect</u>**

<u>The size of the toroidal absorber was initially postulated to be on the parsec scale</u> (Krolik & Begelman, 1986, 1988). Such typical size was simply inferred by the need for the absorber to be large enough to obscure the BLR, which in Seyfert nuclei has a size well below a parsec, based on reverberation studies, but small enough not to obscure the Narrow Line Region (NLR), which is distributed on the 10–100 pc scale

Polarized broad lines have been discovered in several other Seyfert 2 nuclei, contributing to the generalization of the unified model. In a number of type 2 AGN **the presence of an obscured BLR was inferred from the detection of a broad component of hydrogen recombination lines in the near infrared**, such as Paβ, Paα, Brγ, where dust absorption can be several times lower than in the optical (Veilleux et al. 1997; Cai et al. 2010)

X-ray observations of AGN have provided additional evidence.
Most type 2 AGN are characterized by a power-law spectrum similar to Sy1s, favoring a common central engine, but affected by a photoelectric absorption cutoff directly demonstrating the presence of an absorbing medium along the line of sight, with the extreme case of Compton-thick sources.

Another expectation is that the NLR should have a (bi)conical morphology, due to the light cones defined by the nuclear absorber. High-resolution, narrow band imaging has indeed revealed such ionization cones on scales from few 10 pc up to several 100 pc (Pogge 1988; Evans et al. 1991; Wilson & Tsvetanov 1994).
The opening angle of the cones gives the fraction of the sky hidden to our line of sight, which is in reasonable agreement with what inferred from the relative fraction between type 1 and type 2 AGN in the local Universe

From Galactic to Sub-Pc Scale: Absorption at Different Scales

One of the most significant new aspects on the structure of AGN, as emerged in the last few years, is that the standard, parsec-scale "torus" is not enough to explain all the complex absorption features discovered by many observations. While the unified picture remains valid in its more general sense (i.e., **the presence of nonspherically symmetric absorbers at the origin of the type 1/type 2 dichotomy**) several new observations and models, mostly in the X-ray and infrared domain, suggest that **multiple absorbers are present around the central source, on quite different physical scales**

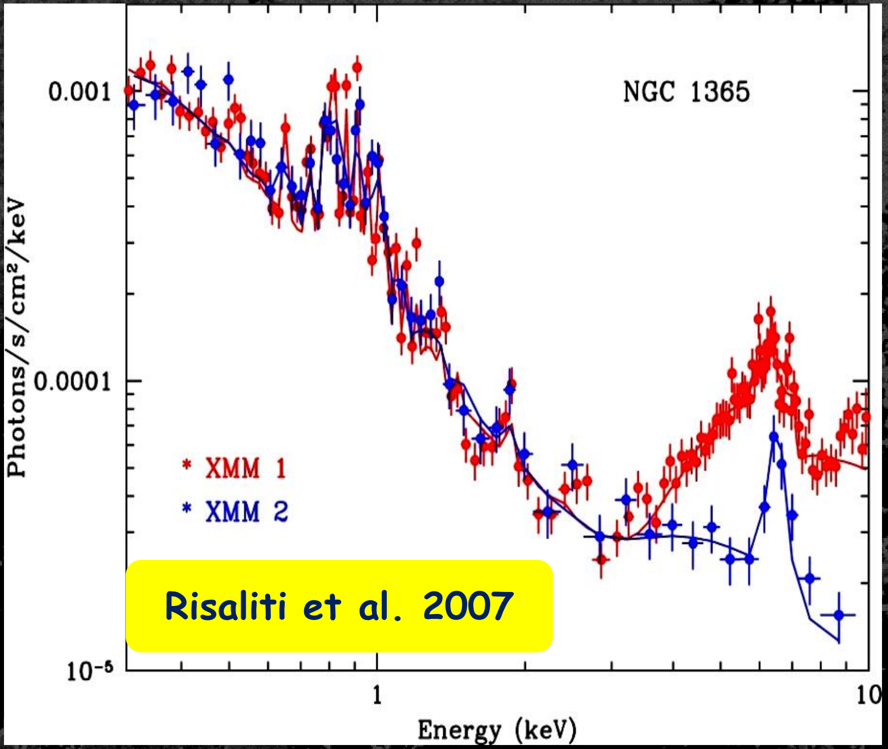
Absorption within the Sublimation Radius

Absorption from Pc-Scale Tori

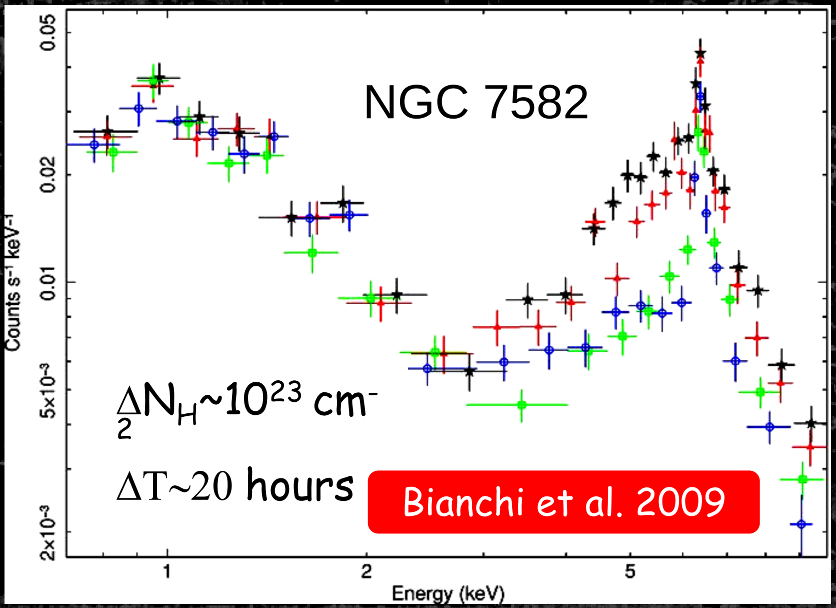
Absorption by Gas in the Host Galaxy

Absorption within the Sublimation Radius

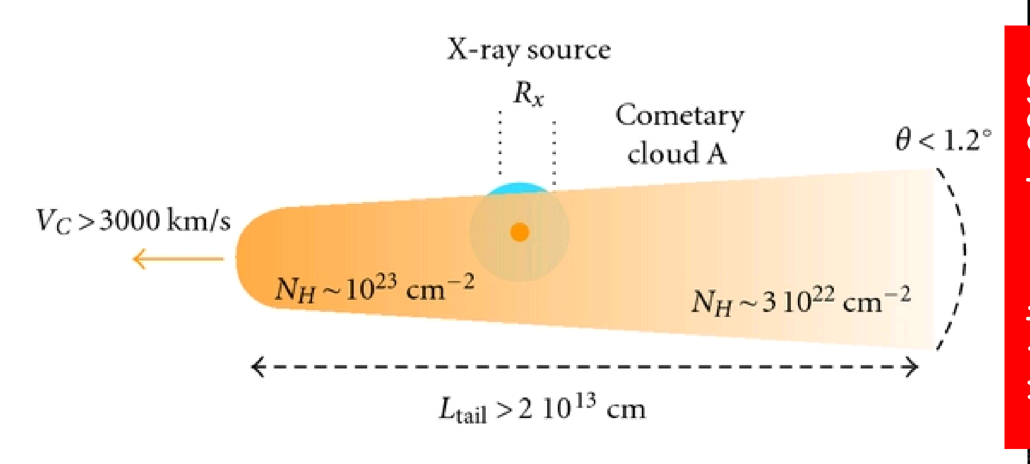
X-ray absorption variability is common in AGN. An analysis of a sample of nearby obscured AGN with multiple X-ray observations, performed a few years ago (Risaliti et al. 2002), revealed that N_H variations are almost ubiquitous. Recent observations with XMM-Newton, Chandra, and Suzaku further confirmed this finding. **The circumnuclear X-ray absorber** (or, at least, one component of it) **must be clumpy and located at subparsec distances from the central source**



An improvement of these estimates was obtained through observational campaigns within a few weeks/days, and/or through the search for N_H variations within single long observations. Such short time-scale studies have been performed for a handful sources: NGC 1365 (Risaliti et al. 2005, 2007, 2009), NGC 4388 (Elvis et al. 2004), NGC 4151 (Puccetti et al. 2007), NGC 7582 (Bianchi et al. 2009), and Mrk 766 (Risaliti et al. 2011)



NGC 1365 shows extreme spectral changes, from Compton thin (N_H in the range 10^{23} cm^{-2}) to reflection dominated ($N_H > 10^{24}$ cm^{-2}) on time scales from a couple of days to ~10 hours. Such rapid events imply that the absorption is due to clouds with velocity $v > 10^3$ km s^{-1}, at distances from the BH of the order of 10^4 r_g (assuming that they are moving with Keplerian velocity). The physical size and density of the clouds are estimated to be of the order of 10^{13} cm and 10^{10}-10^{11} cm^{-3}, respectively. **All these physical parameters are typical of BLR clouds, strongly suggesting that the X-ray absorber and the clouds responsible for broad emission lines in the optical/UV are one and the same**



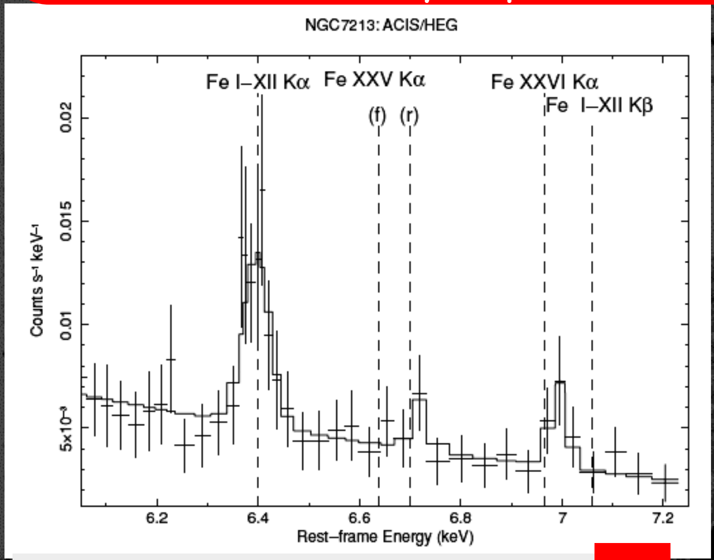
Maiolino et al. 2010

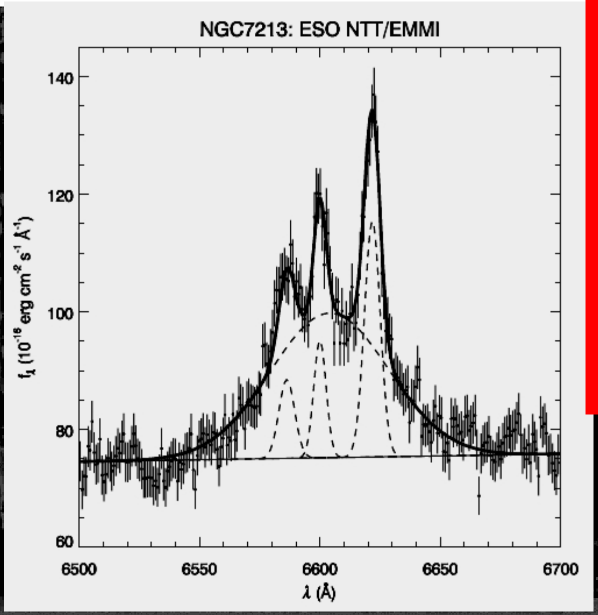
A careful analysis of the spectral X-ray variability during two eclipses revealed **a "cometary" shape of the obscuring cloud, consisting of a high-density head, and an elongated, lower-density tail**. This structure is revealed by the time evolution of two observational parameters of the cloud: its covering factor to the X-ray source (suddenly increasing at the beginning of the occultation, then slowly increasing over a long time interval), and its column density (highest at the beginning, and then decreasing steadily)

Occultations have also been observed in the bright Narrow Line Seyfert 1 Mrk 766 (Risaliti et al. 2011), revealing that **such events are possible (though rare) in on-average unobscured sources**

(see also Ursini's talk!)

One of the most direct consequences of the presence of gas inside the dust sublimation radius is **a decrease of the expected dust-to-gas ratio**, as measured from the ratio between optical/near-IR reddening, and X-ray column density. This is a well-known observational evidence in nearby Seyfert galaxies (Maiolino et al. 2001), which is therefore naturally explained in the context of X-ray absorption by BLR clouds





Bianchi et al. 2008

If the covering factor and the optical depth of the BLR are large enough, a significant fraction of the iron Ka emission line should be produced there

NGC 7213 represents a unique opportunity, because it presents a negligible amount of Compton reflection ($R=\Delta\Omega/2\pi<0.19$: Bianchi et al. 2003, 2004, Lobban et al. 2010). Therefore, the observed neutral iron line cannot be associated to a Compton-thick material, like the torus or the disc

Simultaneous optical/X-ray (Chandra HEG) observations show that the FWHM of the iron line Ka and that of the Ha are both around 2500 km/s

The iron Ka in NGC7213 is produced in the BLR!

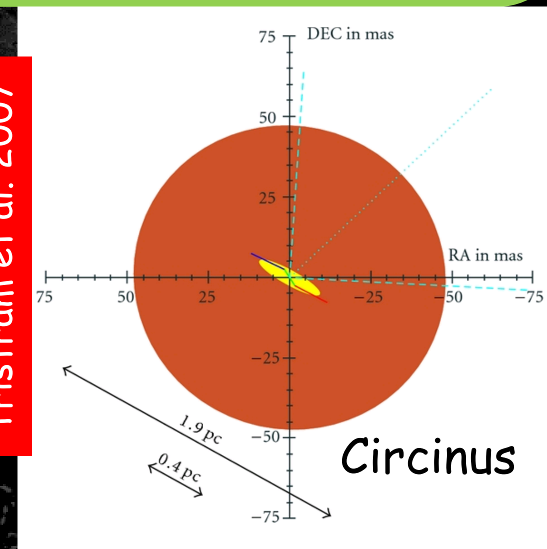
In the future, high resolution X-ray spectroscopy with microcalorimeters and X-ray reverberation studies will be extremely powerful in tackling this issue

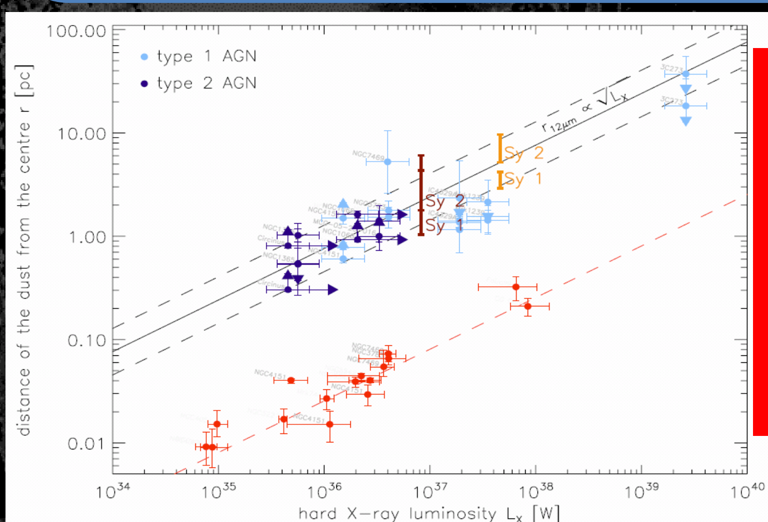
Absorption from pc-scale Tori

<u>Early evidence for a circumnuclear dusty medium on (sub)pc scales was obtained from near-IR studies, which revealed the presence of very hot dust, close to the sublimation temperature</u>, in the nuclei of Sy1s (Storchi-Bergmann et al. 1992, Alonso-Herrero et al. 2001, Oliva et al. 1999). These results have been confirmed by extensive reverberation observational campaigns (Suganuma et al. 2006), with the expected $L^{1/2}$ dependence of the sublimation radius. The covering factor of the circumnuclear dusty medium is very high (exceeding 0.8: Maiolino et al. 2007, Treister et al. 2008), and generally in agreement with the observed type 2/type 1 ratio

Mid-infrared interferometry allowed Jaffe et al. 2004 to map for the first time the dust at parsec resolution in NGC 1068. Their results are consistent with a two-component dust distribution: an inner (0.5 pc of thickness) hot (T>800 K) component, and a more extended (3-4 pc), colder (T~300 K) one. Most of the absorption is located outside 1 pc

Tristram et al. 2007

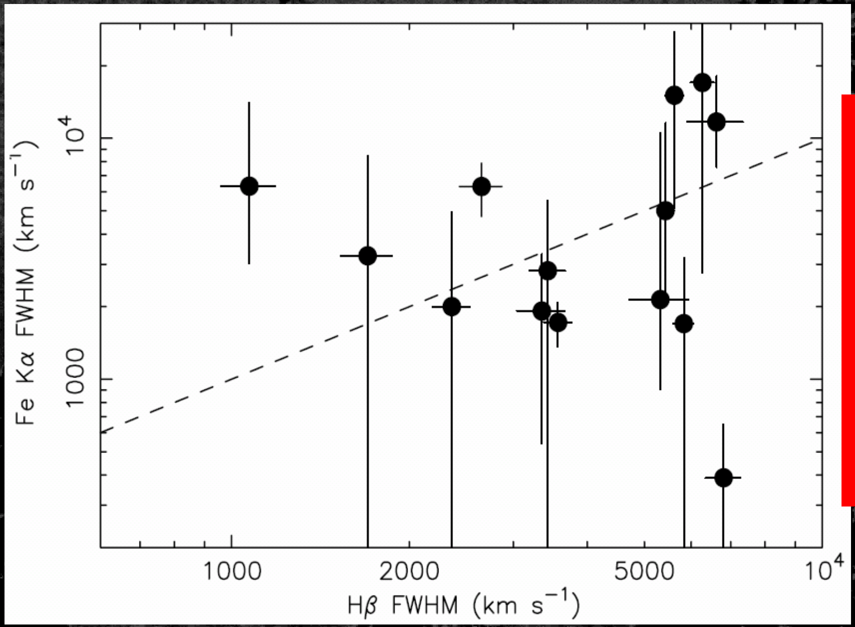




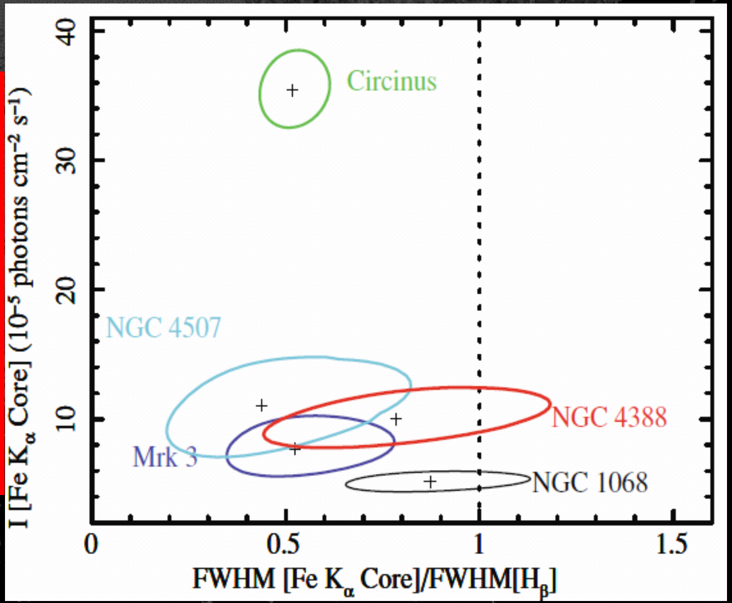
Tristram et al. 2011

Interferometric studies on a sizeable sample of objects showed no significant differences between type 1 and 2 sources and the size of the dusty emitter scales with the square root of the luminosity (Tristram et al. 2009, 2011; Kishimoto et al. 2011)

The presence of Compton-thick neutral material with large covering factor is also supported by the ubiquitous presence of the iron Ka line and the Compton reflection component in the X-ray spectra of Seyfert galaxies (Perola et al. 2002; Bianchi et al. 2004, 2009). Although a component broadened by strong gravity effects arising in the accretion disk is observed in at least a third of the sources (De La Calle et al. 2010, Nandra et al. 2007), a narrow core of the iron line is a much more common feature



Nandra 2006



Shu et al. 2011

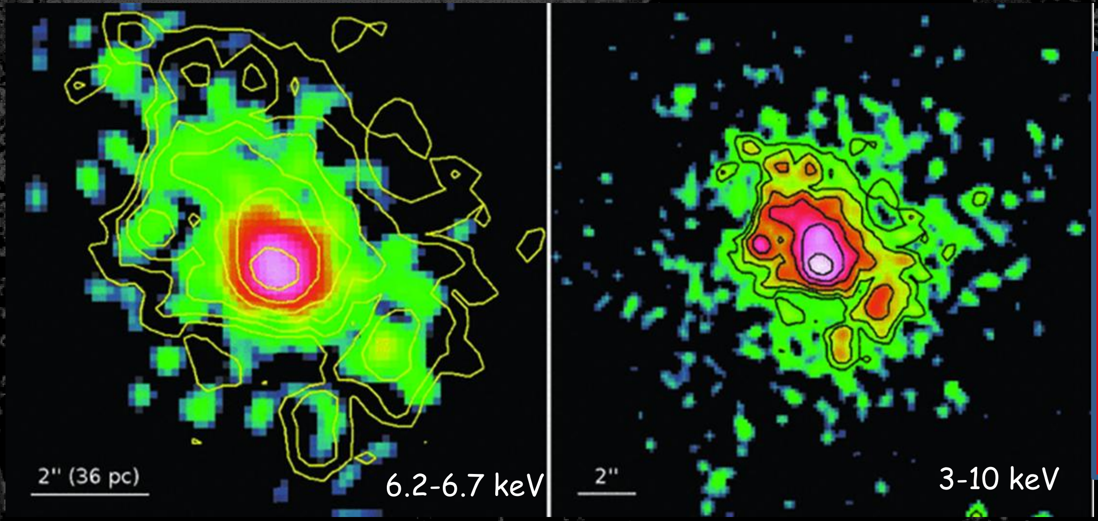
The line, typically unresolved (with upper limits of several thousand km/s for its FWHM), must be produced far from the nucleus, either in the BLR, the torus, or the NLR. Apart from single exceptional cases (like NGC 7213), current X-ray satellites allow us to resolve its FWHM only in a few objects and with limited information, generally leading to inconclusive estimates on the location of the material producing the lines (Nandra 2006, Shu et al. 2011)

Clues in favour of a parsec-scale distance of the material producing the narrow iron line and the Compton reflection component come from the lack of variability of these features

X-ray spectra of Compton-thick sources are completely dominated by reflection features, and they typically do not show any variability even on long time scales (but see recent paper by Guainazzi et al. on Mrk3)

This is particular clear in sources where the central engine fades away for a long time interval (years), while the reflection component (including the Fe Ka line) remains stable over the same time scale (Gilli et al. 2000).

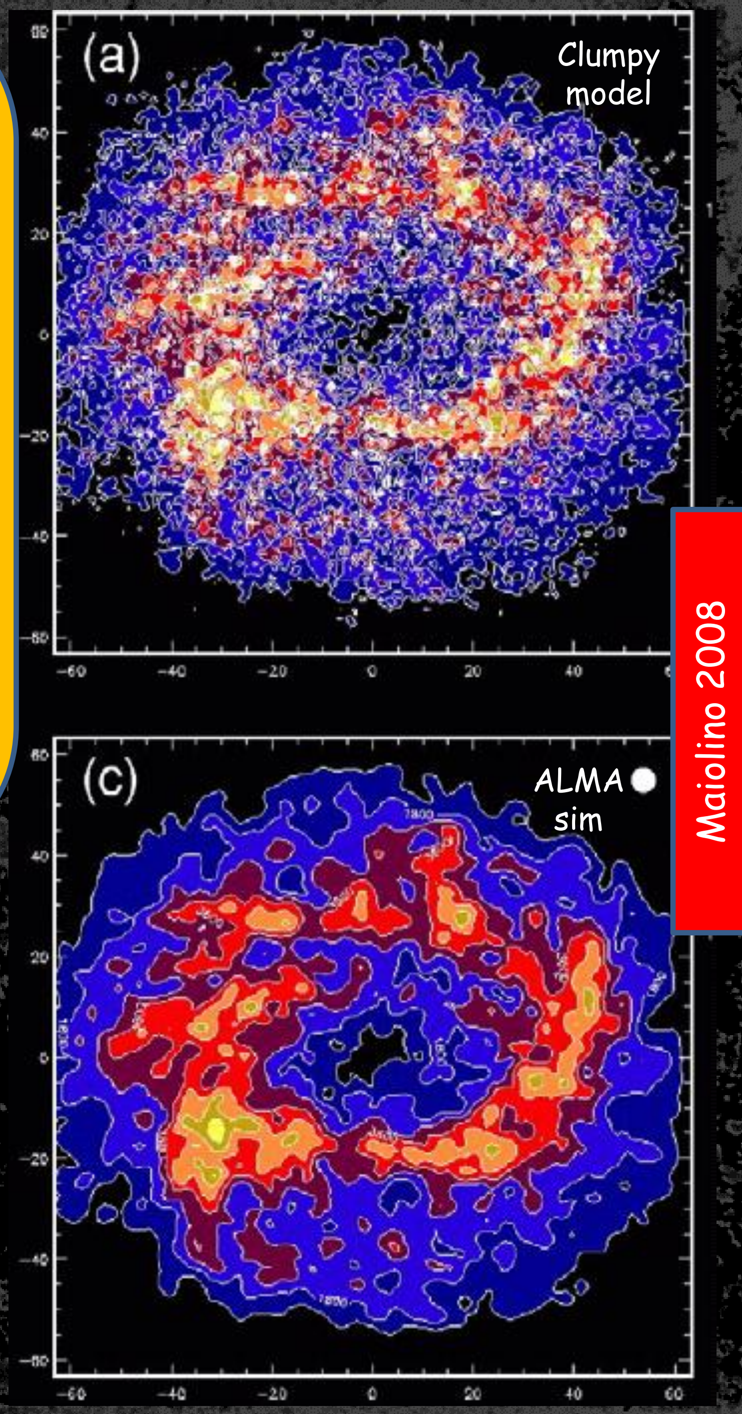
This suggests that the obscuration/reflection occurs on (at least) pc-scale, like the standard torus envisaged in the Unification Models and mapped by interferometry



Marinucci et al. 2012

NGC4945 is one of few AGN where the iron emission line and reflection component is imaged, on projected scales of ~200×100 pc. The central 30 pc accounts for about 50% of the whole emission. The structure is non-homogeneous, with visible clumps and empty regions with sizes of the order of tens of pc (**see Marinucci's talk**)

Recent models have shown that for the dusty pc-scale torus a clumpy structure can better account for the infrared observational properties (Nenkova et al. 2002, 2008; Elitzur & Shlosman 2006). In particular, the very broad infrared SED of AGN requires dust at multiple temperature, which is hardly achieved by models with a compact (pc-scale) uniform torus. Large-scale (100 pc) dusty torii can reproduce the broad IR SED, but can be hardly reconciled with the small sizes observed in mid-IR interferometric observations. A pc-scale, but clumpy torus can at the same time match the observed mid-IR size and reproduce the broad range of dust temperatures, since within each dense clump dust does span a wide range of temperatures



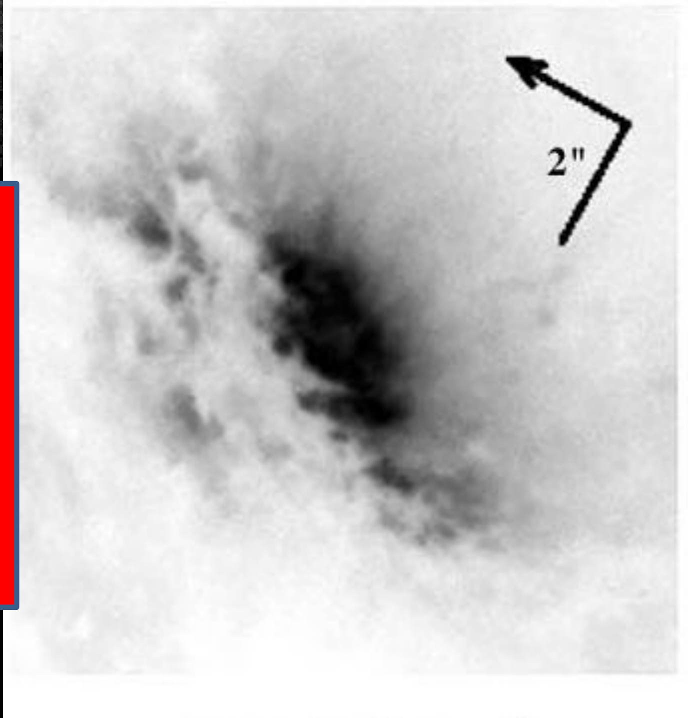
<u>A crucial test of these models will be feasible with ALMA</u>: a clear prediction of this model at subpc resolution is that the morphology of the"torus" at far-IR/sub-mm wavelengths (tracing cold dust) should be very similar to the morphology observed in the mid-IR (tracing warm dust). In contrast, uniform "torus" models expect a strong radial temperature gradient

Absorption from gas in the Host Galaxy

Despite clear evidence in favour of absorption from the BLR and the pc-scale "torus", in some cases **the lowest column densities are consistent with the optical reddening associated with the medium in the host galaxy** (e.g. Matt 2000). Early evidence of obscuration on 100 pc scales by the host galaxy gaseous disk came from the finding that optically selected AGN samples tend to avoid edge-on systems (Maiolino & Rieke 1995), a result which has been confirmed and refined with much higher statistics by using the SDSS survey (Lagos et al. 2011). Furthermore, it has been suggested that the gas in the host galaxy disk can partially obscure also the NLR

Further direct evidence for obscuration on large' scales was obtained through high-resolution HST images, showing that dust lanes at distances of hundreds of parsecs are very common in Seyfert galaxies (Malkan et al. 1998)

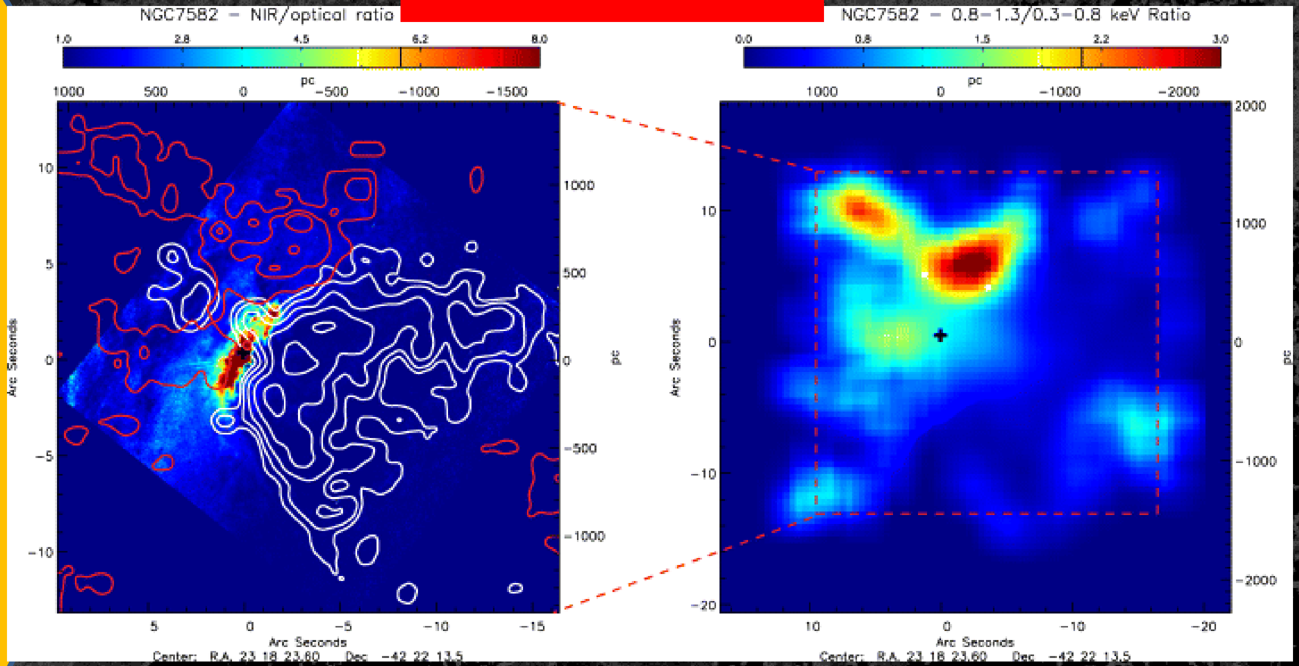
Malkan et al. 2008



NGC 7582 (145 pc/")

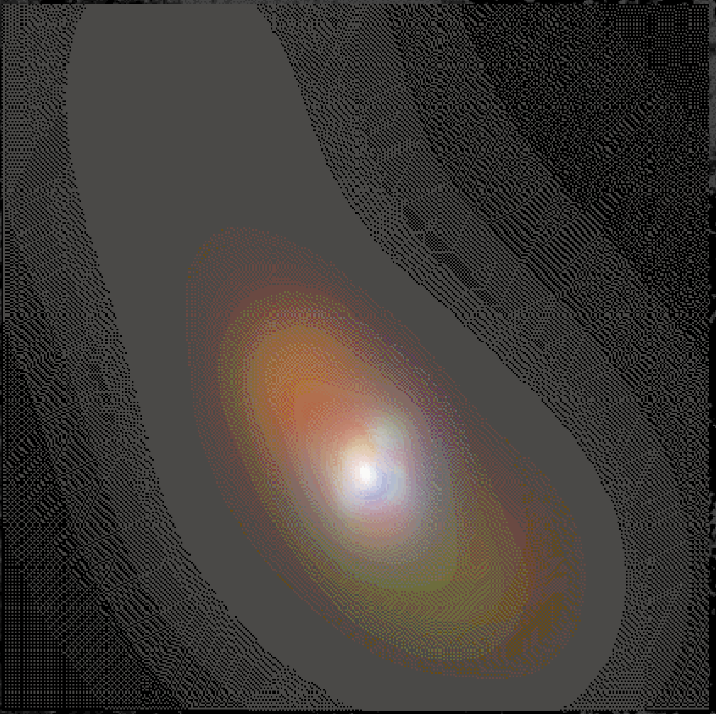
The presence of these structures is correlated with Compton-thin X-ray obscuration, even if not necessarily being directly responsible of the obscuration of the nucleus (Guainazzi et al. 2005). In some cases, the effect of dust lanes can be seen directly as X-ray obscuration towards the soft X-ray emission from the NLR (Bianchi et al. 2007)

Bianchi et al. 2007

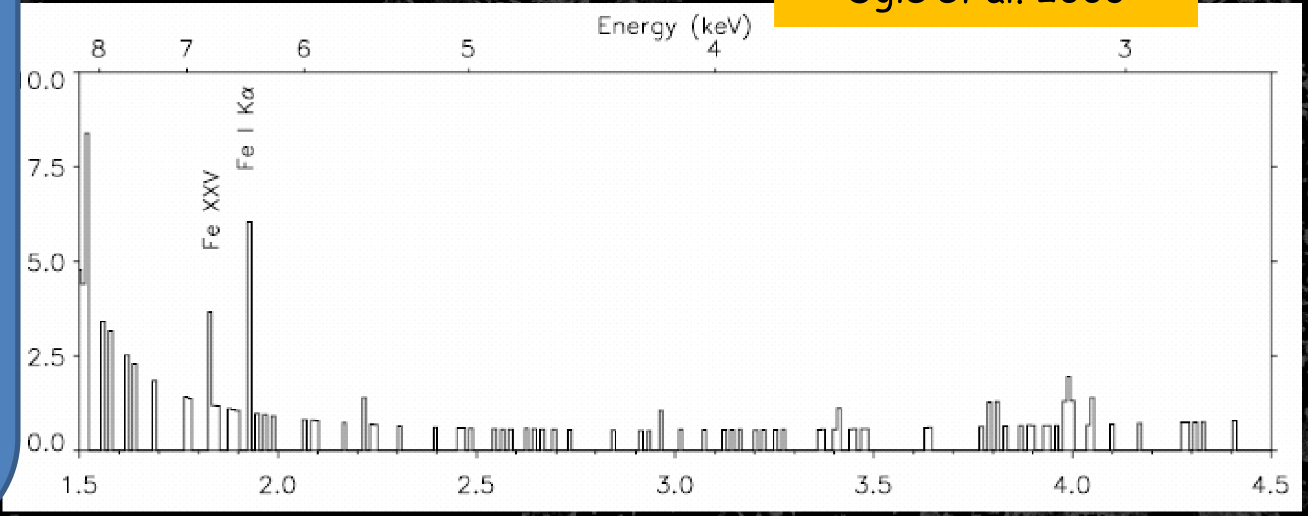


Interferometric maps of the molecular gas distribution have provided additional evidence for large amount of dense gas on the 100 pc scale surrounding AGN, which certainly contributes to the obscuration of the central engine along some line of sights (Schinnerer et al. 2000, Boone et al. 2010, Krips et al. 2011). **The advent of ALMA is going to be a breakthrough by providing detailed maps of the molecular gas distribution in the circumnuclear region of many AGN**

It is worth reminding that the obscuration occurring on such large scales is limited by dynamical mass constraints. Risaliti et al. (1999) showed that Compton-thick gas must be contained on scales significantly smaller than 100 pc, in order not to exceed the dynamical mass in the same region and have a covering factor large enough to account for the high number of observed Compton-thick sources. This in turns means that the bulk of the ubiquitous Compton reflection component and narrow neutral iron Ka line must also come from a compact region



Ogle et al. 2003

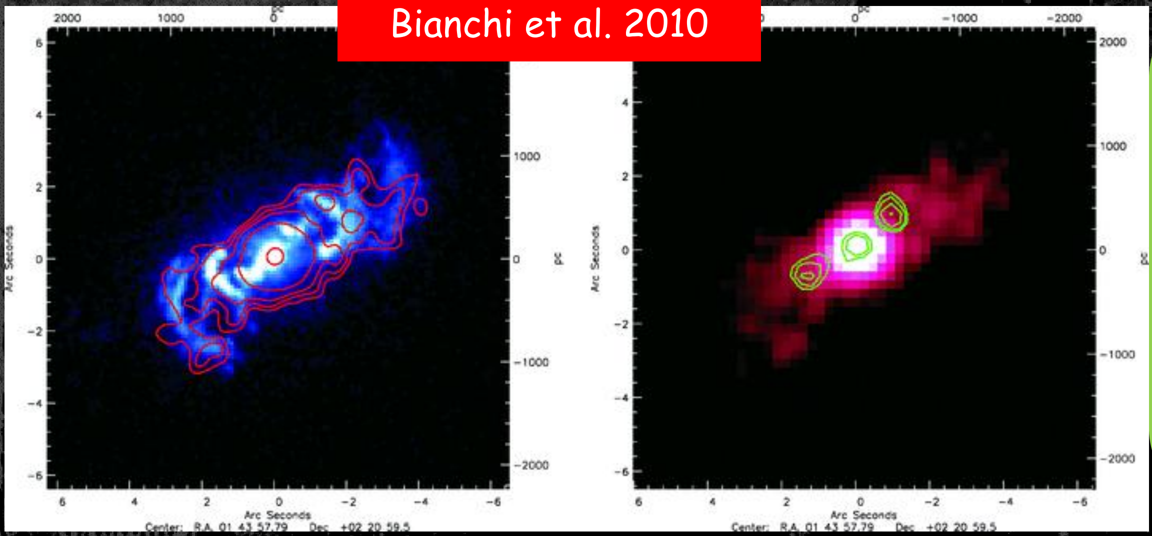


However, in NGC 1068 hard X-ray emission (mostly associated to the reflection component) and the neutral iron line are seen extending up to 2 kpc from the nucleus (Young et al. 2001, Ogle et al. 2003)

Disk-Torus Alignment

Although not explicitly required by any Unification Model, the most natural assumption on the geometry of the circumnuclear matter in AGN is that it is coaxial with the spin of the BH. This expectation is based on an angular conservation argument: if the obscuring torus is related to the inflowing material, it is natural to expect that the torus, the accretion disk, and the black hole rotation (mostly due to the angular momentum of the accreting material) share the same axis. Any radio jet should be aligned to the same axis. Finally, the orientation and the opening angle of the NLR ionization cones are collimated by the inner aperture of the torus, thus being themselves coaligned with the disk/torus axis

Bianchi et al. 2010



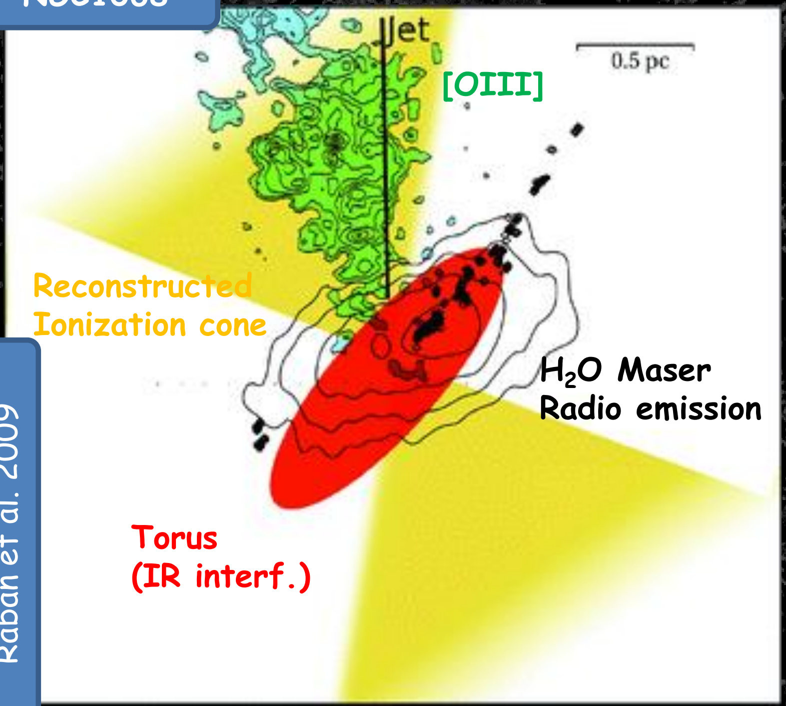
These expectations are very difficult to test, due to the very small scales of the inner regions of AGN. **<u>When larger scales are imaged, at least the radio jet and the optical/X-ray NLR appear to be generally in agreement with this simple picture</u>** (Capetti et al. 1996, Bianchi et al. 2010)

However, if the BH growth is due to multiple, unrelated accretion events, the BH spin may not reflect the rotation axis of the accretion disk. Another possibility is that the obscuring torus is not within the gravitational sphere of influence of the BH (e.g., a galactic dust lane): no obvious physical relation is expected between the torus axis and the BH spin

Mid-infrared interferometric studies allowed us for the first time to directly image the geometry of the torus with respect to the optical cones. **Surprisingly, the results obtained by Raban et al. (2009) strongly suggest that the the torus and the ionization cones are misaligned in NGC 1068**. Moreover, the direction of the radio jet is also clearly tilted with respect to both the NLR and the torus. Some of the discrepancy can be solved by taking into account the detailed kinematics of the outflow, and by assuming a clumpy torus that could prevent the ionization of all the gas present in the geometrical opening angle of the ionization cones. However, these solutions are not in agreement with the results inferred from the appearance of the cones in the infrared

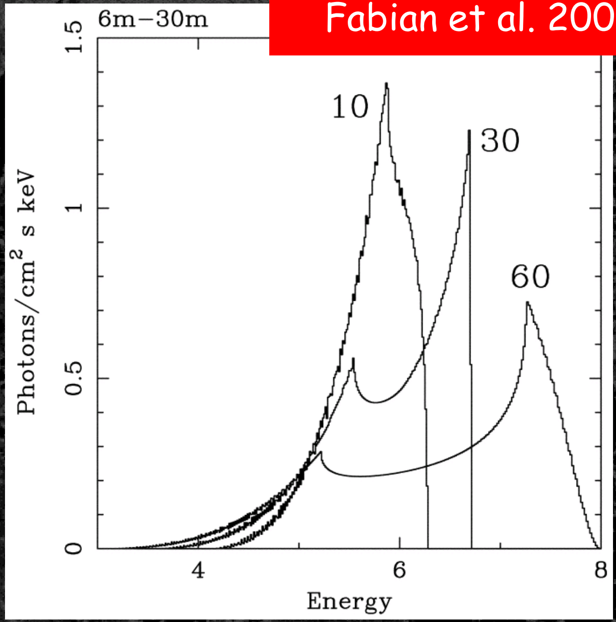
Similar analysis on other sources is clearly needed in order to shade some light on this issue. A promising, independent, method to test the torus/ionization cones misalignment is via X-ray polarimetry, but we will have to wait for a future X-ray mission equipped with a broadband polarimeter (Goosmann & Matt 2011) (see Fabio and Giorgio's talks)

NGC1068



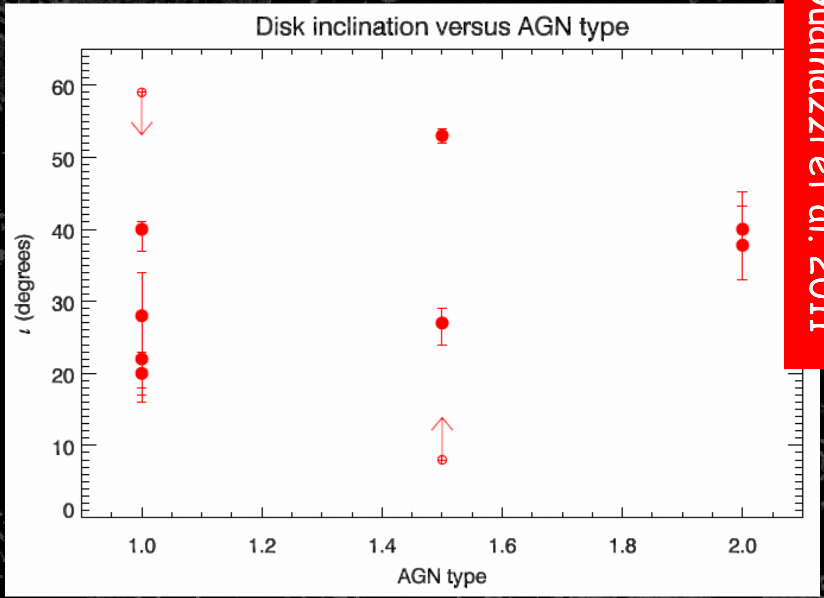
Raban et al. 2009

It is more difficult to estimate the inclination angle of the accretion disk. One possible method is via the relativistic profile of iron emission lines produced in the inner regions of the disk, which is expected to be strongly dependent on the inclination angle. When sizeable samples of AGN are systematically analysed, it appears that a simple relation between the inclination of the nuclear obscuring matter (as measured by the optical type) and that of the accreting matter should be ruled out, in contrast with the naive expectations from Unified Models (Guainazzi et al. 2011). However, the inclination angles derived from the profile of a relativistically broadened line are still affected by large systematic uncertainties



Fabian et al. 2000

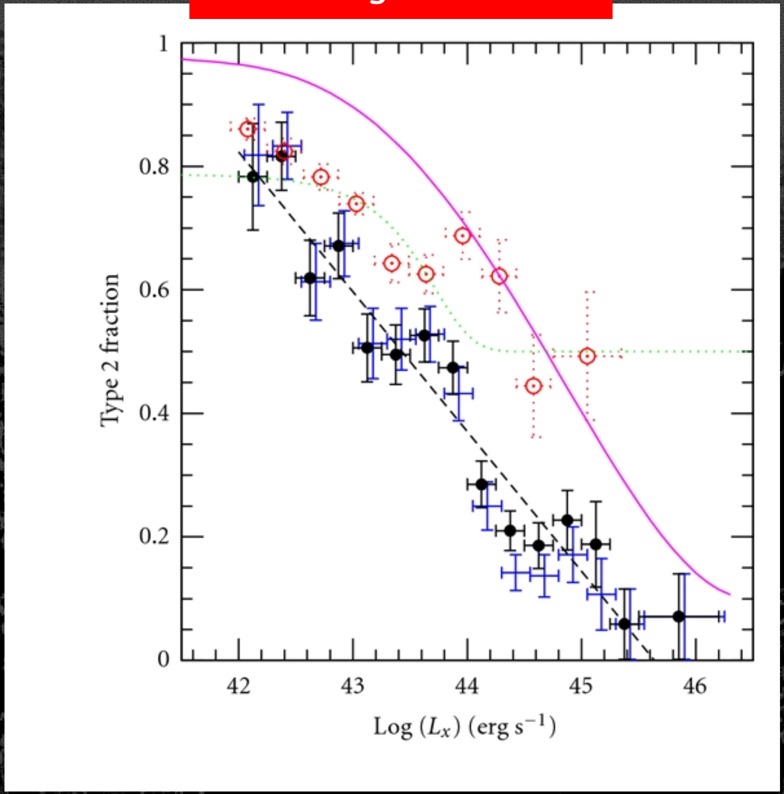
Another method was recently suggested by Risaliti et al. (2011), who analysed the distribution of the equivalent widths of the [OIII] emission line in a large sample of AGN. Their results are again not compatible with the presence of a torus coaligned with the accretion disk, unless the torus covering factor is extremely small



Guainazzi et al. 2011

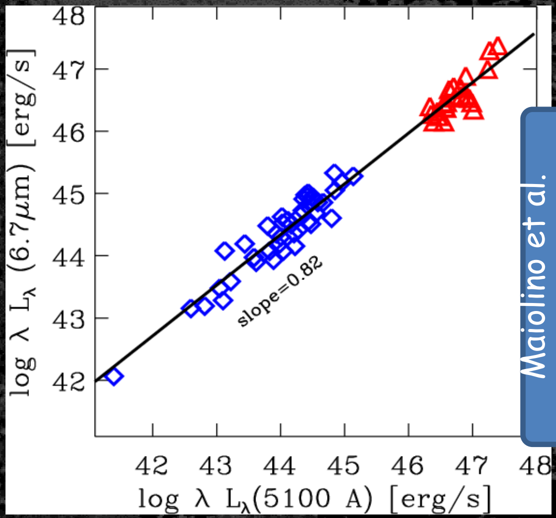
Luminosity and Redshift Dependence of the Covering Factor

Hasinger 2008

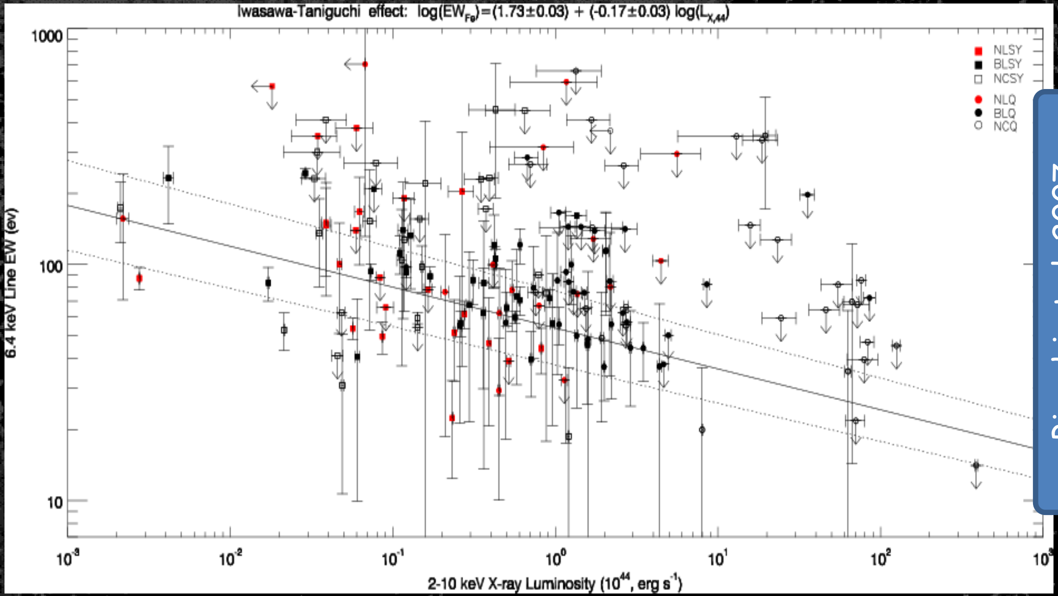


An interesting finding of the recent years has been the evidence **<u>for the covering factor of the obscuring medium decreasing significantly with luminosity</u>**. This effect has been shown quite clearly by various hard X-ray studies (Ueda et al. 2003, Steffen et al. 2003, La Franca et al. 2005, Akylas et al. 2006, Barger & Cowie 2005, Tozzi et al. 2006) and by optical surveys (Simpson 2005), which have measured the relative fraction of obscured and unobscured AGN as a function of the bolometric luminosity. Clearly these works are affected by various uncertainties and caveats, primarily related to possible incompleteness effects and biases that may prevent the identification of obscured AGN in more distant galaxies (hence more luminous, as a consequence of the Malmquist bias). Indeed, these results have been questioned by some authors (Dwelly & Page 2006, Treister & Urry 2005, Wang & Zhang 2007). However, more recent extensive hard X-ray surveys have further confirmed a clear trend for a decreasing fraction of obscured AGN at high luminosity (Hasinger 2008, Della Ceca et al. 2008, Treister et al. 2009, Brusa et al. 2010)

An alternative method to investigate the covering factor of the obscuring medium is by means of the dust reprocessing by the obscuring medium: the ratio between the hot dust emission observed in the near/mid-IR and the primary AGN bolometric emission (optical/UV/Xray), responsible for heating the dust, is proportional to the covering factor of the obscuring medium. <u>**By using ISO and Spitzer data to trace the dust emission, various studies have confirmed that the covering factor of the absorbing medium decreases as a function of luminosity**</u> (Treister et al. 2008, Maiolino et al. 2007, Wang et al. 2005, Mor & Trakhtenbrot 2011)



Maiolino et al. 2007



Bianchi et al. 2007

<u>**The EW of the (narrow) Fe Ka has also been found to anti-correlate with luminosity**</u> ("X-ray Baldwin effect" or "Iwasawa-Taniguchi effect"), a trend which was generally interpreted in terms of decreasing covering factor of the circumnuclear absorbing medium as a function of luminosity (Iwasawa & Taniguchi 1993, Page et al. 2004, Jiang et al. 2006, Guainazzi et al. 2006, Bianchi et al. 2007)

The origin of the anticorrelation between luminosity and covering factor is unclear. The "receding torus" scenario (Lawrence 1991) is often invoked to explain this trend: higher luminosities imply a larger dust sublimation radius and, if the torus has a constant height as a function of radius, this results into a smaller covering factor of the dusty medium. However, this scenario cannot explain the results on the decreasing covering factor inferred from X-ray studies, which do not trace the dusty component of the absorber

In the model proposed by Lamastra (2006), the covering factor-luminosity anti-correlation naturally arises if the X-ray obscuration in Compton-thin sources is due to interstellar gas, distributed in a rotationally supported disk with an extension of a few hundred pc. The covering factor of this disc diminishes as the gravitational pull from the central SMBH and the bulge increases with the BH mass (and, therefore, the luminosity), producing the observed anticorrelation. However, this model can explain the anticorrelation only for Compton-thin sources

Another possible scenario is that the lower covering factor in luminous AGN is simply a consequence of the stronger AGN radiation pressure impinging onto the circumnuclear medium and expelling larger fractions of material. In support of this scenario growing evidence for massive outflows in luminous AGN has been reported in the recent years (Fischer et al. 2010, Feruglio et al. 2010, Rupke & Veilleux 2011, Sturm et al. 2011, Cano-Diaz et al. 2012)

True Type 2 Seyfert galaxies

One of the most convincing pieces of evidence in favor of the Unification Model is the detection of broad optical lines in the polarized spectra of type 2 AGN. However, about **half of the brightest Seyfert 2 galaxies appear not to have hidden broad-line regions in their optical spectra**, even when high-quality spectropolarimetric data are analysed (Veilleux et al. 1997, Tran 2001)

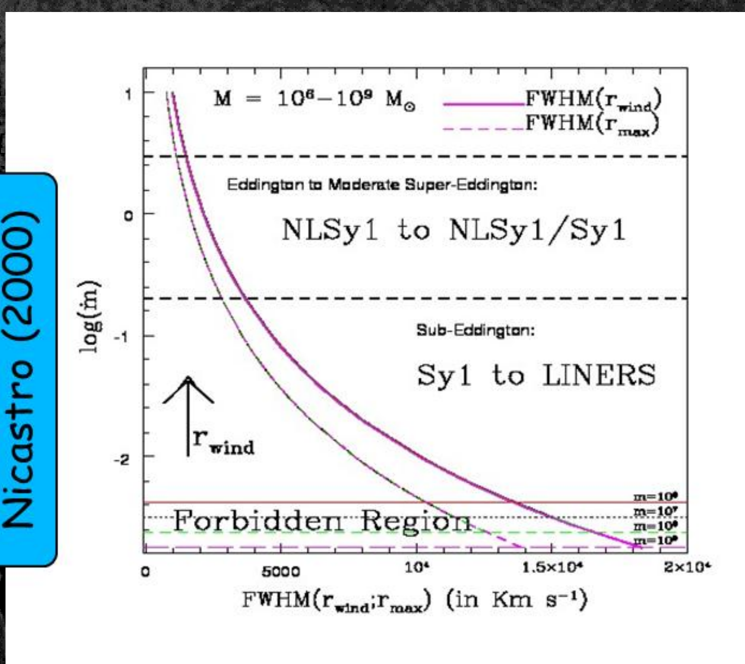
A number of these cases may be associated with nuclei where the mirror reflecting the broad lines either has very low scattering efficiency (either due to low covering factor or low column density) or is obscured (Heisler et al. 1997). Evidence was also obtained that the lack of polarized broad lines is associated with a stronger contribution/dilution from the host galaxy or from a circumnuclear starburst, making the detection of polarized broad lines harder (Alexander 2001, Gu et al. 2001)

However, a number of Sy2s without polarized broad lines may be genuine type 2 Seyferts, in the sense that they intrinsically lack a BLR

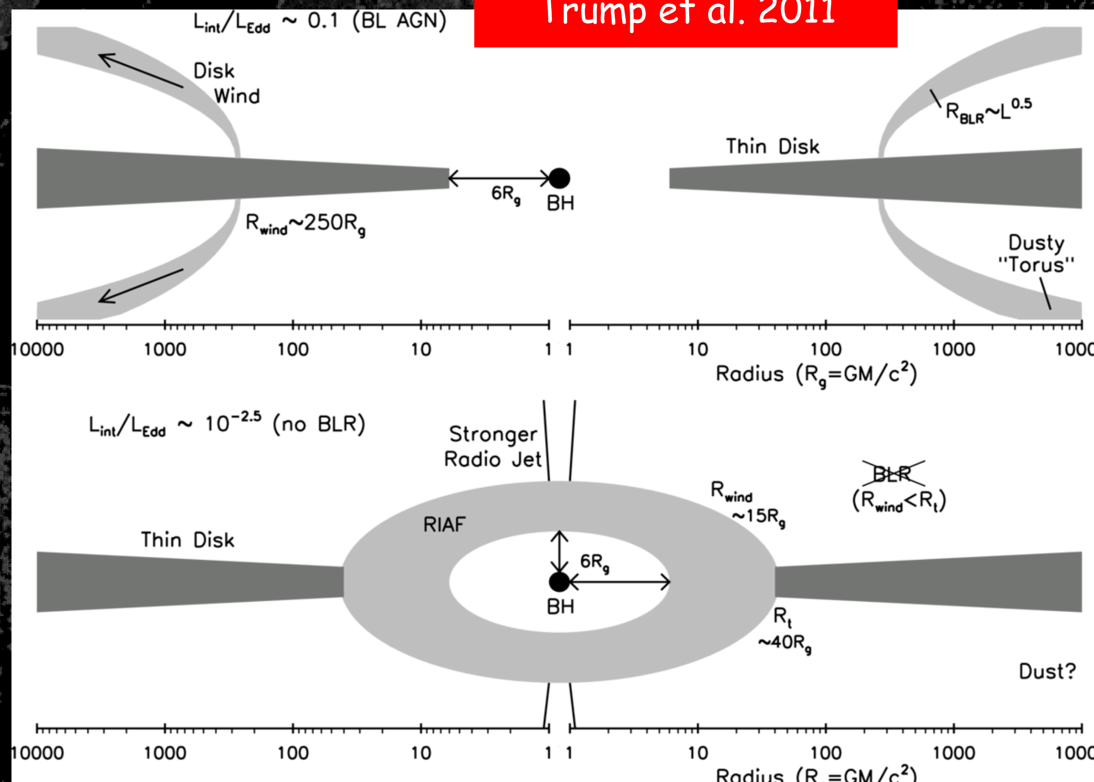
Indeed, observational evidence suggests that Seyfert 2s with polarized broad lines are more easily associated with truly obscured Seyfert 1 nuclei, while Seyfert 2s without polarized broad lines preferentially host weak AGN, possibly incapable of generating a classical BLR (Veilleux et al. 1997, Tran 2001)

The disappearance of the BLR is predicted by several theoretical models. Both Nicastro (2000) and Trump et al. (2011) assume that the BLR is part of a disk wind which originates at the radius where radiation pressure is equal to the gas pressure. The BLR cannot form if the accretion disk has a characteristic critical radius, and the disk wind radius falls below it. This critical radius can be identified with the innermost orbit of a classic Shakura & Sunyaev (1973) disk (Nicastro 2000), or the transition radius to a radiatively inefficient accretion flow (Trump et al. 2011). **In both cases, the formation of the BLR is prevented for Eddington rates lower than a critical value, which can be expressed as $2.4\times10^{-3}\ M_8^{-1/8}$ and $1.3\times10^{-2}\ M_8^{-1/8}$, respectively, where M_8 is the BH mass in units of $10^8\ M_\odot$**

Nicastro (2000)



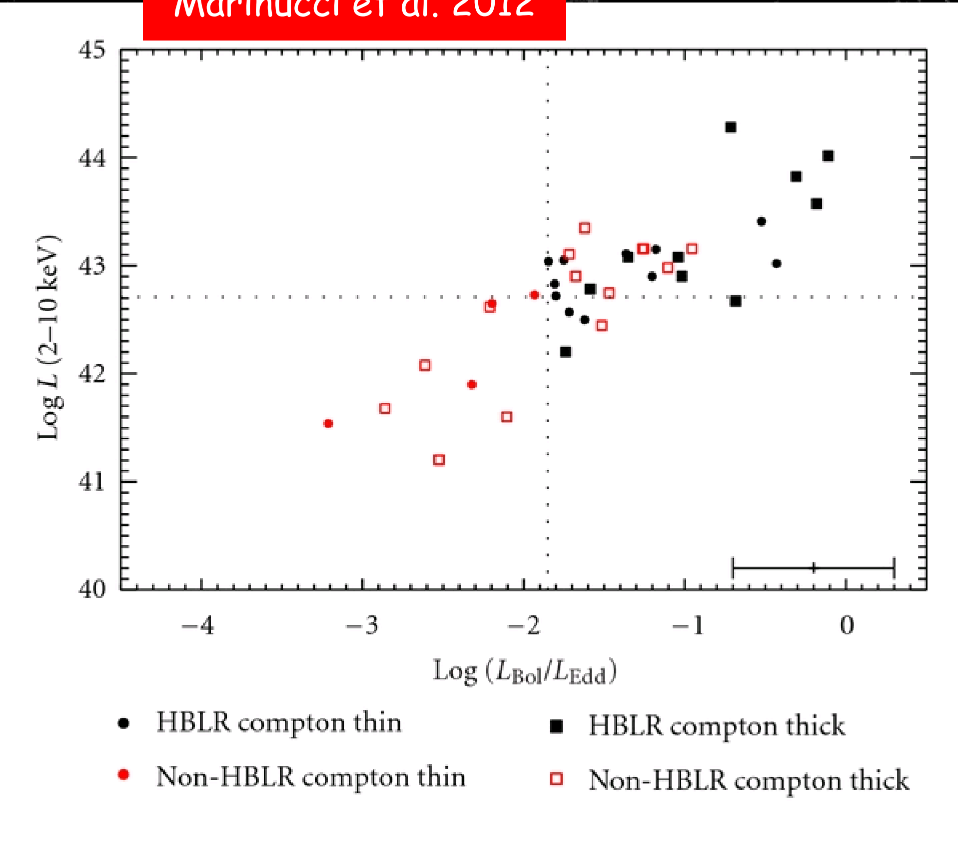
Trump et al. 2011



If the BLR cannot form in weakly accreting AGN, **we expect the existence of "true" Seyfert 2 galaxies, that is, optically classified Type 2 objects, without any evidence of obscuration of their nuclei. Such unabsorbed Seyfert 2 galaxies do exist**, and the best examples (where the lack of the optical broad lines and of the X-ray obscuration are unambiguously found in simultaneous observations with high SNR) have low Eddington rates: NGC 3147 (4×10^{-5}-3×10^{-4}: Bianchi et al. 2008), Q2131427 (2-3×10^{-3}: Panessa et al. 2009), and NGC 3660 (4×10^{-3}-2×10^{-2} : Bianchi et al., 2012)

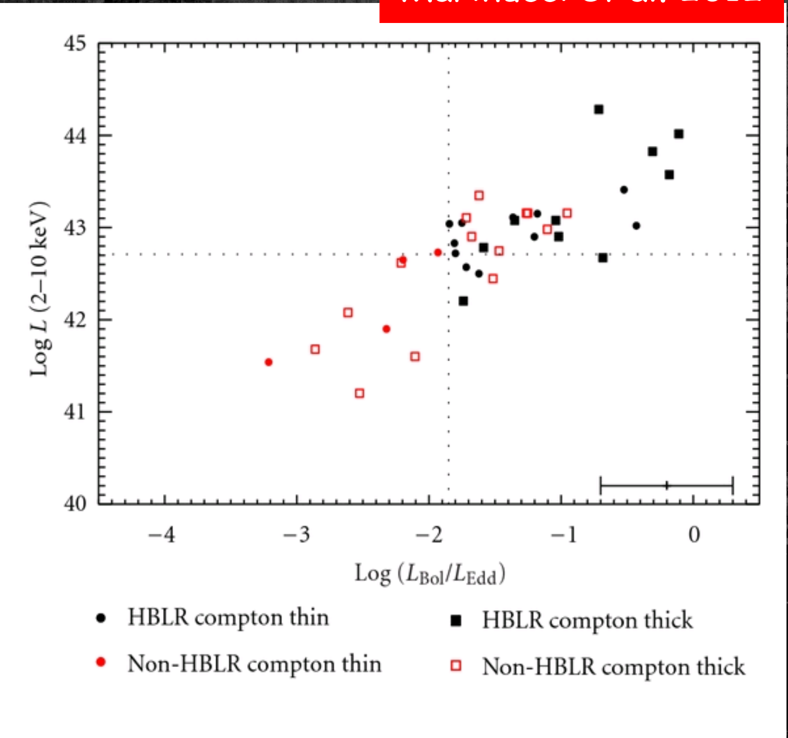
Trump et al. (2011) support their model by showing an observational limit at $L_{bol}/L_{Edd}\simeq0.01$ between AGN with broad optical lines and (X-ray unobscured) AGN without. Another observational evidence of the existence of a minimum accretion rate for the formation of the BLR comes from several studies that point out the absence of broad optical lines in the spectra in polarized light of Seyfert 2s with low Eddington rates (Nicastro et al. 2003; Bian & Gu 2007;Wu et al. 2011). In the recent analysis by Marinucci et al. (2012), the threshold is found at 0.01, which is in agreement both with the model and the data presented by Trump et al. (2011)

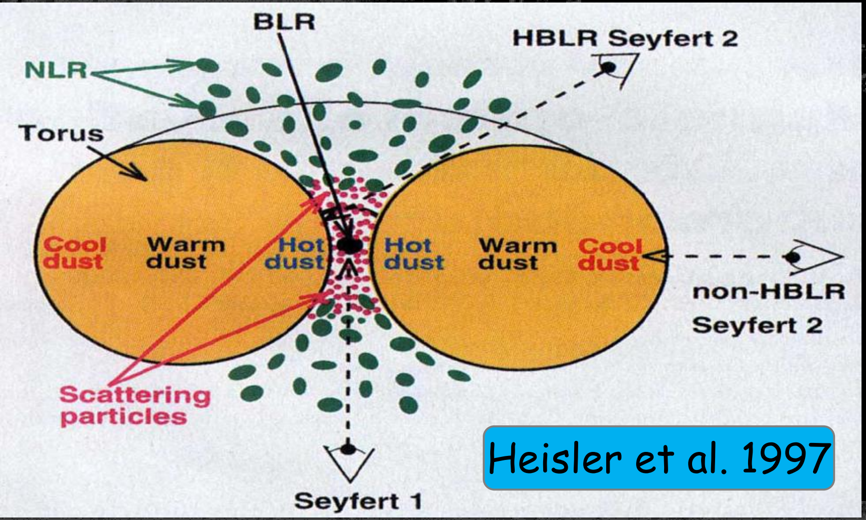
Marinucci et al. 2012



Below this threshold no broad lines are detected (either in total or polarized light). On the other hand, it is clear that above the threshold the BLR still cannot be detected in many Sy2s. These sources should possess a BLR, so there must be something that prevents us from observing it. Indeed, all these sources are Compton-thick, so the nucleus is severely obscured by intervening absorbers. It was suggested that this could be explained within the framework of standard Unification Models, whereby more inclined sources (with respect to the line of sight) should intercept a larger column density of the torus and may obscure the medium responsible for the scattering of the BLR photons (Shu et al. 2007)

Marinucci et al. 2012





Heisler et al. 1997

<u>It appears that there are two classes of non-HBLR:</u>

- those with low accretion rates, really lacking the BLR,
- those with high accretion rate, likely hosting the BLR, but something prevents us from observing it

Are true type Seyfert 2s rare objects?

Apart from NGC 3147, NGC 3660, and Q2131-427, there are not many other strong representatives of this class in literature. If all true type Seyfert 2s are indeed low-accretors, their paucity should not be very surprising. When a sizeable sample of X-ray unobscured radio-quiet AGN withgood-quality spectra is analysed (e.g. CAIXA: Bianchi et al. 2009), only a few (< 5%) lie below the $L_{bol}/L_{Edd} \simeq 0.01$ limit, with NGC 3147 and NGC 3660 among them. The fraction of low-accreting unabsorbed Seyfert 2 candidates rises up to 30% in extensively studied samples derived from surveys (COSMOS: Trump et al. 2011), but the lack of simultaneous optical and X-ray observations, and the low quality of the X-ray spectra, prevent us from drawing firm conclusions on their nature as genuine true type 2 AGN. Interestingly, a similar fraction of $\simeq$ 25% of low-accreting objects are found to lack the signatures of an hidden BLR in polarized light in obscured AGN (Marinucci et al. 2012).

Summary & Conclusions

The Unified Model for AGN has been tested in many different ways in the past few years, through a large set of new imaging, spectral, and timing observations. Overall, **the fundamental aspect of the model, that is, that non-spherically symmetric absorption plays a major role in explaining the differences in the observed features among AGN, has been confirmed**, and even reinforced by the most recent observations. However, some more complexity has been added. **There is now strong evidence of at least three absorption components on very different scales**

On scales of hundreds of parsecs, or even larger (galactic dust lanes), circumnuclear matter has been imaged, with different techniques, and is clearly responsible of the "type 2" (in optical/UV) or "absorbed" (in X-rays) classification of a significant fraction of AGN

On the parsec scale, and down to the dust sublimation radius, the "standard" torus, as initially postulated in the earliest works on AGN unification, has been now directly imaged in a few sources with interferometric techniques, and its presence is suggested by X-ray reflection properties, and by dust reverberation mapping in the near-IR

On the 0.01 pc scale, the presence of dust-free gas along the line of sight has been demonstrated through X-ray absorption variability in several AGN, thus suggesting that part of the observed X-ray absorption is due to Broad Line Region clouds