EW[OIII] as an orientation indicator

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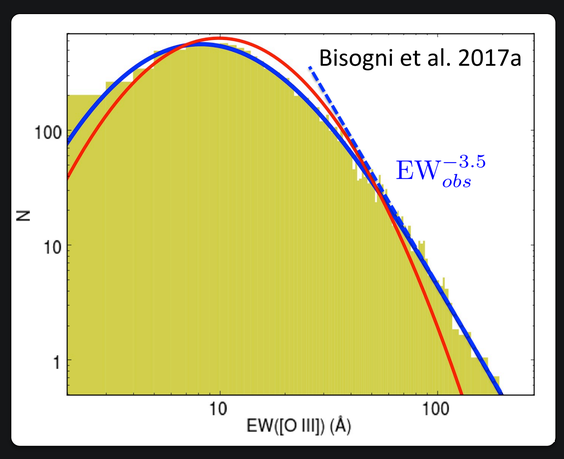
Abstract:

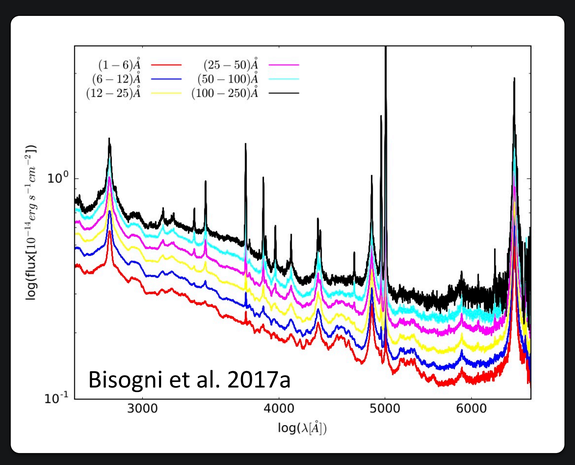
We present an analysis of the average spectral properties of ~12,000 SDSS quasars as a function of accretion disk inclination, as measured from the equivalent width of the [O III] 5007Å line. The use of this indicator on a large sample of quasars from the SDSS DR7 has proven the presence of orientation effects on the features of UV/optical spectra, confirming the presence of outflows in the NLR gas and that the geometry of the BLR is disk-like. Relying on the goodness of this indicator, we are now using it to investigate other bands/components of AGN. Specifically, the study of the UV/optical/IR SED of the same sample provides information on the obscuring "torus". The SED shows an increase of the IR fraction moving from face-on to to edge-on positions, in agreement with models where the torus is coaxial with the accretion disk, and characterized by a clumpy structure.

[Bisogni et al. 2017a*, MNRAS, 464, 385B, *Bisogni et al. 2017b, in prep.]

INTRODUCTION:

The observed EW[OIII] distribution shows a power law tail for high EW values that can be produced only by orientation (Risaliti et al. 2011).

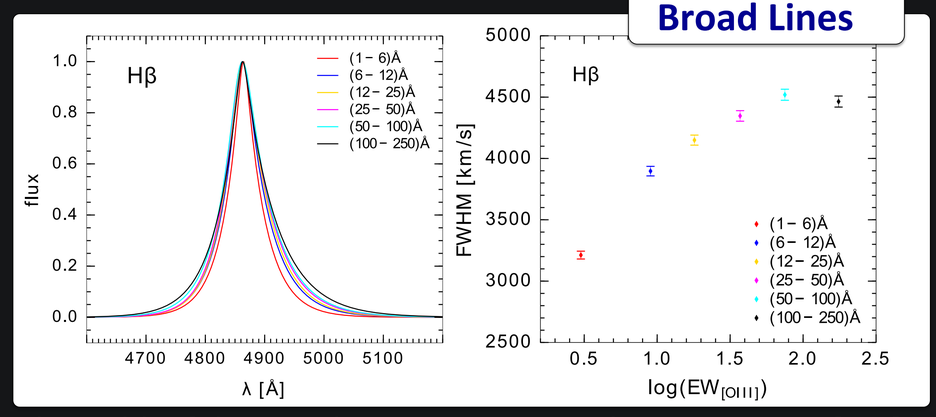




We split the sample in EW[OIII] bins and look for orientation effects on spectral emission features of representative spectra (Bisogni et al. 2017a)

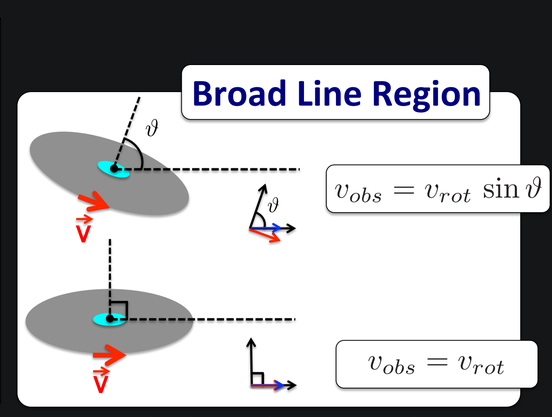
Results on optical spectra:

Broad Lines

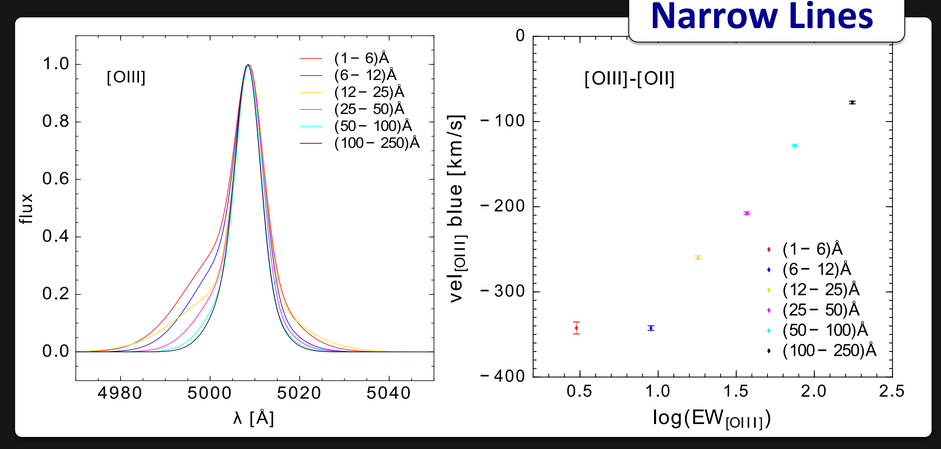


The width of the Broad Lines increases with increasing EW[OIII], as expected when observing objects at higher inclinations

Broad Line Region

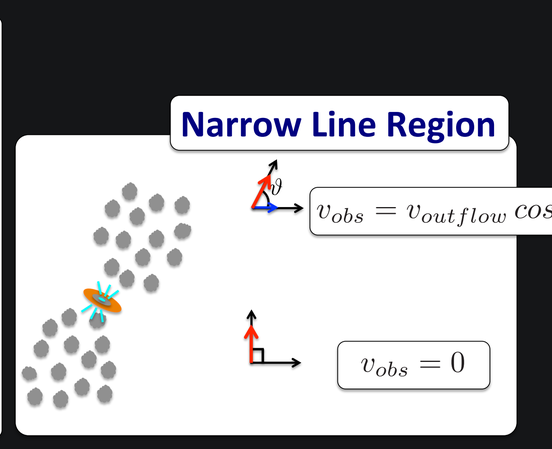


Narrow Lines

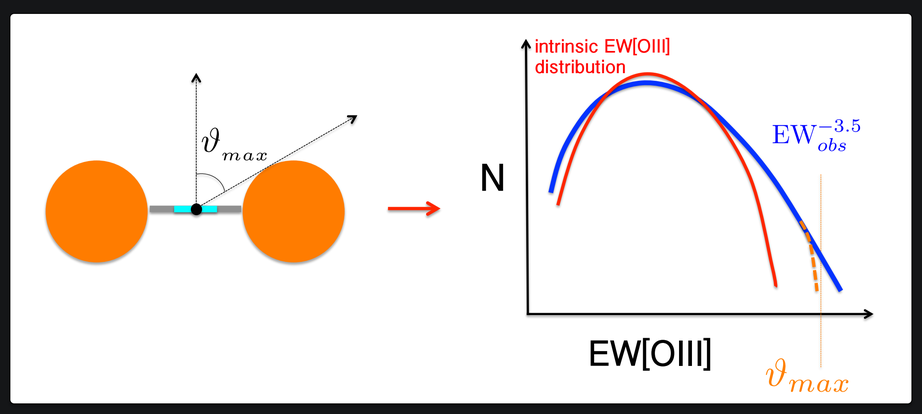


The absolute value of the velocity of the [OIII] blue component decreases with increasing EW[OIII], as expected when observing objects at higher inclinations

Narrow Line Region



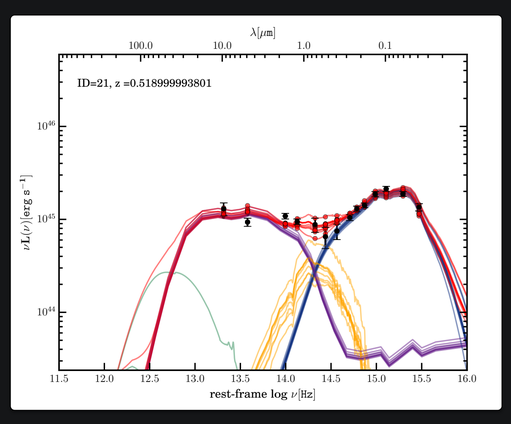
Implications for the Torus



If the Torus has the smooth structure depicted in the Unified Model for AGN, then exists a maximum angle over which we should not see any emission. This is NOT what seen in the observed distribution.

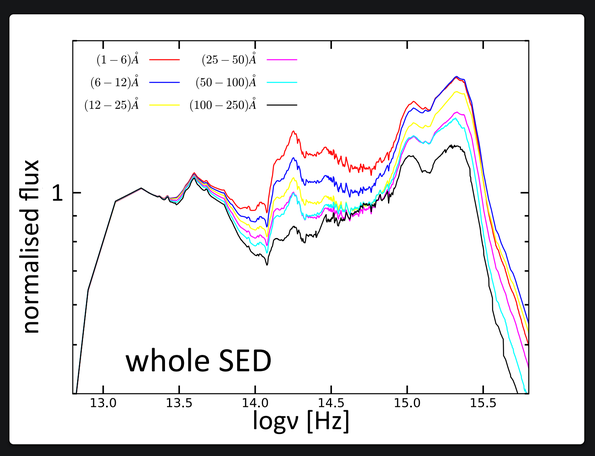
Method:

AGNfitter (Calistro Rivera et al. 2016) was used to obtain the SED for each object. We considered data (or upper limits) from **WISE** (Wright et al. 2010), **2MASS** (Skrutsie et al. 2006), **GALEX** (Martin et al. 2005) and **SDSS** (Shen et al. 2011).

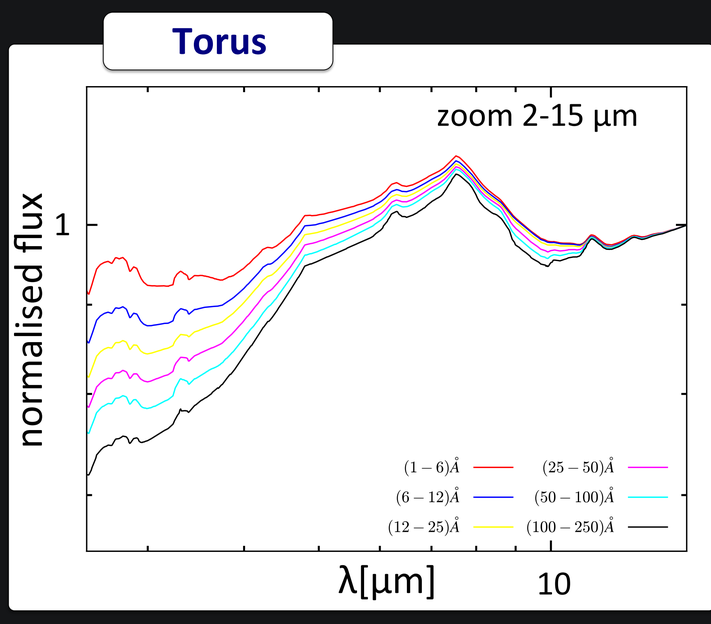


Example of SED fitting with AGNfitter; green, purple, orange and blue components represent starburst, torus, galaxy and disk emissions respectively

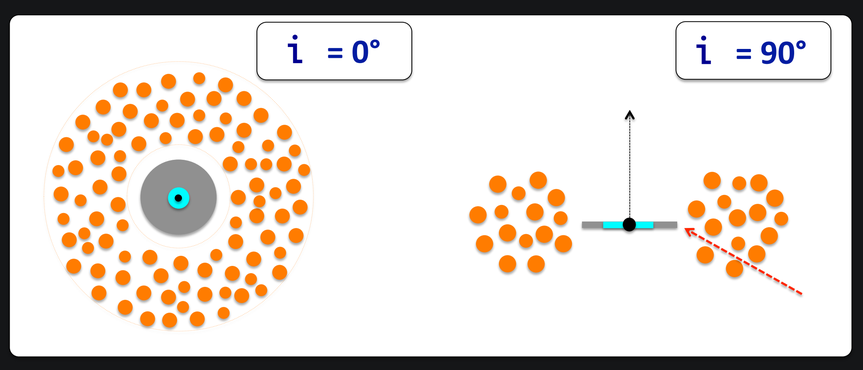
SED stacking for sources in each EW[OIII] bin (in the same fashion of the one performed for optical spectra), realised after flux normalisation to a reference frequency (log ν = 13.3 → λ~15μm)

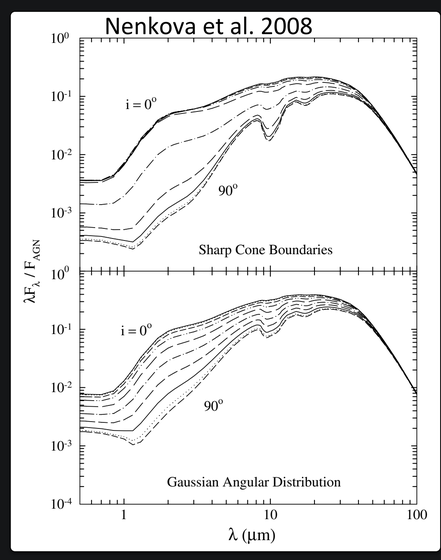


Torus



The behaviour of the IR SED as a function of EW[OIII] is that expected from the emission of a torus when the line of sight intercepts the torus from a *face-on* to an *edge-on* position, in agreement with the theoretical models by Nenkova et al. 2008. Moreover, the fact that we observed Broad Emission Lines even in AGN in positions close to the edge-on suggests that the torus is clumpy.





REFERENCES:

Bisogni S., Marconi A., Risaliti G., 2017, MNRAS, 464, 385B
Calistro Rivera G., Lusso E., Hennawi J. F., Hogg D. W., 2016, ApJ, 833, 98C
Martin C. D. et al. 2005, ApJ, 619L, 1M (The Galaxy Evolution Explorer, GALEX)
Nenkova M., Sirocky M. M., Nikutta R., Ivezić Ž, Elitzur M., ApJ, 2008, 685, 160N
Risaliti G., Salvati M., Marconi A., 2011, MNRAS, 411, 2223R
Shen Y. et al 2011, ApJS, 194, 45S (A Catalog of Quasar Properties from SDSS DR7)
Skrutsie M. F. et al. 2006, AJ, 131, 1163 (The Two Micron All Sky Survey, 2MASS)
Wright E. L. et al. 2010, AJ, 140, 1868W (The Wide-field Infrared Survey Explorer, WISE)