A Glossary to some General (Astro)Physical terms

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Abstract

This is a simple document which will hopefullyeventually be a pretty complete list/glossary of various Astro)Physical terms and 'what they mean'. There will be some overlap here with my other Research Notes, e.g. the Emission Line document...

1 A

2 B

2.1 Bondi Accretion

AGN Accrete from the ISM, Via Bondi accretion:

$$\dot{M} \simeq (1.4 \times 10^{11} \mathrm{g/s}) \left(\frac{\mathrm{M}}{\mathrm{M}_{\Theta}}\right) \left(\frac{\rho}{10^{-24}\ \mathrm{g/cm}^3}\right) \left(\frac{\mathrm{c_s}}{10\mathrm{km/s}}\right)^{-3} \tag{1}$$

2.2 BPT diagram

Straight from:Level 5 BPT

"Baldwin, Phillips & Terlevich" (BPT) diagrams demonstrate how LINERs can be distinguished from normal H II regions and normal AGNs (Seyferts and QSOs) on the basis of their [O III] λ5007 / Hβ, [N II] λ6583 / Hα, and [S II] $\lambda\lambda$6716, 6731 / Hα flux ratios. Here it is seen that the Seyfert 2s have high values of each ratio. H II regions define a locus of lower values which does not overlap with the region of parameter space occupied by the Seyferts. The LINERs can be distinguished from the Seyfert 2s by their low values of [O III] λ5007 / Hβ relative to [N II] λ6583 / Hα, and from the H II regions by their larger values of [N II] λ6583 / Hα.

[O III]/[O II] is sensitive to ionization parameter (how ionized is the gas). [O I]/ H α is sensitive to hardness of the radiation field.

3 C

3.1 Covering Factor

From Roseboom et al. (e.g., 2013)... "The fraction of sight-lines to the AGN centre obscured by dust."

3.2 Comption Thick

Straight from: Comastri, astro-ph/0403693.

The spectrum of the hard X-ray background records the history of accretion processes integrated over the cosmic time. Several pieces of observational and theoretical evidence indicate that a significant fraction of the energy density is obscured by large columns of gas and dust. The absorbing matter is often very thick, **with column densities exceeding $N_{\mathrm{H}} \simeq 1.5 \times 10^{24}$ cm^{-2}, the value corresponding to unity optical depth for Compton scattering**. These sources are called "Compton thick" and appear to be very numerous, at least in the nearby universe. Although Compton thick Active Galactic Nuclei (AGN) are thought to provide an important contribution to the overall cosmic energy budget, their space density

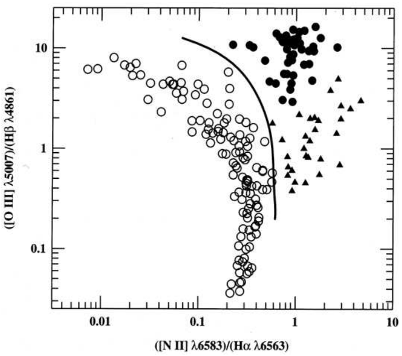

Figure 1:

and cosmological evolution are poorly known. The properties of Compton thick AGN are reviewed here, with particular emphasis on their contributions to the extragalactic background light in the hard X-ray and infrared bands.

4 D

4.1 Duty cycle

"the fraction of the time that an AGN/QSO is active."

5 L

5.1 LINERS

Straight from Sturm et al., 2006, ApJL, 653, L13:
Since their identification as a class of galactic nuclei more than 25 years ago (Heckman 1980), the nature of low-ionization nuclear emission-line regions (LINERs) has remained controversial. Their optical spectra are characterized by enhanced narrow emission lines of low-ionization species, quite distinct from those of both H II regions and classical active galactic nuclei (AGNs). They are found in one-third to one-half of all types nearby galaxies (e.g., Ho et al. 1997). In many LINERs the emission is concentrated near the nucleus (a few times 100 pc; e.g., Pogge et al. 2000), but in others it extends over larger regions, up to a few kiloparsecs (Veilleux et al. 1995). There is substantial evidence that many LINERs are powered by accretion onto massive black holes and that these objects, due to low accretion rates, constitute the low-luminosity end of the AGN class (Quataert 2001; Kewley et al. 2006). If many LINERs at low and high redshifts are indeed low-luminosity AGNs, this would have a significant impact on major issues in astronomy such as the growth history of central black holes and the relation of AGNs to galaxy formation and evolution.

6 R

6.1 Reddening

7 S

7.1 Salpeter time

$$t_S = M/\dot{M} = 4.5 \times 10^7 \left(\frac{\epsilon}{0.1}\right) \left(\frac{L}{L_{\rm Edd}}\right)^{-1} \tag{2}$$

where $\epsilon = L/\dot{M}c^2$ is the radiative efficiency for a QSO radiating at a fraction $L/LEdd$ of the Eddington luminosity. Commonly accepted values of these two key parameters for luminous QSOs are $\epsilon = 0.1$ and $L/LEdd = 1$. Martini, P. (QSO Lifetimes; http://adsabs.harvard.edu/abs/2004cbhg.symp..169M).

This critical accretion rate, [the Eddington mass accretion rate], is proportional to the mass of the accreting object, which implies that the mass of an object that is growing at the maximal (Eddington) accretion grows exponentially on a timescale known as the Salpeter time,

$$t_{Sal} = \frac{\epsilon \sigma_T c}{4\pi G m_p} \approx 45\epsilon_{0.1} 10^6 \text{ years} \tag{3}$$

from "Massive Black Hole Growth and Formation" from Paolo Coppi.

7.2 Soltan Argument

$$\frac{\epsilon}{1-\epsilon} \rho_{\rm BH} c^2 = \int e(z)(1+z)dz \tag{4}$$

$e(z)dz$: present energy density from AGN in redshift range z to $z + dz$.
$\rho_{\rm BH}$: mean cosmic density of nuclear black holes.
η: radiative efficiency
The Soltan argument works approximately for $\eta \approx 0.1$, so observed AGN must account for most of nuclear black hole growth.

Refs:
www.aei.mpg.de/ pau/conf_vid/Miralda.pdf
www.bo.astro.it/ vignali/PhD.../Merloni_PhD_Bologna_Tuesday.pptx www.astro.yale.edu/coppi/pubs/bhgrowth4.pdf
http://ned.ipac.caltech.edu/level5/March02/Ferrarese/Fer2.html

8 T

8.1 Thomson cross-section

$N_{\rm H} \geq \sigma_{\rm T}^{-1} \simeq 1.5 \times 10^{24}$ cm^{-2}.

For an electron:

$$\sigma_{\rm T} = \frac{8\pi}{3} \left(\frac{\alpha \hbar c}{mc^2}\right)^2 = 0.6652 \times 10^{-24} \text{ cm}^{-2} \tag{5}$$

8.2 Thomson scattering

Thomson scattering is the elastic scattering of electromagnetic radiation by a free charged particle. It is just the low-energy limit of Compton scattering: the particle kinetic energy and photon frequency are the same before and after the scattering. This limit is valid as long as the photon energy is much less than the mass energy of the particle: $\nu \ll mc^2/h$.

References

Roseboom I. G., Lawrence A., Elvis M., Petty S., Shen Y., Hao H., 2013, MNRAS, 429, 1494