The physical process(es) that quench the galaxy are unclear. In part, quenching may be due to a change in the nature of accretion: rapid accretion of cold streams of infalling gas at low mass transitioning to slow accretion of hot gas in hydrostatic equilibrium at high mass (e.g. Dekel et al. 2009). In principle these processes are included in numerical and semi-analytic models of galaxy evolution. Nevertheless, these models require some additional process to be at play in order to reproduce the observed properties of massive galaxies. Heating and/or the ejection of surrounding gas by an AGN-driven outflow to suppress the cold accretion is a popular idea. In addition the models also require AGN feedback to keep galaxies that arrive in the red/dead population from forming too many stars from the slow accretion of their hot halo gas. Thus, in the current paradigm, AGN play a crucial role in the evolution of massive galaxies.

2. BASIC METHODOLOGY

2.1. Overview of the Local AGN Population

The fundamental property that we consider to define an AGN is that its power source involves extracting energy from the relativistically-deep potential well of a SMBH at or near the center of a galaxy.

In this paper we will present strong empirical evidence that the low-redshift population of AGN can be divided into two main categories. The first category consists of objects whose dominant energetic output is in the form of electromagnetic radiation produced by the efficient conversion of the potential energy of the gas accreted by the SMBH. Historically, these objects have been called either Seyfert galaxies or QSOs depending upon rather vague and arbitrary criteria involving luminosity and/or redshift. In the rest of this review we will refer to these as radiative-mode AGN. The second category consists of objects that produce relatively little radiation, and whose primary energetic output takes the form of the bulk kinetic energy transported in two-sided collimated outflows (jets). These jets may be ultimately powered by the accretion of gas or by tapping the spin energy of the SMBH. Historically, this AGN population has been called (low-excitation) radio galaxies. In this review we will refer to them as jet-mode AGN. As we will show in this review, these two populations are virtually disjoint in terms of the basic properties of their SMBHs and host galaxies.

Let us then begin by describing the basic building blocks for these two types of AGN (see Fig. 3 for schematic diagrams). We refer readers to the texts of Krolik (1999), Netzer (2013), Osterbrock & Ferland (2005), Peterson (1997), and the review by Yuan & Narayan in this volume, for the gory details. In the first category (radiative-mode AGN), the SMBH is surrounded by a geometrically-thin, optically-thick accretion disk through which an inflow occurs. The accretion disk has a radial temperature gradient and the resulting total thermal continuum emission emerges in the extreme ultraviolet through visible portion of the electromagnetic spectrum. The accretion disk is surrounded by a hot corona which Compton-up-scatters the soft seed photons from the disk into the X-ray regime. As the X-rays impact the accretion disk their spectral energy distribution is modified through fluorescence and reflection off the accretion disk. The ionizing radiation from the disk and corona heats and photo-ionizes a population of dense gas clouds located on scales of light-days to light-years from the SMBH leading to the production of UV, optical, and near-IR permitted emission-lines. The velocity dispersion of the population of clouds is typically several thousand km s^{-1}, leading to its designation as the Broad Line Region based on the resulting emission-line spectrum.

On larger scales, the SMBH and accretion disk are surrounded by a region of dusty molecular gas (which we will refer to as the obscuring structure). Its inner radius is set by the sublimation temperature of the most refractory dust grains and is hence larger in more luminous AGN. In this region some of the incident UV/visible photons from the accretion disk and the soft X-rays from the corona are absorbed by the dust

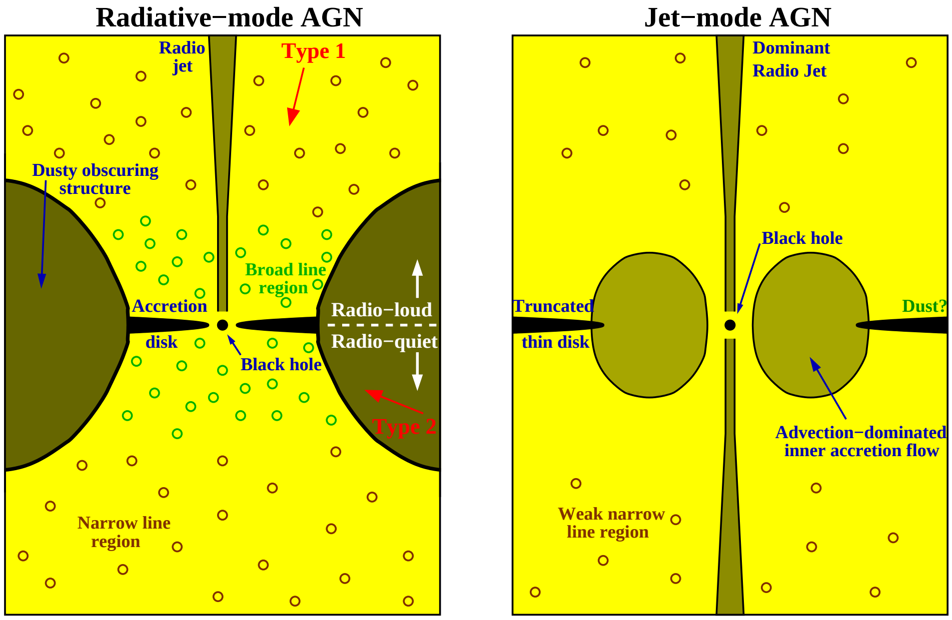

Fig. 3.— Schematic drawings of the central engines of radiative-mode and jet-mode AGN (not to scale). Radiative-mode AGN (left panel) possess a geometrically-thin, optically-thick accretion disk, reaching in to the radius of the innermost stable orbit around the central supermassive black hole. Luminous ultraviolet radiation from this accretion disk illuminates the broad-line and narrow-line emission regions. An obscuring structure of dusty molecular gas prohibits direct view of the accretion disk and broad-line regions from certain lines of sight (Type 2 AGN), whereas they are visible from others (Type 1 AGN). In a small proportion of sources (predominantly towards the high end of the range of black hole masses) powerful radio jets can also be produced. In jet-mode AGN (right panel) the thin accretion disk is replaced in the inner regions by a geometrically-thick advection-dominated accretion flow. At larger radii (beyond a few tens of Schwarzschild radii, the precise value depending upon properties of the accretion flow, such as the Eddington-scaled accretion rate), there may be a transition to an outer (truncated) thin disk. The majority of the energetic output of these sources is released in bulk kinetic form through radio jets. Radiative emission is less powerful, but can ionize weak, low-ionization narrow-line regions, especially where the truncation radius of the thin disk is relatively low.

and this absorbed energy emerges as thermal infrared emission. The total column density of the obscuring structure spans a range in inferred column densities from roughly 10^{23} to $10^{25}\mathrm{cm}^{-2}$. The highest column densities are sufficient to absorb even hard X-rays (these cases are Compton-thick). As ionizing radiation escapes along the polar axis of the obscuring structure it photo-ionizes gas on circum-nuclear scales (few hundred to few thousand pc). This more quiescent and lower density population of clouds produces UV, optical, and infrared forbidden and permitted emission-lines, Doppler-broadened by several hundred $\mathrm{km\,s}^{-1}$, and is hence called the Narrow Line Region.

Observing an AGN from a sight-line nearer the polar axis of the obscuring structure yields a clear direct view of the SMBH, the disk/corona, and Broad Line Region. These are called Type 1 (or unobscured) AGN. When observing an AGN from a sight-line nearer the equatorial plane of the obscuring structure, this central region is hidden and these are called Type 2 (or obscured) AGN. This is the basis for the standard Unified Model for radiative-mode AGN (e.g. Antonucci 1993) which asserts that the Type 1 and 2 populations differ only in the viewing angle from which the AGN is observed. The presence of AGN can still be inferred in the Type 2 objects from the thermal infrared emission from the obscuring structure, from hard X-rays transmitted through the structure (when it is Compton-thin), and from the emission-lines with tell-tale line ratios from the Narrow Line Region.

In some cases, the obscuring material can be the larger-scale dusty interstellar medium of the host galaxy. This is particularly relevant when the host galaxy's disk is viewed at a large inclination or the galaxy is in the throes of an on-going major merger with a strong central concentration of dusty gas. This material will sometimes be sufficient to obscure the optical, UV, and soft X-ray emission from the AGN accretion disk and Broad Line Region, but insufficient to attenuate the hard X-rays (e.g. Gelbord 2003). The effect of this is nicely demonstrated by Lagos et al. (2011), who use SDSS data to show that the host galaxies of optically-obscured AGN are skewed toward edge-on orientations, while those optically-classified as Type 1 have a much higher probability of having a face-on orientation.

In the second category (jet-mode AGN) a distinct mode of accretion onto the SMBH exists that is apparently associated with low accretion rates and which is radiatively inefficient. The geometrically-thin accretion disk is either absent, or is truncated in the inner regions, and is replaced by a geometrically-thick structure in which the inflow time is much shorter than the radiative cooling time (e.g. Narayan & Yi 1994, 1996, Quataert 2001, Narayan 2005, Ho 2008). These are called advection-dominated or radiatively-inefficient accretion flows (ADAFs/RIAFs). A characteristic property of these flows is that they are capable of launching two-sided jets. Note that powerful jets are also launched by a small fraction of radiative-mode AGN (e.g. radio-loud QSOs). The jets are (far and away) most easily detected via the synchrotron emission they produce at radio wavelengths. This can extend from optically-thick (synchrotron self-absorbed) emission on pc-scales all the way out to regions far beyond the stellar body of the galaxy (reaching Mpc-scales in extreme cases). In typical local radio galaxies the jets travel at relativistic velocities (Lorentz gammas of several) when launched, but appear to rapidly decelerate and destabilize as they interact with the gaseous halo of the host galaxy and transition to sub-sonic turbulent plumes. At the highest radio luminosities (most commonly found in the radio-loud radiative-mode AGN) the jets survive as highly-collimated structures until they terminate as bright shocks (hot spots) at the interface with the circum-galactic or inter-galactic medium. The survival or disruption of the jets leads to the Fanaroff & Riley (1974) morphological classification of radio galaxies (see Urry & Padovani 1995 for further discussion).

Missing from the above description are the objects that may trace the lowest luminosity portion of the AGN population. This population has been reviewed in this journal by Ho (2008). Since his review, evidence has grown that at least some of the objects previously classified as the lowest-luminosity AGN (the Low-Ionization Nuclear Emission-line Regions, or LINERs, with the very weakest optical emission-lines) are not bona fide AGN (e.g. Cid Fernandes et al. 2012, Yan & Blanton 2013). However, the remaining more powerful LINERs are very likely to be members of the jet-mode AGN population (e.g. Nagar et al. 2005, Ho 2008, Best & Heckman in preparation), albeit with rather modest radio luminosities.

Fig. 4 summarizes this description of the local AGN population, and how the common AGN classes fit within in. The blue text within that figure describes the properties of a *typical* example of each category of AGN. As the review develops, we will describe the evidence for this, and discuss the range of properties seen for each AGN class.

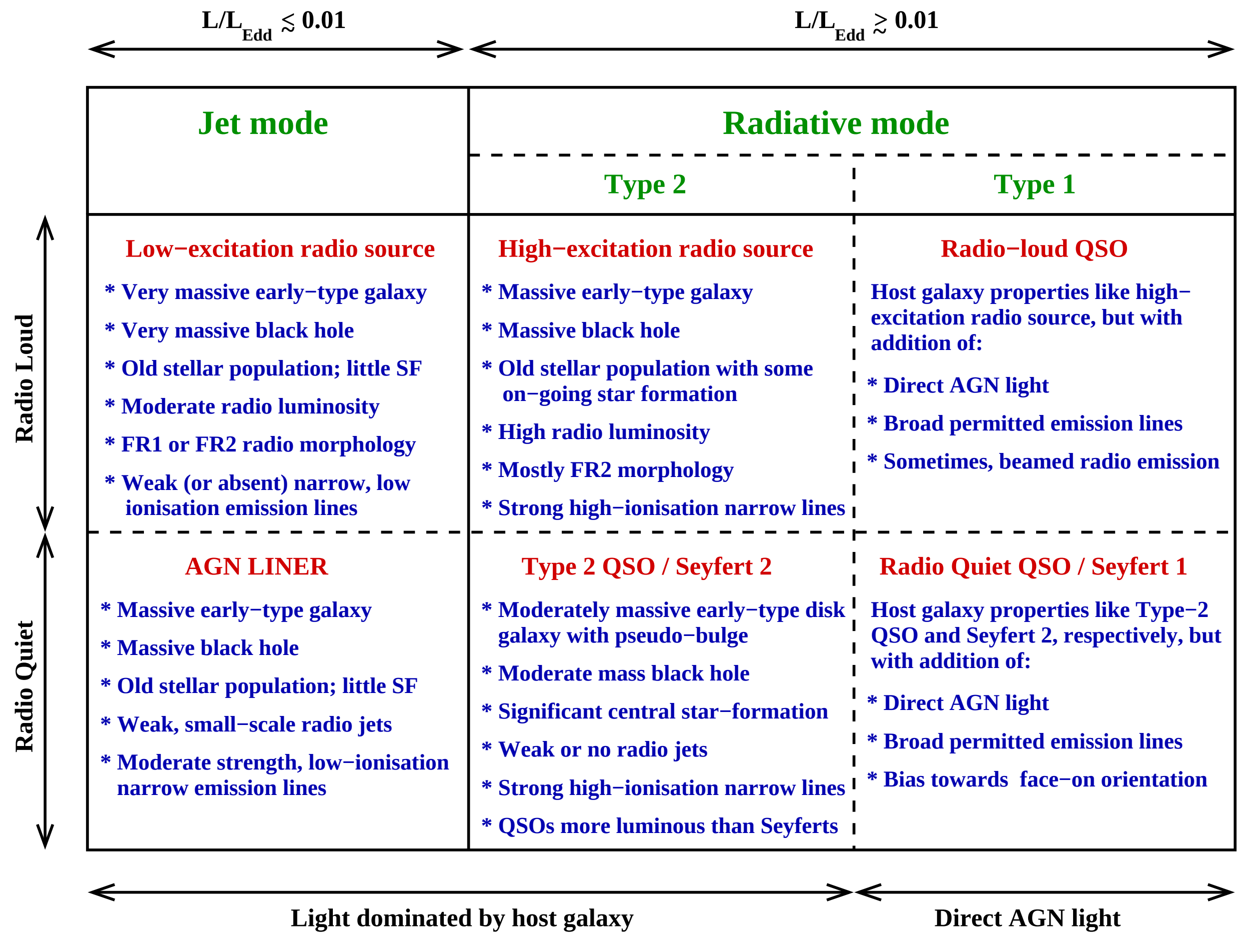

Fig. 4.— The categorisation of the local AGN population adopted throughout this review. The blue text describes *typical* properties of each AGN class. These, together with the spread of properties for each class, will be justified throughout the review.

2.2. Finding AGN

This review is focused on insights into the co-evolution of SMBHs and galaxies that have been derived from large surveys of the local universe. For such investigations of the radiative-mode AGN it is the obscured (Type 2) AGN that are far and away the more valuable. In these objects the blinding glare of the UV and optical continuum emission from the central accretion disk has been blocked by the natural coronagraph created by the dusty obscuring structure. The remaining UV and optical continuum is generally dominated by the galaxy's stellar component (Kauffmann et al. 2003a) which can then be readily characterized. In the sections to follow we will therefore restrict our discussion of radiative-mode AGN to techniques that can recognize Type 2 AGN. For the jet-mode AGN the intrinsic UV and optical emission from the AGN is generally weak or absent unless the observer is looking directly down the jet axis (e.g. Urry & Padovani 1995). Thus, the host galaxy properties can be easily studied without contamination.