Quasars, Their Host Galaxies, and Their Central Engines

A Definition: Structure

- QSOs (quasistellar objects, shortened later to “quasars”) belong to a subclass of objects termed AGNs, Active Galactic Nuclei.
- => A QSO is more a feature than a discrete object.

A Definition: “Active”

- An “active” nucleus is simply much more luminous than an inactive one.
- AGN classification encompasses QSOs, Seyferts, radio galaxies, others.

A Definition: Spectrum

- QSOs are apparently luminous across huge swaths of the EM spectrum and yet most have high redshifts, which made their discoverers realize they were dealing with objects that had immense absolute magnitudes.
- Some are comparatively quiet in the radio bands; these are RQQs. Their louder counterparts are RLQs.
- Despite some variation in spectra, their galactic hosts generally share a few characteristics.

Where They Live

- J.S. Dunlop et al. completed an imaging study in 2003 of RQQs, RLQs and RGs.
- The bulge component was found to dominate across the sample (ellipticals). Further, there appears to be a threshold of BH mass that divides RQQs and RLQs.

Where They Live: Host Morphology

Where They Live: BH Mass

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The Central Engine

- Generally accepted that accretion onto the BH is what fuels quasars; infalling matter gains KE, emits radiation.
- The problem with this simple thermal model lies in the wide spectral distribution.
- An additional force must be at work.

The Central Engine: Relativistic Protons


The Central Engine: Fermi Acceleration

- But how do the protons maintain relativistic energies while swirling around the BH? They are colliding with things and losing energy; something must be working to replace it.
- Mechanism known as first order Fermi shock acceleration, where the energy essentially comes from the QSO’s powerful magnetic fields, provides a possible answer.

The Central Engine: Fermi Acceleration

- Proton repeatedly bounces off moving “magnetic mirrors”, magnetic fields with gradients that act like shock waves.
- This allows the proton to eventually collide with another relativistic proton and produce the aforementioned electrons needed to explain the spectrum.

Summary

- Quasars are AGNs, simply very luminous galactic nuclei.
- They tend to live in elliptical, highly redshifted bulge-dominated galaxies with relatively massive BHs.
- Their wide and highly luminous spectral distributions are accounted for by a model whereby radiation is produced both thermally and by collisions of relativistic protons.