An evolutionary scenario for AGN unification

M. Böttcher[1] (*Physics and Astronomy Department, Rice University, MS 108 6100 S. Main Street, Houston, TX 77005-1892*), C. D. Dermer (*E. O. Hulburt Center for Space Research, Code 7653 Naval Research laboratory, Washington, DC 20375-5352*)

Abstract

Different types of active galactic nuclei (AGNs) show large variations in their luminosities and spectral energy distributions that cannot be explained exclusively by orientation effects. For example, blazar subclasses ranging from flat-spectrum radio quasars (FSRQs) through low-frequency-peaked BL Lac objects (LBLs) to high-frequency-peaked BL Lac objects (HBLs) exhibit a sequence of increasing spectral hardness with decreasing luminosity. The decreasing luminosity can be interpreted as a reduction in the jet power from the central energy source, which is presumably powered by accretion onto a supermassive black hole.

Using an analytic model for the combined synchrotron, synchrotron-self-Compton, and external-Compton broadband emission from blazars, we propose an evolutionary scenario that links the different blazar subclasses in terms of a decreasing Eddington ratio of the accretion power. As the accretion power declines with time, less gas and dust is available to scatter accretion-disk radiation and produce an external Compton-scattered component in the blazar jet. This evolutionary trend produces the sequence FSRQ $\rightarrow$ LBL $\rightarrow$ HBL. This scenario may also link radio-loud AGNs, namely blazars and radio galaxies, with radio-quiet Seyferts. According to this picture, Seyfert AGNs constitute the high Eddington-ratio limit of the evolutionary sequence. Eddington ratios $\gtrsim$ a few % result in an optically-thick accretion disk extending to the innermost stable orbit which quenches relativistic jet production, in analogy with the observed anti-correlation between radio and soft X-ray activity in some Galactic black-hole candidates.

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[1] Chandra Fellow