

Chapter 2 : The Nature of the Broad Absorption-Line Region and BALQSOs

In section 1.3 of the preceding chapter, we asked several questions about the nature of BALQSOs. Here, we attempt to summarize the success of previous studies in answering some of those questions. Note that since our knowledge of the nature of the BALR is still very uncertain, characteristics are often discussed assuming a single type of phenomenon. That is, results from individual BALQSOs are used to make “global” models which are presumed to apply to all (or most) BALQSOs. As our knowledge increases, division into sub-classes will be almost inevitable.

2.1 : The Global Covering Factor and the Fraction of QSOs with BALRs

The first BALQSO discovered (PHL 5200, 2225–0534), has wide, deep, smooth troughs extending from zero outflow velocity to $\sim 20,000 \text{ km s}^{-1}$. The profile was reminiscent of the absorption profiles of P-Cygni class stars, and thus the first models of the BALR were spherically symmetric with a covering factor from the perspective of the central engine of $\sim 100\%$. The primary difficulty of this model was accounting for the observed emission. A hollow shell surrounding small central source should produce about as much re-emitted line photons (resonance line scattering) in any given direction as photons absorbed along the line-of-sight. However, the equivalent width of BALs often exceed the equivalent widths of the BELs (by about a factor of three in the case of PHL 5200, Junkkarinen *et al.* 1983).

In the case of a spherical outflow with velocity increasing with distance from the central source (accelerating, see Lucy 1971), this model does not predict the deep troughs at near zero velocity seen in some BALQSOs. A decelerating outflow model can solve this problem of deep troughs at low velocities (Surdej and Swings 1981). However, this model still requires emission adjacent to the absorption trough, which cannot explain the cases where the absorption trough is detached from the emission line. It is necessary in these