The Blandford-Znajek theory revisited

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Summary: The Blandford-Znajek theory (1977) is generally studied to understand the generation of powerful relativistic jets. However, it could also give important insights about the feedback between a rotating black hole, its ergosphere, and a surrounding accretion disk. The energy flow between these systems could be understood by studying the BZ power as a function of a slip factor, which in turn is defined as a function of the angular velocity of the black hole and the angular velocity of the magnetic field lines (generally anchored to the disk). The distinct stages could explain the different types of observed AGN (with/ without jets), but could also help understanding the evolution of the merging of binary AGN.

For more details, see arXiv:1205.3128

Blandford-Znajek Power

$$L_{\rm BZ} = k f(B, r_{\rm H}, a) \frac{\omega_{\rm F}(\omega_{\rm H} - \omega_{\rm F})}{\omega_{\rm H}^2}$$

Magnetic field (B)
Event horizon radius (r_H)
Spin (a)
Normalization (k)

Angular velocity magnetic field lines (ω_F)
Angular velocity black hole (ω_H)

Slip factor

$$s = \frac{\omega_{\rm F} - \omega_{\rm H}}{\omega_{\rm F}} = 1 - \frac{\omega_{\rm H}}{\omega_{\rm F}}$$

$$L_{\rm BZ} \propto \frac{s(s-1)}{(1-s)^3}$$