The unification of radio loud AGN: two powers, a break, and an angle.

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Please see talk by Meyer

Based on results by Meyer et al. 2011 we argue for the following picture: For a given accretion rate $\dot{m}$ in Eddington units, the jet kinetic power L_{kin} has an upper bound at $L_{kin,\max} = a\dot{m}L_{Edd}$ where $a \sim 1$.

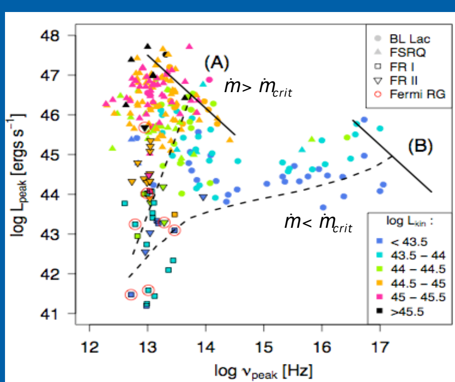
Because the accretion mode changes at $\dot{m} = \dot{m}_{crit} \approx 0.01$ from the radiatively inefficient ADAF to the radiatively efficient thin disk (Narayan et al. 1997, Ghisellini & Tavecchio 2009), the phenomenology of the jet depends on

(i) the $\dot{m}$ of the accreting black hole
(ii) the jet power
(iii) the orientation of the jet

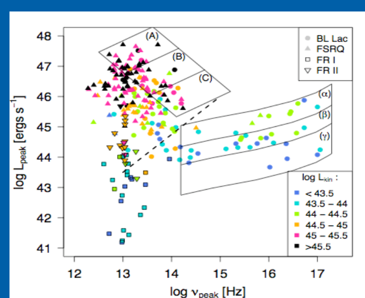
The aligned population of these sources forms a broken power sequence, while the misaligned jets populate the envelope of unaligned sources.

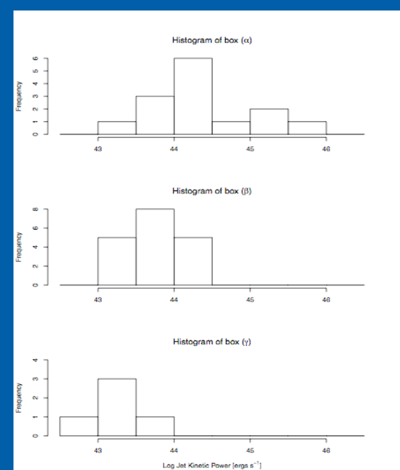
Jets hosted by systems with $\dot{m} < \dot{m}_{crit}$ have high synchrotron peak frequencies (ν_s~10^{16-17} Hz) when aligned (this family includes the TeV blazars), and significantly lower frequency peaks (ν_s~10^{13} Hz) when misaligned (these are FR I radio galaxies). These jets most probably exhibit velocity gradients in their sub-pc jets. When they are somewhat misaligned they have intermediate synchrotron peak frequencies (ν_s~10^{14-15} Hz). In all cases these jets have low jet kinetic power.

Jets hosted by systems with $\dot{m} > \dot{m}_{crit}$ have low synchrotron peaks (ν_s~10^{12-14} Hz), they are on the average more luminous when aligned (this family includes FSRQs), and when misaligned (becoming FR II radio galaxies) their peak frequency diminishes only slightly, suggesting a single velocity flow, at least for the plasma emitting the peak of the synchrotron SED. Broad lines and a big blue bump can be seen, becoming stronger relative to synchrotron for more powerful and more misaligned sources.



Lkin_Ledd_hist.pdf





THE BROKEN POWER SEQUENCE: For a fixed black hole mass, the solid line B depicts the locus of aligned jets in a system with $\dot{m} < \dot{m}_{crit}$ as the jet power increases up to its maximum value. The solid line A depicts the locus of an aligned jet in a system with $\dot{m} > \dot{m}_{crit}$ as the jet power increases.

THE ENVELOPE: The broken line B is an example of debeaming tracks in the case of a decelerating flow (Georganopoulos & Kazanas 2003) and that of A in the case of a single velocity flow. Color coding for jet kinetic power.

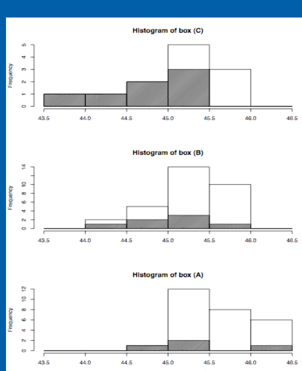
Data from Meyer et al. 2011,ApJ in press

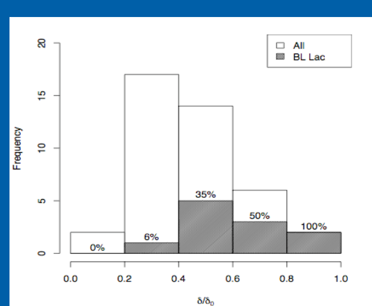
Q: Do we see the jet power increasing along the broken power sequence?

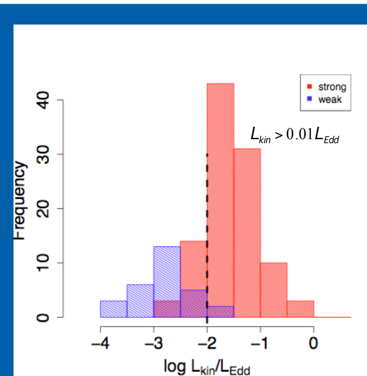
A: For weak sources, yes.

We split the weak sources into three layers α,β,γ, defined by curves similar to the broken line B and plot their jet powers in a histogram (above).

As can be seen, the average jet power increases from layer γ to α, as expected in our scheme.







Q: Do we see the jet power increasing along the broken power sequence?

A: For powerful sources yes too.

We split the sources that are close to the power sequence line A into three zones, A, B, C and for each plot a histogram of their jet power. Shaded are the BLs. We see that the average jet power increases from C to A, and that the fraction of BLs decreases. This is because, for more powerful sources, stronger cooling shifts the synchrotron SED to lower frequencies, revealing the BLR.

Q: The more misaligned sources of a given jet power are, the fewer of them will be classified as BLs. Do we see that?

YES. We isolated the orange sources (44.5 < log jet power <45) and split them in terms of distance from the solid line A along lines parallel to the broken line A. This distance is a measure of (δ\δ$_0$), where δ$_0$ is the Doppler factor for a totally aligned source. As can be seen, the fraction of BLs decreases as the ratio (δ\δ$_0$) decreases.

The signature of the critical transition

Weak sources (blue here) accrete at $\dot{m} < \dot{m}_{crit} \approx 0.01$ and they are expected to have jet kinetic power lower than $\sim 0.01 L_{Edd}$ as we find. Strong sources (red here $\dot{m} > \dot{m}_{crit} \approx 0.01$) accrete above $\sim 0.01 L_{Edd}$

If this proves to be robust, we will be lead to accept that powerful accretion cannot produce weak jets.