MODELS FOR EXTRAGALACTIC RADIO SOURCES

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ABSTRACT. Doubt is cast on the reality of the following four assumptions commonly made in the treatment of extragalactic radio sources : (1) The central engine is a black hole; (2) Electrons can be accelerated in situ in the knots and heads of the jets, to large Lorentz factors $\gamma \gtrsim 10^2$, with an efficiency exceeding 30%; (3) The (non-thermal) radiation emitted by the beam fluid is isotropic in some (comoving) Lorentz frame; and (4) The flow velocity in the jets of SS 433 is v = 0.26 c.

1. THE CENTRAL ENGINE

A black hole represents the ultimate state of any high mass concentration. On the other hand, hydrogen-burning can re-expand a massive rotator, of compactness $u:=R_s/R \lesssim 5.10^{-3}$(R=radius, R_s=Schwarzschild radius), in the form of a strong stellar wind (Kundt, 1979). Such winds are observed throughout the BLR (Stoner & Ptak, 1985), NLR and perhaps even in the form of large-radius emission shells (Kundt & Krause, 1985). If such winds had not blown, the accumulated consumption integrated over cosmic times of a putative black hole would be in marginal conflict with upper bounds on the unresolved core masses of nearby galaxies (Soltan, 1982, who assumes a high conversion efficiency ε >> 1% and very conservative core-mass upper bounds).

The black-hole model has also difficulties in explaining rapid UV-variabilities (Stoner & Ptak, 1985) and polarization, which ask for strong deviations from axial symmetry of the driving engine.

Another indication against black holes in AGN is given by their similarity to the binary neutron-star sources Sco X-1 (cf. Kundt & Gopal-Krishna 1984) and SS 433 (Margon,1984) as well as to young stellar objects (YSO; cf.Konigl,1982) and a few white-dwarf systems.In all these cases, supersonic twin-jets are apparently produced by a non-collapsed magnetised rotator at the center of a feeding disk (Kundt, 1984a).

2. IN SITU ACCELERATION

It is often argued that the short lifetimes of the synchrotron-emitting electrons in the optical knots of the jets ask for in situ acceleration.

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On the other hand, a TV screen shows that in situ deceleration is an alternative possibility to explain bright spots in a jet : in the absence of significant obstacles (such as filamentary obstructions, or photons), extremely relativistic charges can move loss-free ($\vec{E}\times\vec{B}$-drift). The high efficiency claimed by workers on shock acceleration models is by no means established (Kundt, 1984b).

3. RELATIVISTIC BEAMING

Almost all publications on relativistic beaming have assumed that the jet-fluid radiates isotropically in its comoving frame (e.g. Kellermann & Pauliny-Toth, 1981; Begelman et.al.,1984). This assumption implies different values of the bulk Lorentz factor γ (between 2 and 20) for different questions asked (Scheuer & Readhead,1979). The assumption lacks plausibility and is inconsistent with a relativistic power-law distribution of the supersonically streaming charges (Kundt & Gopal-Krishna, 1980, 1981). As demonstrated clearly at this Symposium, it leads to all kinds of difficulties. These difficulties go away when (intensity-dependent) wide-angle beaming patterns of the collision-free jet-material are permitted. No tight correlaiton then exists between γ and the inclination angle of a jet. All values derived for γ are strict inequalities and consistent with $\gamma \gtrsim 10^2$ (Kundt, 1982a).

An extremely relativistic bulk velocity of the streaming pair plasma is a natural consequence of the fact that on its way from the BLR to the outer head, this plasma reduces its pressure from $\gtrsim 1$ dyn cm^{-2} to less than 10^{-8} dyn cm^{-2} without excessive dissipative losses (Kundt, 1982b). Not even SS 433 need be a counter example to this 'unified scheme' (Kundt, 1985).

4. References

Begelman,M.C., Blandford,R.D., Rees,M.J., 1984 : Rev.Mod.Phys. 56, 255
Kellermann,K.I., Pauliny-Toth, I.I.K.,1981 : Ann.Rev.Astron.Astrophys. 19, 373
Konigl,A., 1982 : Astrophys.J. 261, 115
Kundt,W., 1979 : Astrophys. Sp. Sci. 62, 335
Kundt,W., 1982a : IAU 97, eds. Heeschen & Wade, Reidel, Dordrecht, p.265
Kundt,W., 1982b : Mitt. Astron. Ges. 57, 65
Kundt,W., 1984a : Astrophys. Sp. Sci. 98, 275
Kundt,W., 1984b : J. Astrophys. Astr. 5, 277
Kundt,W., 1985 : Astron. Astrophys. 150, 276
Kundt,W., Gopal-Krishna, 1980 : Nature 288, 149
Kundt,W., Gopal-Krishna, 1981 : Astrophys. Sp. Sci. 75, 257
Kundt,W., Gopal-Krishna, 1984 : Astron. Astrophys. 136, 167
Kundt,W., Krause,M., 1985 : Astron. Astrophys. 142, 150
Margon,B., 1984 : Ann. Rev. Astron. Astrophys. 22, 507
Scheuer,P.A.G., Readhead,A.C.S., 1979 : Nature 277, 182
Soltan,A. 1982 : Mon. Not. Royal Astron. Soc. 200, 115
Stoner,R., Ptak,R. 1985 : Astrophys. J. 297, 611