

Precession in Extragalactic Parsec-Scale Accretion Disks

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Abstract. In this work, we study the feasibility of four physical mechanisms for driving jet/disk precession in the galaxies NGC 4258, NGC 1068, 3C 120, OJ 287 and Arp 102B. Given the many observational uncertainties that still exist in the parameters of those AGN, we find that it is difficult to discriminate unambiguously what mechanism is actually responsible for precession.

Keywords. galaxies: active, accretion, accretion disks

Accretion onto a supermassive black hole has been invoked as the main process behind the huge quantity of energy released in AGN. Some AGN exhibit signatures of warping/precession in their parsec-scale disks, which are inferred from interferometric water-maser observations and/or changes in apparent velocity and orientation of their jets. This implies the existence of departures from a planar mass distribution along the disk. Several mechanisms have been proposed to explain precession (e.g., Caproni *et al.* 2006 and references therein). We consider in this work four distinct scenarios: tidal torques due to the companion supermassive black hole (SBBHS), the Bardeen–Petterson effect (BP), irradiation, and magnetically driven torques (RAD and MAG, respectively). In order to analyse the feasibility of these precession mechanisms, we selected five AGN with precession periods reported in the literature: NGC 4258, NGC 1068, 3C 120, OJ 287 and Arp 102B. We adopted in our calculations a power-law surface density accretion disk, Σ , varying the power-law index s from -2 to 0 . In the case of MAG, we have also assumed a power-law distribution for the z -component of the magnetic field, B_z , which is parallel to the black hole rotation axis. The corresponding index χ was varied from 0 to -3 , keeping the magnetic field strength at the gravitational radius at 10^4 G for all objects of our sample. We can summarize the main results as follows: SBBHS can provide precession timescales compatible with those inferred in 3C 120 and OJ 287. RAD cannot induce precession at the observed rates in these five AGN. For MAG, our results suggest two distinct regimes: for accretion disks with $s \leq -1$, B_z must be radially constant in order to reproduce the observed precession periods; otherwise, it is necessary to invoke a constant Σ and B_z with $\chi \leq -1$. In the steady state regime, BP produces precession timescales compatible with those observed in NGC 4258, NGC 1068, and 3C 120.

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Reference

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