The Jet Collimation Profile of 3C273 Colin Lonsdale, Kazunori Akiyama, Vincent Fish (MIT Haystack Observatory) Keiichi Asada, Masa Nakamura (ASIAA), Hiroshi Nagai, Kazuhiro Hada (NAOJ)

Abstract: The process of jet collimation in radio galaxies and quasars has been a topic of theoretical and observational study for decades, and the narrow opening angles of such jets frequently seen on large scales place severe constraints on mechanisms. Recent work has indicated that the Bondi radius at around $10^5 R_s$ may be an important transition region beyond which active collimation gives way to a conical flow geometry consistent with an unconfined high Mach number flow. In this paper we discuss high resolution multiwavelength VLBI imagery of the powerful quasar 3C273, yielding collimation profile data over ~ 2.5 decades of distance from the core, from $10^{4.5}$ to 10^7 R_s. The results are compared to similar data for the lowpower radio galaxy M87, and are discussed in the context of different models for active collimation inside the Bondi radius.





3C273 Jet Width Measurements



- VLA 22 GHz MERLIN I.6 GHz
- 100 pc (z ~10⁶-10⁷ R_s) VLBA 1.6 GHz (8 epochs from 2008, 2009, 2011)
- $-10 \text{ pc} (z \sim 10^5 10^6 \text{ R}_s)$ VLBA 15 GHz (MOJAVE: 65 epochs during 2007-2014)
- 1 pc (z ~ $10^4 10^5 \text{ R}_s$) VLBA 43 GHz (BU Blazar; 76 epochs during 2007-2014)





Why is there so much more Faraday rotation in 3C273 as compared to M87?

An obvious possibility is that the accretion flow is much stronger, and the medium much denser in the high power source. Jet orientation and the strength of the line of sight magnetic field may also play a role. Possibly the higher density environment is what allows the more powerful jet to be confined and collimated in 3C273.

Conclusions

- circum-BH material inside the Bondi radius
- Polarimetry and RM gradients can yield essential clues
- powerful new constraints on these questions

 Evidence for parabolic shape in the inner regions Based on VLBA 15 GHz and 43 GHz data Higher resolution, higher SNR data needed To get accurate values inside the Bondi radius GMVA+ALMA at 3mm, and EHT at 1.3mm Data reduction pending

Clues from Polarimetry?

 Evidence is accumulating that collimation is related to generic properties of Sensitive new VLBI observations at 3mm and 1.3mm will soon provide