PARAMETER STUDY OF A SEMI-ANALYTICAL RELATIVISTIC MHD JET MODEL IN COMPARISON WITH RECENT VLBI OBSERVATIONS

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W. Vlemmings, M.H.M. Heemskerk, Y. Cavecchi, S. Markoff, P. Polko and D. Meier

Marscher et al. 2008
AGN JETS

QUASI STATIONARY FEATURES IN AGN JETS

- In several AGN, there is evidence of a quasi-stationary feature in the super magnetosonic jet. Recollimation Shock (RCS)

- The stationary feature occurs at distances from the BH in the $10^3$-$10^6 \ R_g$ that translate into angular sizes of $10$\ s of $\mu$as to $10$\ s of mas.

- Downstream of this feature, the jet structure changes into a “new”, coherent, steady jet up to large distances from the BH (~lobes, 100s of kpc). RCS = “Jet break”
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**NGC 6251**

**1H 0323+342**

**M87**

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Tseng et al. 2018

Hada et al. 2018

Asada&Nakamura2012, Nakamura&Asada2013
**MAIN POSSIBLE CAUSES OF A RECOLLIMATION SHOCK**

- **External collimation**  ➔ change in the ambient pressure at the Bondi radius

  - e.g. Asada & Nakamura 2012, Nakamura & Asada 2013

Parabolic: collimation

- $P_{\text{ISM}} \sim r^{-2.5}$

- $z \sim r^\alpha$

  - $0 < \alpha < 1$

Conical: adiabatic expansion

- $P_{\text{ISM}} \sim \text{const}$

- $z \sim r$

ISM ~ $r^{-2.5}$

ISM ~ const

BONDI radius
MAIN POSSIBLE CAUSES OF A RECOLLIMATION SHOCK

- **External collimation** ➞ change in the ambient pressure at the Bondi radius
  - e.g. Asada & Nakamura 2012, Nakamura & Asada 2013

- **Self-collimation** ➞ magnetic focusing at the Fast Magnetosonic Separatrix Surface
  - e.g. Vlahakis et al. 2000, Polko et al. 2010, 2013, 2014, Ceccobello et al. 2018
AGN JETS

PARAMETER SEARCH WITH THE NEW METHOD  Ceccobello et al. 2018

Parameter space previously explored, up to Polko et al. 2014

~6 months
AN EXAMPLE OF SOURCE-DRIVEN PARAMETER SEARCH: M87
AN EXAMPLE OF SOURCE-DRIVEN PARAMETER SEARCH:

**M87**

Radial profile

Jet sheath LF profile

Asada & Nakamura (2012)

Mertens et al. (2016)

Jet sheath LF profile

spine

sheath
AN EXAMPLE OF SOURCE-DRIVEN PARAMETER SEARCH: M87

Radial profile

Jet sheath LF profile

PRELIMINARY
Thanks to the new algorithm, we can now perform source-driven parameter searches.

Non-relativistic extension and parameter study of the MHD jet model (Ceccobello et al. in prep).

**NEXT STEP:** Coupling with the radiative transfer code AGNJET (e.g. Markoff et al. 2005, Crumley, Ceccobello et al. 2017, Connors et al. 2017) and further development of this code to include non-relativistic radiative processes and fit the SEDs of several kinds of systems.