# *Re-collimation shocks in relativistic stratified jets*

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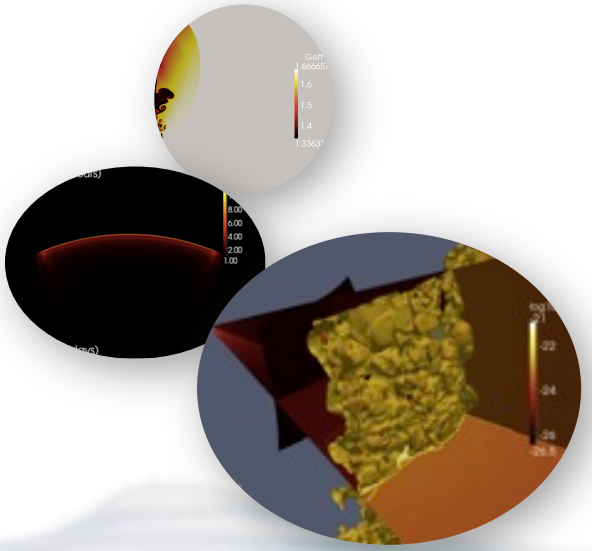


# Over pressured jet

**The relativistic jet covered a large distances covered in galactic medium**

- Jet becomes over pressured

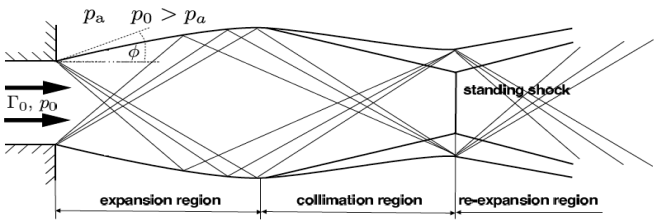
Gómez et al 1996, Agudo et al. 2001, Mimica et al. 2009, Fromm et al. 2016, …

**Result**

- re-collimation shocks
- Re-acceleration of the jet

$$dZ = 2MR$$

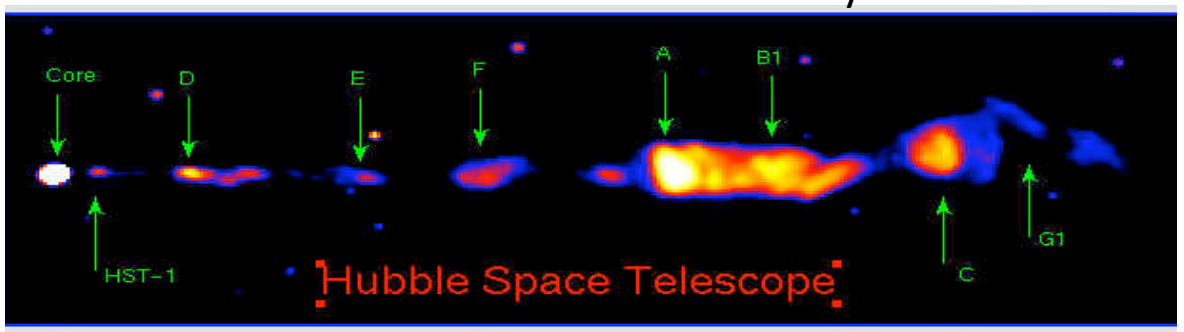
$Z =$




Daly & Marscher 1988

**Uniform jet**

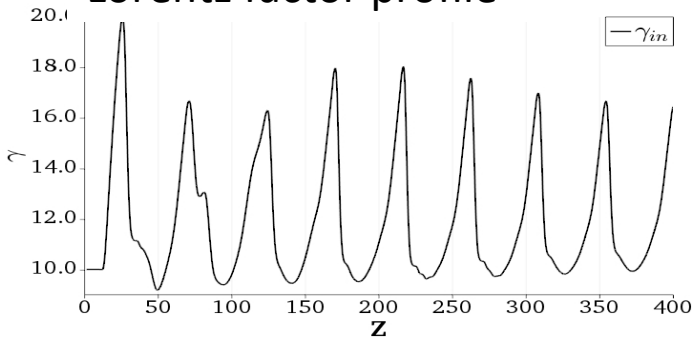
- Equidistance for cylindrical jet
- Increasing distance for the conical jet



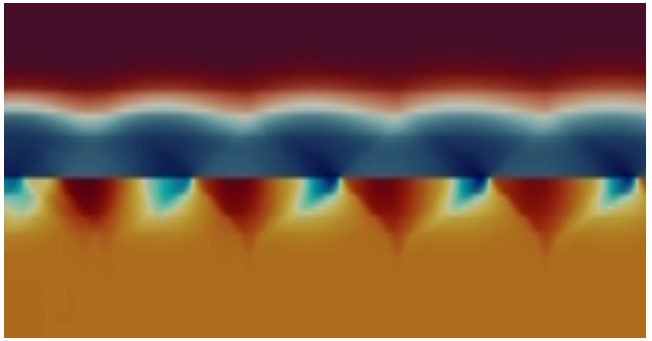
# Re-collimation shocks

- Re-collimation shocks appears with density and pressure increase,
- Rarefaction waves appears with Lorentz factor increase.

Lorentz factor profile




Density



Pressure

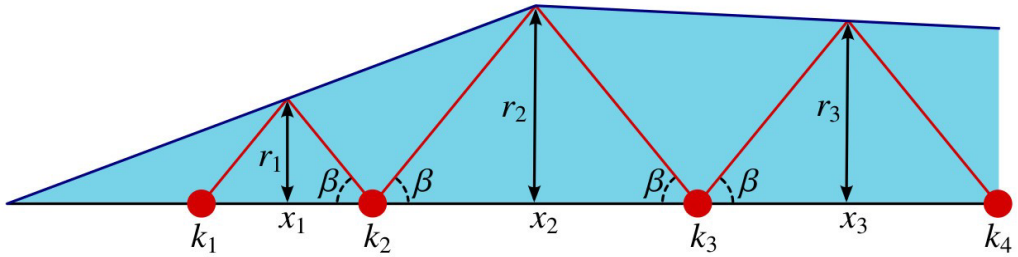
# Radio knots as re-collimation shocks

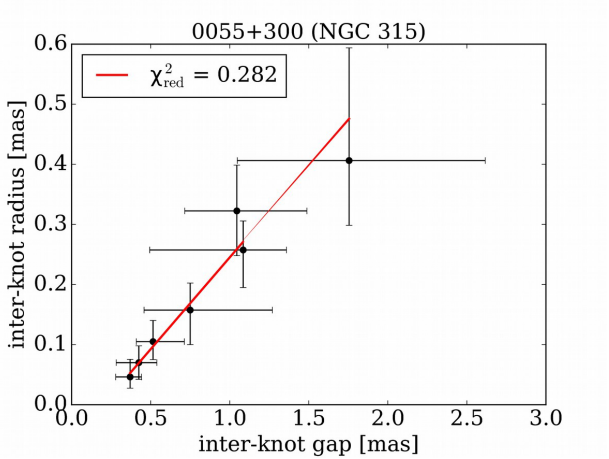
**Assumptions :**

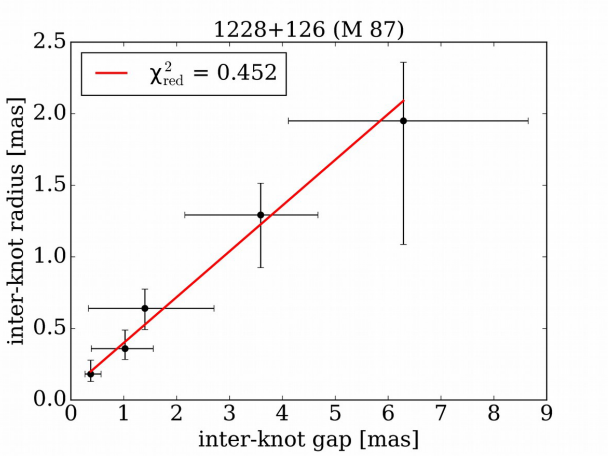
- Constant speed
- Constant sound speed

**Results**

- Constant Mach number
- Inter-knot distance dZ =2M R



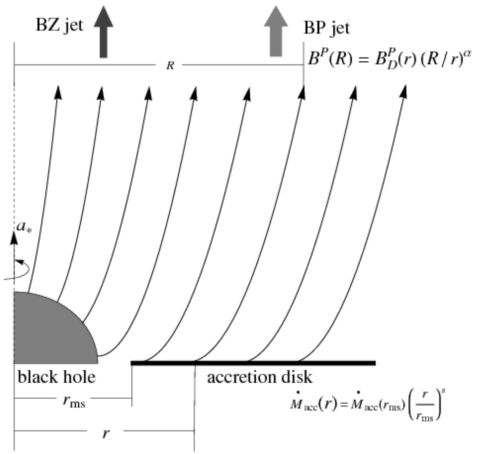



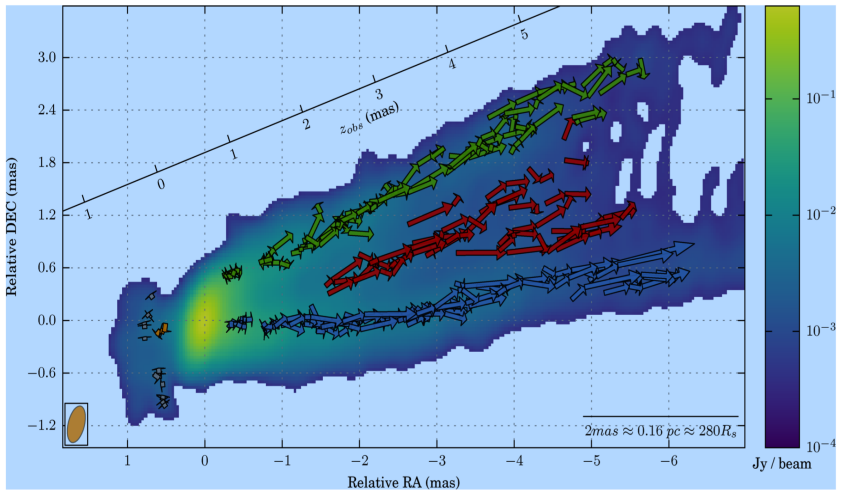
# Models (Two-component outflow)

## Two flow model (Sol et al. 1989)

- Mildly relativistic sheath composed of e−/p+ and driven by MHD forces → transports most of the kinetic energy
- Ultra-relativistic spine composed of e−/e+ pairs → responsible for most of the emission




Xie et al. 2012



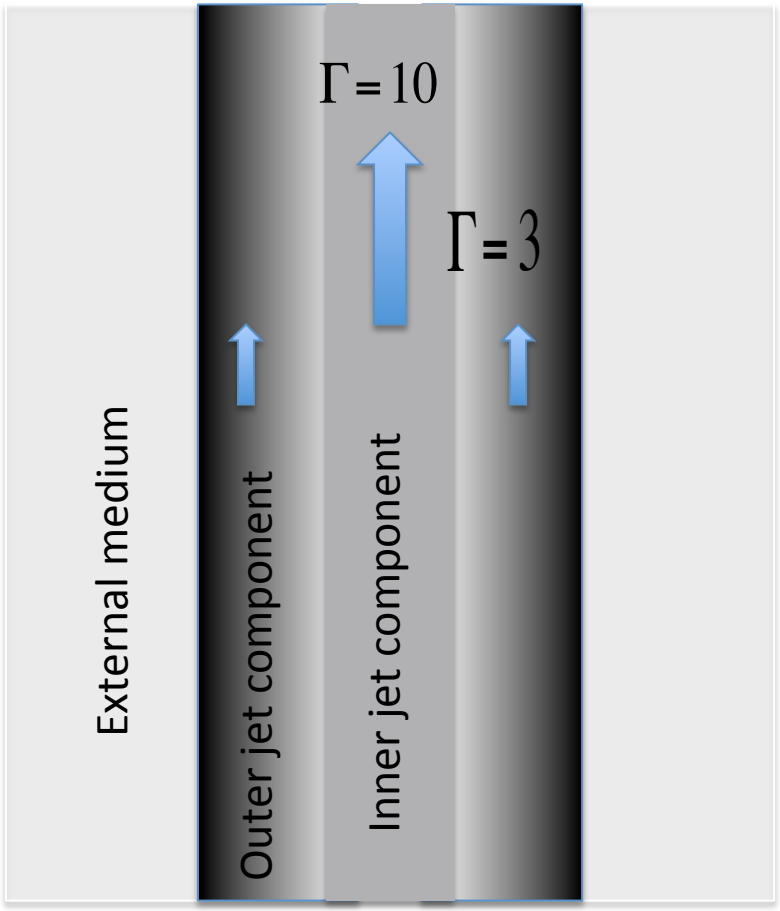

Merten et al. 2016

O. Hervet, Z.Meliani et al. 2017

# Two-component jet model

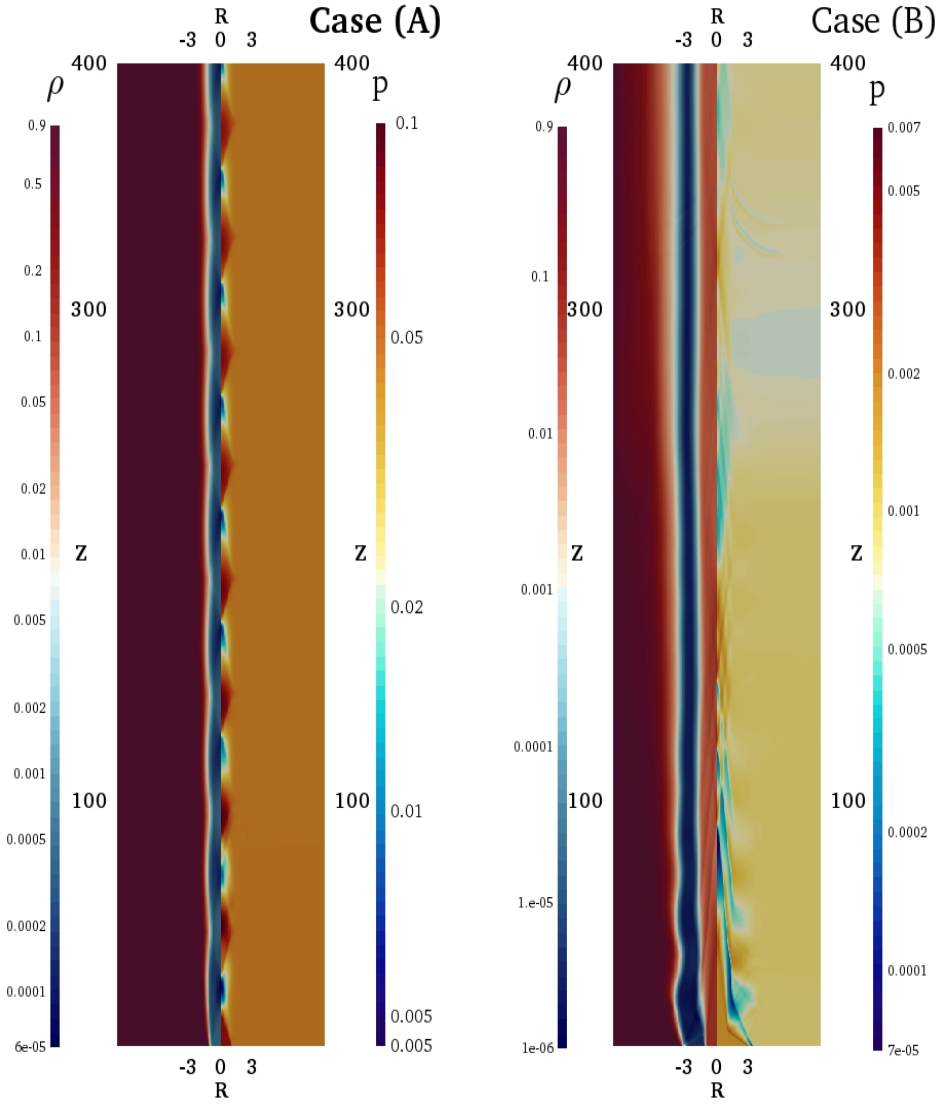
## Model and aim

- Two-component jet with fast inner component and slow outer component,
- Mainly classified following the kinetically power between inner and outer jets.

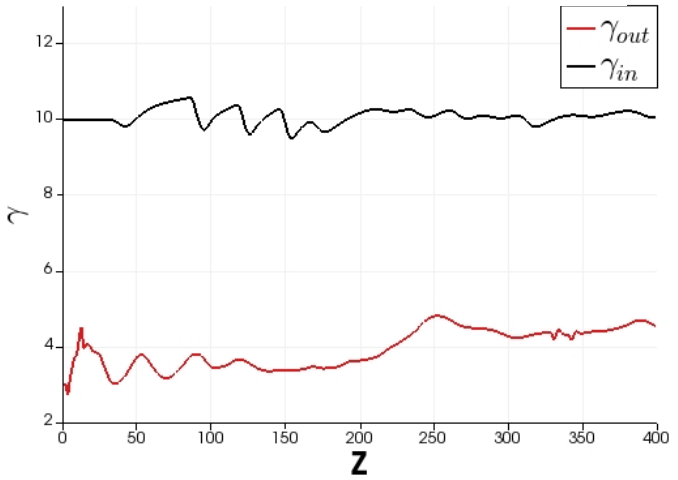



Jet structure

# Powerful inner jet component




Lorentz factor profile



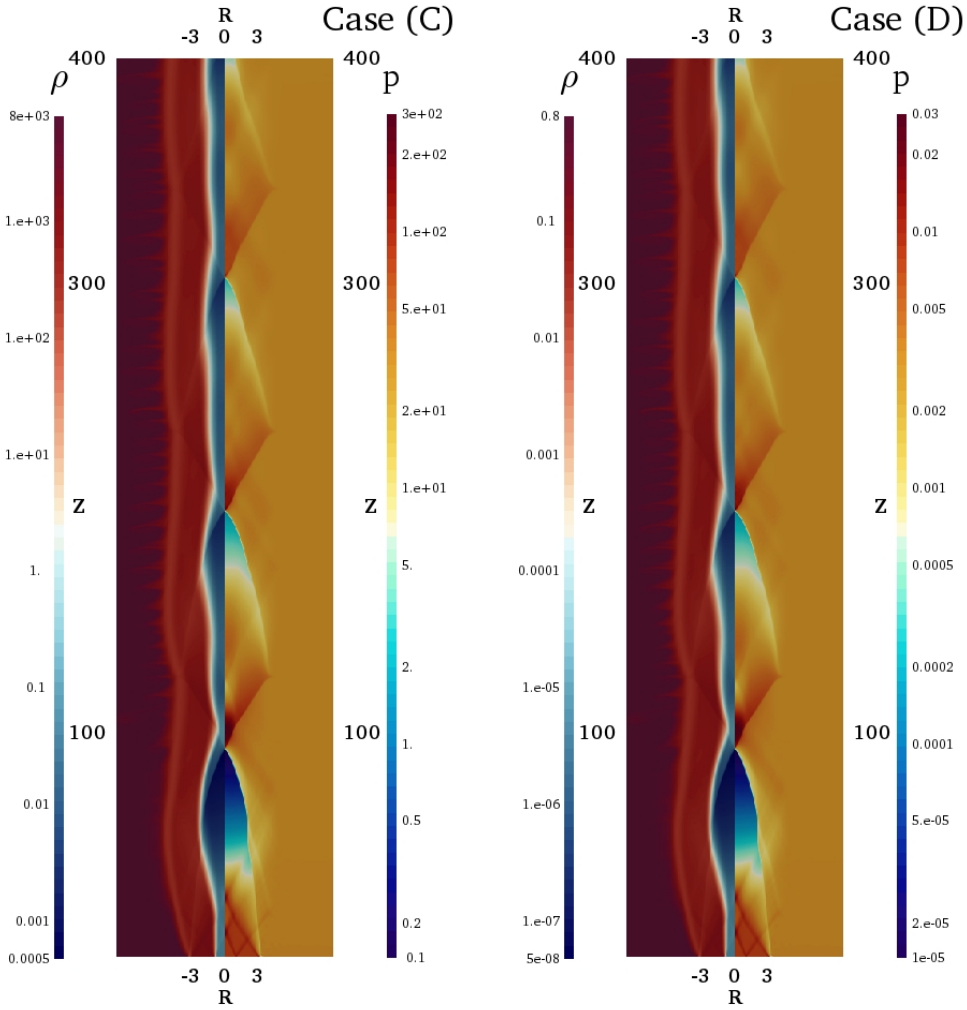

**Uniform jet: case (A)**

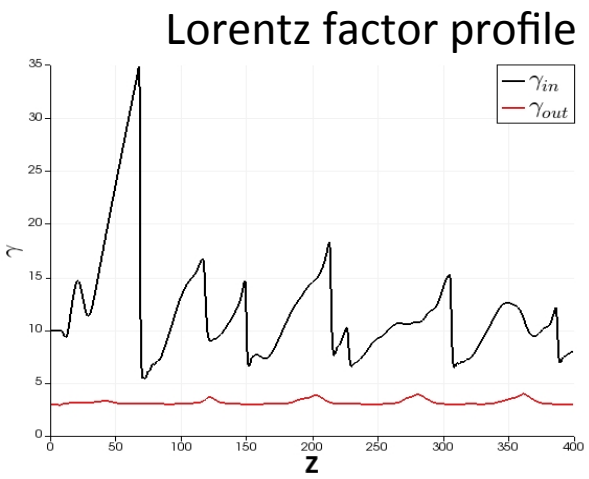
- Equidistance shocks

**Weak shear layer: case (B)**

- Shock waves damping
- Energy transfer to outer jet component

# Jet with the two components of the same power

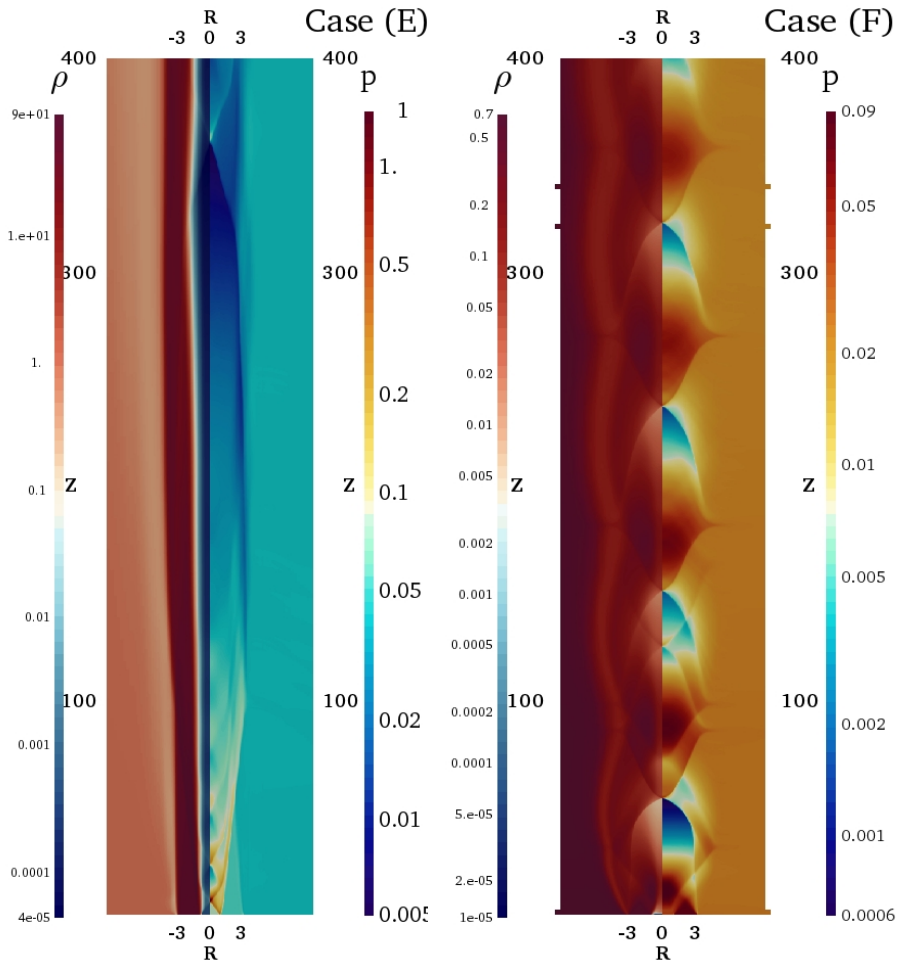


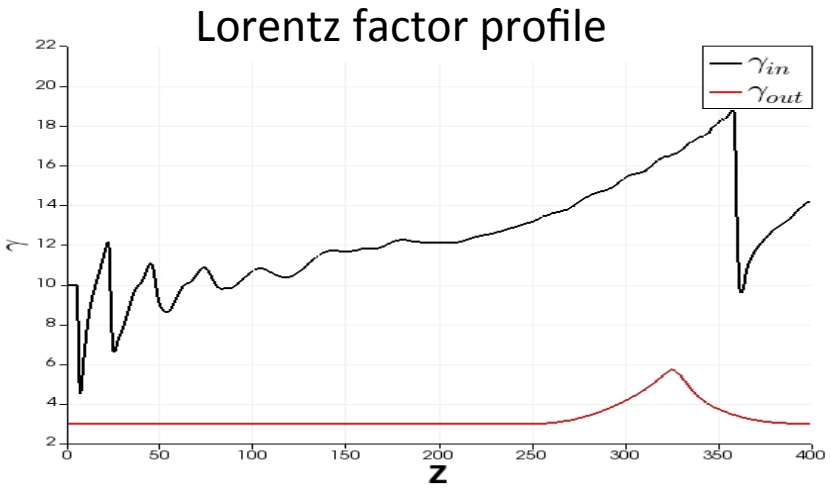




**Jet components with same power:**

- Strong first acceleration,
- Shock wave damping,
- Two-shock wave length.

# Jet with powerful outer component



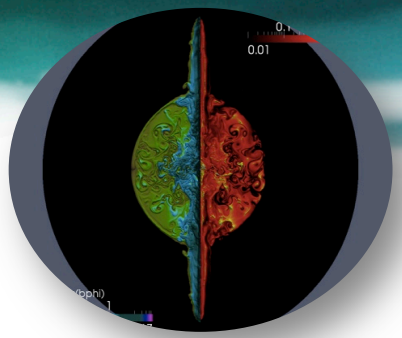




**Powerful outer jet component**:

- Stationary shocks near the core
- Moving shocks downstream

**Empty spine**

- Jet decollimation
- Increase of inter-shocks distance




# CONCLUSION

Jet classification can be related to jet structuration and re-collimation shocks.