# A constrained transport method for the solution of Resistive Relativistic plasmas in the PLUTO code

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Extragalactic jets on all scales - launching, propagation, termination

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# Introduction and equations

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The equations used to describe a relativistic resistive plasma are (Komissarov 2007):

$$\begin{cases} \partial_t D + \nabla \cdot (\rho\gamma \boldsymbol{v}) = 0 \\ \partial_t \boldsymbol{m} + \nabla \cdot (\rho h \gamma^2 \boldsymbol{v}\boldsymbol{v} - \boldsymbol{E}\boldsymbol{E} - \boldsymbol{B}\boldsymbol{B} + p_{\rm tot}\mathsf{I}) = 0 \\ \partial_t \mathcal{E} + \nabla \cdot \boldsymbol{m} = 0 \\ \partial_t \boldsymbol{B} + \nabla \times \boldsymbol{E} = 0 \\ \partial_t \boldsymbol{E} - \nabla \times \boldsymbol{B} = -\frac{\gamma}{\eta}\left[\boldsymbol{E} + \boldsymbol{v} \times \boldsymbol{B} - (\boldsymbol{E} \cdot \boldsymbol{v})\boldsymbol{v}\right] - (\nabla \cdot \boldsymbol{E})\boldsymbol{v} \end{cases}$$

where $\eta$ is the resistivity.

# Numerical algorithms

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Maxwell equations (MMBDZ):

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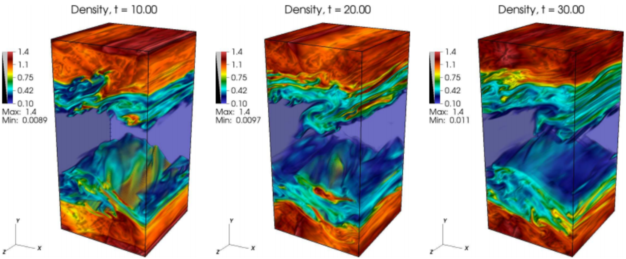
The solution to the Riemann problem is obtained under condition $\sigma = 0$ and is based on the combination of two solvers: a Maxwell solver for the outermost electromagnetic waves and a solver across the sound waves where only hydrodynamical variables have non trivial jumps.

# Results and conclusions

The new module of PLUTO code (Mignone et al. 2007) is able to solve RRMHD equations in 1D, 2D or 3D both with low and high resistivity.



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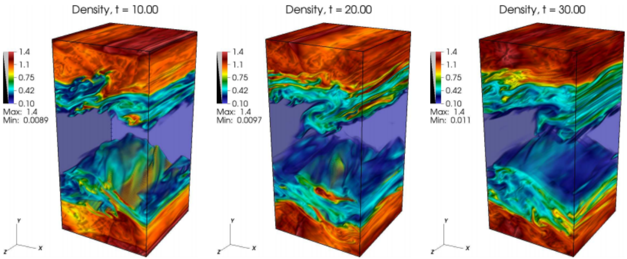


The solution tends to the ideal solution if the resistivity is low, while it becomes more diffusive (as it should be) as the resistivity increases. The module is available in the latest version of PLUTO (4.4) under conditions.