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Stability analysis of relativistic magnetised astrophysical jets: a hyper-unstable solution

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Astrophysical jets are considered among the most stable structures throughout the cosmos, as they are able to propagate to distances many times their initial radii. In this context we conduct a linear stability analysis on astrophysical outflows, for which the dynamics are described by the relativistic magnetohydrodynamics. A new peculiar solution emerged, having instabilities' growth timescales comparable to the light crossing time. These time intervals are extraordinarily small compared to values already found in the literature, hence we name the mode as hyper–unstable. We study and find the jet physical parameters affecting the new mode, and the parameters' range for which these hyper–unstable solutions are present. The mode is characterised as local, due to the fact that it is developed mainly at the boundary of the jet. In addition, we run a series of simulations in order to study the non–linear evolution of this mode. The simulations verify the analytical results and showcase a new specific configuration established. A really interesting trait of this new configuration is the creation of vortices which do not dissipate and travel with relativistic velocities for timescales of several hundred jet light crossing times.

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