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On the Nature of Virial Liapunov Functional in Hydrodynamic Instability

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There is a persistent myth of ‘irrationality’ of ‘virial’ Liapunov functionals used in proofs of fluid instability. The aim of the paper is to address that issue and to produce the unifying and systematic concept on introducing of ‘virials’. Our ‘virial’ can be introduced via the second variation of Lagrangian, and correspondent ‘virial equality’ is closely linked to the Jacobi equation for deviations of geodesics. This link explains the nature of ‘virial’ as Liapunov functional. It may be considered as the ‘distance’ between two geodesics corresponding to the main flow and perturbed flows. New applications of ‘virials’ to instabilities both states of rest (‘converse Lagrange theorems’) and flows (‘horseshoe instability’ and ‘Arnold’s instability’) are considered and further perspectives are discussed.

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