Quantum and Plasma Science 2020

2020

Vol.04 No.1

The Ideas on Development of Instability

Igor V. Lebed

Institute of Applied Mechanics, Russia

Abstract

Multimoment hydrodynamics equations draw the following pattern of development of unstable process in system. Crossing the first critical Reynolds number value is accompanied by the stability loss. The system loses its stability when entropy outflow through the surface confining the system can't be compensated by entropy produced within the system. In accordance with solutions to the multimoment hydrodynamics equations, the system, when loses stability, remains further unstable. As Reynolds number grows, one unstable mode is replaced by another mode, also unstable. The change in unstable flow regime is governed the tendency of a system to discover the fastest path to depart from the state of statistical equilibrium.

The behavior of unstable system is a mirror image of system behavior in the stability mode. With elimination of external influence, the state of stable system rushes to the state of statistical equilibrium. On the contrary, the state of unstable system rushes away from the state of statistical equilibrium without any additional influence. Both of these processes are described by direct hydrodynamics equations. In the absence of external influence, an extremely unlikely transition from the equilibrium to non-equilibrium is described by reverse hydrodynamics equations. In the instability mode, the reverse equations lead the system in the direction of statistical equilibrium with high probability.

This behavior of unstable system is at variance with Landau-Hopf scenario, to which solutions of the Navier-Stokes equations follow. In accordance with Landau-Hopf scenario, a system that has lost stability inevitably finds some new stable position, near which it performs harmonic periodic or multiperiodic movement. Thus, only stable solutions to the classic hydrodynamics equations can be put in conformity to observed unstable phenomena. Unlike the equations of multimoment hydrodynamic, the Navier-Stokes equations fail when trying to interpret unstable phenomena, in particular, the phenomenon of vortex shedding called the Kelvin-Helmholtz instability.

Biography:

Igor V. Lebed graduated from the Faculty of Chemical Physics at the Moscow Institute of Physics and Technology and the post-graduate course of the Institute. After defending his thesis, I.V.Lebed was sent to work in Zhukovsky Central Institute of Aerohydrodynamics. Currently, I.V.Lebed is an employee of the Institute of Applied Mechanics, Russian Academy of Science.

The first ideas initiated a new direction in hydrodynamics came to I.V.Lebed in the late seventies. The first work on this theme has been published in 1990 in the journal "Chemical Physics Letters". The fundamental concepts and methods for the new direction are represented in monograph "The Foundations of Multimoment Hydrodynamics – Part 1: Ideas, Methods and Equations", 2018.

Speaker Publications:

1.I.V.Lebed, Derivation of equations of multimoment hydrodynamics for a gas of particles with internal structure, Physica A, 2019, Vol.515, pp.715-747.

2.I.V. Lebed, The Foundations of Multimoment Hydrodynamics– Part 1: Ideas, Methods and Equations, Nova Science Publishers, New-York, 2018.

3.I.V. Lebed, About the transition to turbulence through chaotic distortion of vortex shedding, Journal of Advances in Physics, 2016, Vol.12, pp.4460-4480.

4.I.V. Lebed, Multimoment hydrodynamics in problem on flow around a sphere: entropy interpretation of the appearance and development of instability, Open Journal of Fluid Dynamics, 2014, Vol.4, pp.163-206.

5.I.V. Lebed, Development of instability in the problem of flow around a sphere, Russian Journal of Physical Chemistry B, 2014, Vol.8, pp.240-253.

EuroSciCon Conference on Plasma Physics; Amsterdam, Netherlands- February 21-22, 2020.

Abstract Citation:

Igor V. Lebed, EuroSciCon Conference on Plasma Physics; Amsterdam, Netherlands- February 21-22, 2020