

# Stability of Streaming Plasmas: Celebrating a 50th and a 100th Anniversary

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The subject of waves and instabilities in streaming plasmas has an enormous scope including both laboratory fusion and astrophysical plasmas, even up to cosmic scales. It is a happy coincidence that the spectral equations of magnetohydrodynamics (MHD) describing these phenomena date back to the same year as the foundation of the FOM-Institute for Plasma Physics Rijnhuizen. I will focus on the first anniversary and extend it to the 100th anniversary of another scientific contribution that provides the fundament for an even larger range of physical phenomena.

The occasion is the preparation of the very first chapter of our second volume on Magnetohydrodynamics [1]. Trying to describe the spectral theory of moving plasmas, and to compute relevant MHD spectra on that basis, a fundamental inconsistency in the literature had to be resolved. This is the widely, and wrongly, perceived idea of “non-self adjointness” of the stationary flow problem. In fact, self-adjointness of the occurring operators (the generalized force operator and the Doppler–Coriolis shift operator) was proved right away, but not exploited in a meaningful manner. After an extended struggle with this subject, an effective method was developed to accurately compute all the eigenvalues in the complex  $\omega$  plane. Moreover, an oscillation theorem (à la Sturm–Liouville) was proved that enables one to map out sequences of such eigenvalues. The methods are applied to the hydrodynamic Rayleigh–Taylor and Kelvin–Helmholtz instabilities, and their MHD extensions for magnetically confined plasmas, and to the magneto-rotational instability in accretion disks.

[1] J. P. Goedbloed, R. Keppens and S. Poedts, *Advanced Magnetohydrodynamics* (Cambridge University Press (to appear, March 2010)).