# About the dissipative Newton equation

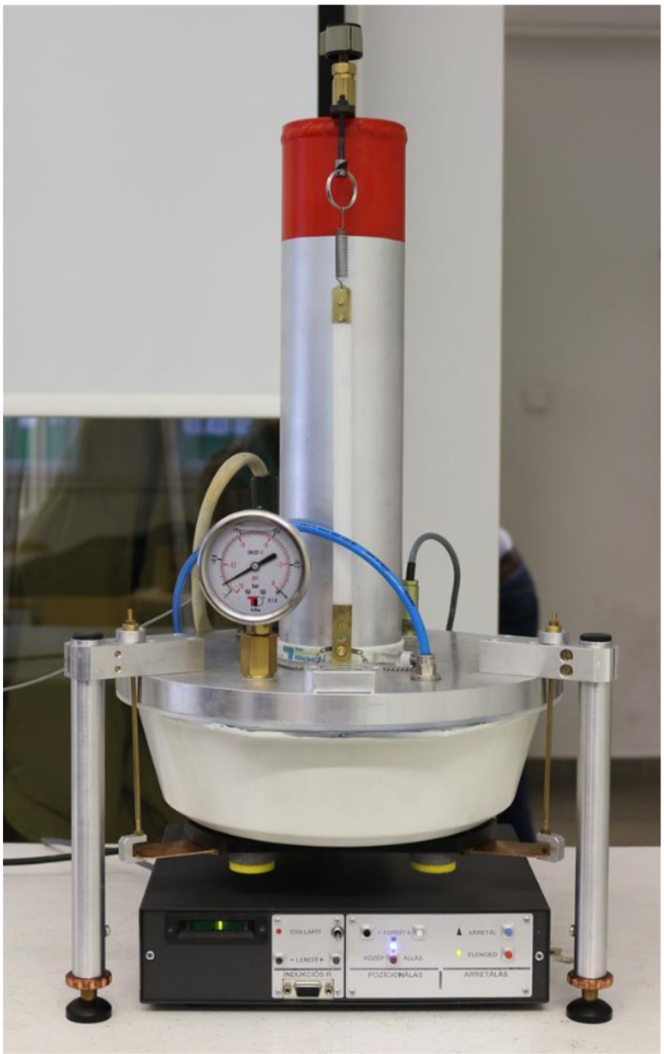
**Péter Ván**[1]

[1]HUN-REN Wigner Research Centre for Physics, Hungary

The fundamental nature of the second law of thermodynamics can best be examined through its contribution to fundamental theories and through experiments. Numerous examples demonstrate how thermodynamic concepts contribute to the foundations of physics [1–2]. In such cases, compatibility with existing approaches is the main goal, but experimental verifications and predictions that differ from existing approaches are rare.

In this presentation, I show the thermodynamic foundations of classical mechanics. Within this framework, ideal Newtonian mechanics appears as the dissipative-free limit of a more general, dissipative theory. The thermodynamic approach predicts a simple but novel, dissipative contribution to momentum that depends on the applied force and leads to a damping coefficient whose dependence on the inertial mass is specific and experimentally verifiable. Several well-known equations, including the thermodynamic version of the Eliezer–Ford–O'Connell equation for radiation reaction, can be derived as special cases. Furthermore, a torsion balance experiment with a variable moment of inertia has been designed to measure this effect (fig. 1). The first results of these measurements are shown.

Finally, we present some arguments regarding why and how thermodynamics can be both fundamental and emergent.



References:

[1] T. Jacobson, Thermodynamics of Spacetime: The Einstein Equation of State, Physical Review Letters, 75:1260-3, 1995.

[2] G. Lindblad, Completely positive maps and entropy inequalities, Communications in Mathematical Physics, 40/2:147-151, 1975.

[3] P. Ván, Holographic fluids: a thermodynamic road to quantum physics, Physics of Fluids, 35/5:057105, 2023.

[4] M. Szücs and P. Ván, Thermodynamic compatibility, holographic property and wave-function representation of generalized weakly nonlocal self-gravitating non-relativistic fluids, arXiv:2504.07296.

[5] P. Ván, About the dissipative Newton equation, arXiv:2603.13989.