Classical holography

Peter Ván
Wigner RCP, Budapest, Hungary

Quantum mechanics, superfluids, and capillary fluids are closely related: it is thermodynamics that links them. Newtonian gravity can be formulated in the framework of nonequilibrium thermodynamics, introducing a scalar field, the gravitational potential, as a thermodynamic state variable. In both cases, a general method validates the requirements of the Second Law of Thermodynamics for continua and calculates the consequent restrictions on the evolution equations and constitutive relations. A simple Galilean relativistic spacetime model and a clear concept of the role of entropy inequality are in the background. Both in quantum mechanics and in Newtonian gravity, perfect fields are holographic in the sense that the volumetric force density can be expressed as pressure divergence: the equation of field momentum conservation can be transformed into the form of a Newton equation. This classical holographic characteristic of perfect fields follows due to thermodynamic compatibility.

There is a bridge between field and particle representations of a physical system, the bridge is holography, and the key to holography is the Second Law of thermodynamics.