


Superfluid thermodynamics

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Quantum to fluid

Connected realities

quantum mechanics \rightarrow *superfluids* \rightarrow capillary fluids

From special to general. Analogy?

$$i\hbar\partial_t\Psi + \frac{\hbar^2}{2m}\Delta\Psi - \Phi\Psi = 0,$$

Madelung transformation

$$\Psi = Re^{i\frac{\hbar}{m}S}.$$

$\rho = |\Psi|^2$, $\mathbf{v} = \nabla S$, fluid form:

$$\dot{\rho} + \rho\nabla \cdot \mathbf{v} = 0, \quad \rho\dot{\mathbf{v}} + \nabla \cdot \mathbf{P}_{\mathbf{K}}(\rho, \nabla\rho, \nabla^2\rho) = \mathbf{0},$$

Perfect Korteweg fluids.

Fluid to quantum

Thermodynamic deduction

capillary fluids \implies *superfluids* \implies quantum mechanics

Consequences

- Second Law instead of variational principles
- Second Law instead of holography

A superfluid is not water with zero viscosity.
What about QGP?