

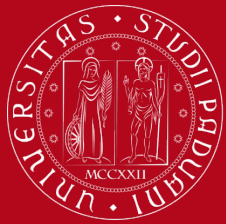


Condensed Matter Theory

Macroscopic Quantum Phenomena

Speaker: Prof. Dr. **Luca Salasnich**, PhD

Full Professor of Theoretical Physics



MACROSCOPIC QUANTUM PHENOMENA

I) Bose-Einstein Condensation

ii) Superfluidity

iii) Superconductivity

iv) Laser light

Phenomena where a macroscopic number of particles (or pairs) occupy the same single-particle (or two-particle) quantum state.

At thermal equilibrium but also out-of-equilibrium.

RESEARCH TOPICS:

Quantum field theory of Bose-Einstein condensation with atomic quantum gases

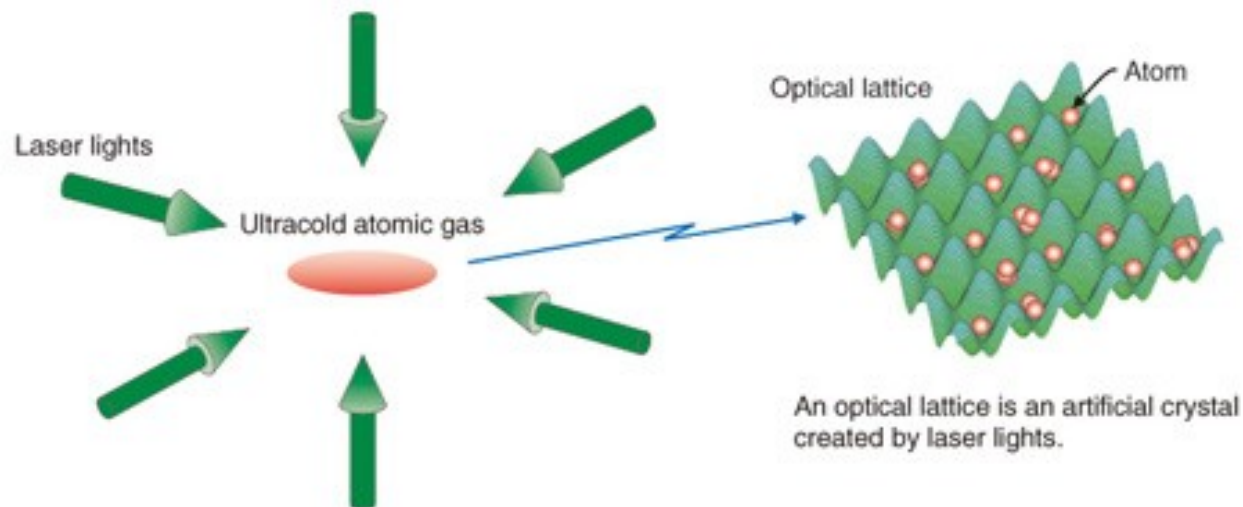
BCS-BEC crossover and high- T_c superconductors

Quantized vortices and solitons in BEC, superfluids, superconductors and laser light

Macroscopic quantum tunneling with Josephson junctions

Quantum physics in curved geometries, and also in 2D or 1D systems

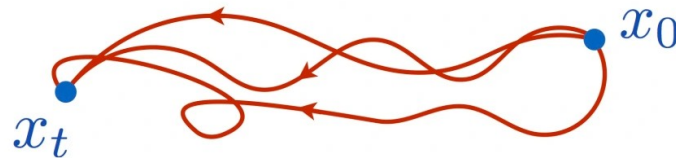
Quantum field theory of laser light in optical cavities and nonlinear media



Methods of Theoretical and Mathematical Physics

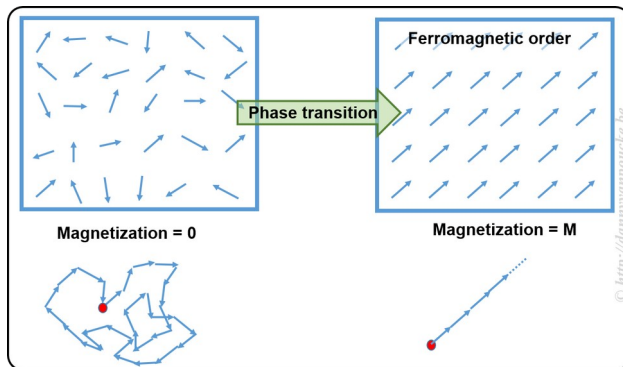
Quantum field theory, Feynman path integral, quantized vortices, solitons

$$\langle x_t | e^{-i\hat{H}t/\hbar} | x_0 \rangle =$$



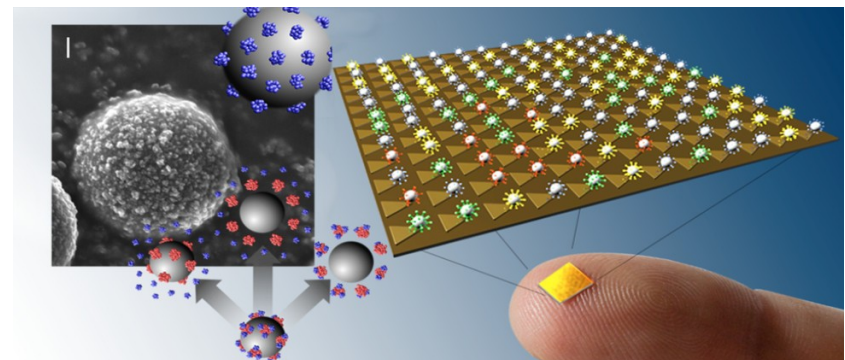
Quantum Statistical Mechanics

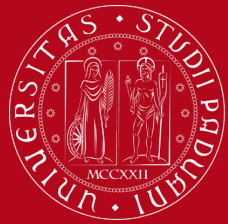
Phase transitions with quantum gases, superconductors, spin systems



Low-Dimensional Physics

Quantum field theory of many-body systems confined in quasi-2D or quasi-1D in flat or curved manifolds



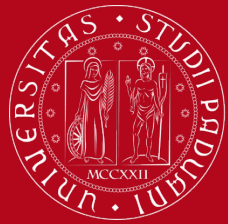


Main recent scientific results of the group

- An average of 8 Scientific Papers per year
- Papers published in prestigious scientific journals, among them:
 - Nature Reviews Physics (impact factor: 44.8)
 - Physics Report (impact factor: 23.9)
 - Physical Review Letters (impact factor: 8.1)
- Invited Talks at many International Conferences and Schools

Examples:

- A. Tononi and L. Salasnich, Low dimensional quantum gases in curved geometries, Nature Rev. Phys. **5**, 398 (2023).
- A. Tononi, F. Cinti, and L. Salasnich, Quantum Bubbles in Microgravity, Phys. Rev. Lett. **125**, 010420 (2020).
- A. Tononi and L. Salasnich, Bose-Einstein condensation on the Surface of a Sphere, Phys. Rev. Lett. **123**, 160403 (2019).
- L. Salasnich and F. Toigo, Zero-Point energy of ultracold atoms, Phys. Rep. **640**, 1 (2016).



Group characteristics:

- Direct interaction with the PI without mediation of collaborators
- No annoying weakly group meetings
- Friendly and respectful environment
- Large network of international collaborators (for PhD and grants)
- No competition among group members
- Strong competition to be always at the edge of the knowledge
- Active collaborations with experimental groups (LENS and UK)

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Contact

Prof. Luca Salasnich:

Ufficio n. 338

luca.salasnich@unipd.it

<https://materia.dfa.unipd.it/salasnich/>

Other informations:

The research group is informally composed by

- 1 full professor*
- 2 associate professors*
- 1 visiting professor*
- 3 PhD students*
- 2 MSc students, 3 BSc students*

Remark: within the Excellence DFA Project “Quantum Frontiers”, there will be “specific” PhD positions in the next years.