



Course unit English denomination	Quantum Physics of Atoms and Ions
Teacher in charge (if defined)	Luca Salasnich
Teaching Hours	24
Number of ECTS credits allocated	3
Course period	02/2025 - 06/2025
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (50% minimum of presence) ☐ No
Course unit contents	1. Bose-Einstein condensation with ultracold alkali-metal atoms (4 h). 2. Experimental trapping techniques for atoms and ions (4 h). 3. Topological states with ultracold atoms: quantized vortices and dark solitons. Bright solitons (4 h). 4. Superfluid hydrodynamics for bosons and fermions. Macroscopic quantum tunneling and Josephson junctions (4 h). 5. Two-dimensional systems: topological phase transition of Kosterlitz-Thouless (2 h). 6. BCS theory for superconductors and fermionic atoms. Ginzburg-Landau equation(2 h). 7. BCS-BEC crossover for atoms (4 h).
Learning goals	The students will learn the main quantum phenomena with atoms and ions (and also superconductors) which are currently under intensive investigations: Bose-Einstein condensation, topological quantum states, macroscopic quantum tunneling and Josephson effect, and BCS-BEC crossover.
Teaching methods	Lessons with slides but also seminars of experts, among them Francesco Minardi(Univ. di Bologna) e Alexander Yakimenko (Univ. di Kiev).
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	.



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Examination methods
(in applicable)

Seminar on a topic of the course to be agreed with the lecturer

Suggested readings

Slides of the lecturer

Additional information

web page of the course
<http://materia.dfa.unipd.it/salasnich/phd/>
