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| Course unit English denomination | Quantum Physics with Atoms and Ions |
| SS | PHYS-04/A |
| Teacher in charge | Prof. Luca Salasnich |
| Teaching Hours | 24 |
| Number of ECTS credits allocated | 3 |
| Course period | March - June 2026 |
| Course delivery method | <input checked="" type="checkbox"/> In presence <input type="checkbox"/> Remotely <input type="checkbox"/> Blended |
| Language of instruction | English |
| Mandatory attendance | <input checked="" type="checkbox"/> Yes (50% minimum of presence) <input type="checkbox"/> No |
| Course unit contents | <ol style="list-style-type: none">1. Bose-Einstein condensation with ultracold alkali-metal atoms.2. Experimental trapping techniques for atoms and ions.3. Topological states with ultracold atoms: quantized vortices and dark solitons. Bright solitons.4. Superfluid hydrodynamics for bosons and fermions. Macroscopic quantum tunneling and Josephson junctions.5. Two-dimensional systems: topological phase transition of Kosterlitz-Thouless.6. BCS theory for superconductors and fermionic atoms. Ginzburg-Landau equation.7. BCS-BEC crossover for atoms. |
| Learning goals | The student will learn the basic 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. The student will be able to discuss and analyze both theoretical and experimental methods and techniques in this field of research. |
| Teaching methods | Slides + Blackboard + Questions and Answers |



Course on transversal,
interdisciplinary,
transdisciplinary skills

☐ Yes
☒ No

Available for PhD
students from other
courses

☒ Yes
☐ No

Prerequisites
(not mandatory)

None.

Examination methods
(if applicable)

Seminar of the student on a specific topic of the course.

Suggested readings

R. Onofrio and L. Salasnich, Physics and Technology of Ultracold Atomic Gases (Springer, 2024).

Additional information



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PhD Physics