



**COLLOQUIUM INAUGURALE
DEL DOTTORATO IN FISICA, A.A. 2022/2023
LEZIONE VOLTIANA**

Dipartimento di Fisica, A102
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Quantum simulation

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Material science and quantum chemistry, among other fields, have shown the hard way that our capacity to solve quantum mechanical problems is severely limited. Exact solutions with 10^{23} particles are out of the question, approximate analytical solutions are hard to find and control and numerical approaches suffer from the inherent limitation of representing a quantum problem on a classical computer. In the last two decades or so, the idea of doing quantum simulations, namely finding quantum systems that can *solve* specific problems has gained considerable traction due to progress in cold atomic gases and in material science. In this talk, the challenges in this field will be reviewed, starting from the reasons why we need such quantum simulators, and then giving several examples in cold atomic gases and condensed matter of realised quantum simulators and the problems that they allowed to tackle.