Contribution ID : **93**   Type : **presentation (QT PhD program student)**

A new programmable quantum simulator with two-electron Rydberg atoms in optical tweezer arrays

lunedì 29 agosto 2022 18:20 (15)

I will present a new programmable quantum simulator based on Rydberg strontium atoms trapped in optical tweezers arrays at CNR-INO and Department of Physics in Florence. This new experimental setup, supported by an infrastructural program of CNR, is now under construction in our laboratories as a joint effort of CNR and the University of Florence. I will present the main features of the apparatus, including the techniques that will be employed for the generation of programmable arrays of optical tweezers and for the control of the different sources of decoherence. I will also discuss the advantages offered by two-electron atoms, including narrow optical transitions that can be exploited for effective atomic cooling schemes, and the existence of a metastable state that provides an additional degree of freedom for the manipulation of individual atoms, as well as a direct connection to frequency metrology. I will finally discuss the applications that we envision for this new setup, in particular the simulation of quantum spin models with different types of interactions and topologies, and the realization of multi-particle entangled states.

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Session Classification : Students Talks 1