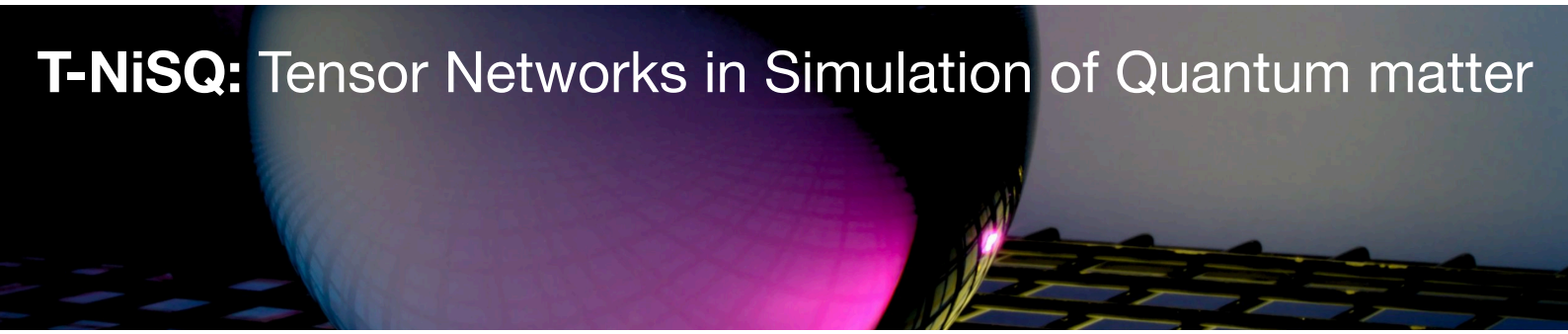
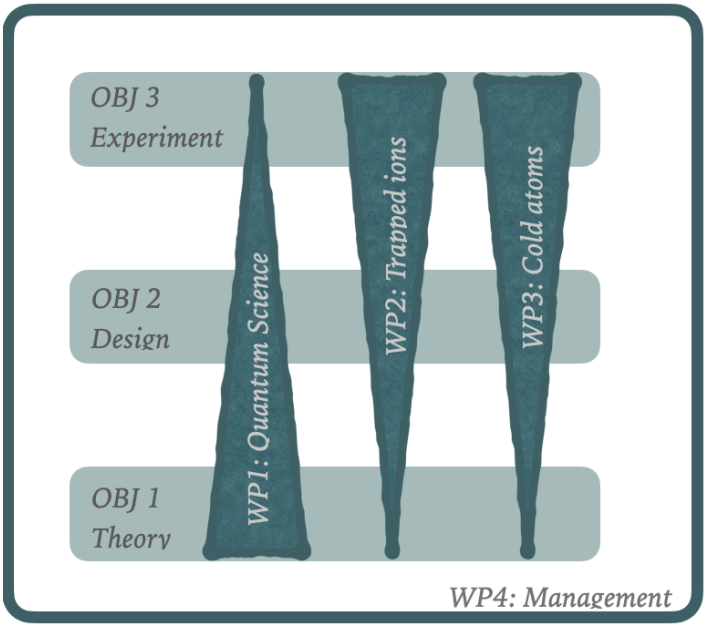
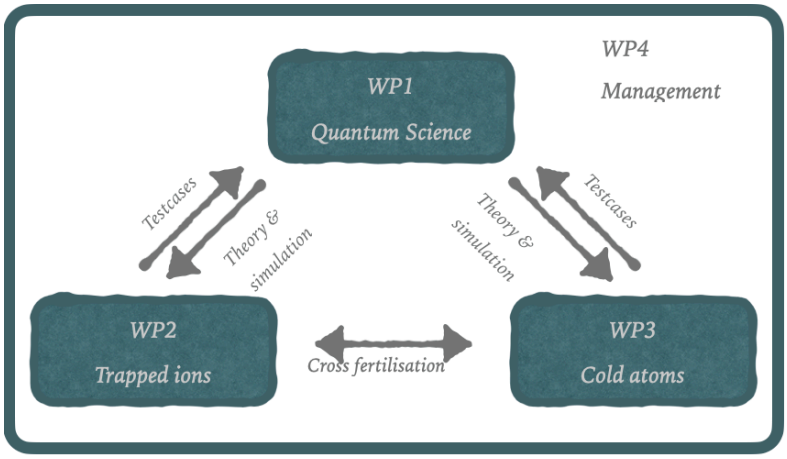
T-NiSQ: Tensor Networks in Simulation of Quantum matter



In the Quantum Science era where Noisy Intermediate-Scale Quantum (NISQ) devices are accessible, quantum information tools to guide their development play a fundamental role. With the foreseen increasing complexity of available NISQ devices, their classical simulations – that drove their development until now – will soon fail to keep up. There is thus an urgent need for increasingly powerful diagnostic tools that can be applied to quantum devices even in the quantum advantage regime. We plan to systematically develop quantum-inspired algorithms to benchmark, certify and validate quantum devices. At the center of the quantum-inspired algorithms lay tensor networks (TN), one of the most powerful paradigms for simulating quantum many-body lattice systems, both in- and out-of-equilibrium. The results of T-NiSQ will be an essential tool to advance our understanding of dynamical and strong- correlation effects in quantum matter also beyond the NISQ era.



T-NISQ Structure: Three main intertwined objectives are planned, reached by building on the activities of three work packages (quantum science, trapped ions, and cold atoms).



In T-NiSQ we plan to develop novel and dedicated quantum inspired algorithms to design and engineer quantum devices and to test them in state-of-the-art quantum simulations and computations. In particular, we will develop benchmarking tools for high-dimensional quantum systems in presence of noise.

CONSORTIUM

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QUANTERA
INFN National Institute for Nuclear Physics
DFG Deutsche Forschungsgemeinschaft
FWF Der Wissenschaftsfonds.
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