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Unconventional superconducting devices and designs for quantum architectures

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We will report on special properties of smart superconducting circuits and of hybrid tunnel-ferromagnetic Josephson junctions (JJs) on how to engineer the macroscopic phase in quantum circuits.

The possibility to control and drive tunnel-ferromagnetic JJs through different physical means allows for novel tuning mechanisms that are not susceptible to specific noise sources in a transmon configuration. Moreover, digital control based on classical superconducting ultra-low power electronics is being adapted to perform qubit control and readout for scalable architectures in this linked digital-quantum hybrid system. In this framework, we will discuss how the macroscopic phase of carefully designed superconducting circuits can be manipulated to perform digital phase detection of weak coherent radiation, thus constituting a phase-readout protocol for a superconducting qubit.

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