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Exchange interactions of paramagnetic spins on -Al_2O_3 JONATHAN DUBOIS, Lawrence Livermore National Laboratory, DONGHWA LEE, Oak Ridge National Laboratory, NICOLE ADELSTEIN, VINCENZO LORDI, Lawrence Livermore National Laboratory — Although Superconducting qubits (SQs) represent a promising route to achieving a scalable quantum computer, maintaining coherence remains a major challenge. It is generally accepted that the phase coherence of SQs are reduced by interactions of superconducting states with magnetic spins in the environment. In a previous study we showed that magnetic spins can be induced by ambient molecules on the Al_2O_3 substrate and lead to a paramagnetic noise in SQs. [PRL 112, 017001 (2014)] In this follow-on work we show how the induced surface magnetic moments can interact with each other and lead to competing magnetic ordering on the surface In particular, the energy landscape of diverse arrangements of surface magnetic spins are considered to understand spin-spin interaction mechanisms and magnetic ordering boundaries on the Al_2O_3 surface. In addition, we will also discuss how the ordered surface spins can be controlled by mechanical strain on the substrate. In conclusion, we propose routes to improving SQ performance by enhancing or minimizing magnetic ordering of induced spins on Al_2O_3 surface.

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