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Anatomy of the exchange gate action in undoped accumulation-mode SiGe quantum dot devices A.A. KISELEV, R.S. ROSS, M.G. BORSELLI, K. ENG, K.S. HOLABIRD, T.M. HAZARD, M.F. GYURE, HRL Laboratories LLC, 3011 Malibu Canyon Road, Malibu CA 90265 — We discuss simulations of an undoped accumulation-mode SiGe device containing an electrostatically formed double quantum dot in its active area. We validate our virtual model by extensive device characterization (in terms of gate actions, dot addition energies, etc.) and quantitative comparisons to concurrent experimental data. Next, we trace and map in detail the turn-on of the inter-dot exchange interaction by the exchange gate located between the dot gates. Of primary interest is the ability to control (i.e., both to completely shut off and to gradually modulate in the neV to μeV range) the exchange energy between the two separated electrons. We identify a potential obstacle to proper device operation, the formation of additional dot states under the progressively more forward-biased exchange gate. This effect is limited, however, to the case of large dot gate diameter and/or large dot-dot separation. Lastly we quantify and analyze the consequences of cross-capacitance between adjacent exchange and dot gates. Sponsored by the United States Department of Defense. Approved for public release, distribution unlimited.

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