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High fidelity gates with simple pulses FELIX MOTZOI, JAY GAMBETTA, FRANK WILHELM, University of Waterloo — Fast oscillating terms in the Hamiltonian such as off-resonant excitation and counter- rotating terms can be a significant source of error in quantum information implementations. We expand on techniques first developed for controlling 3-level systems, Derivative Removal by Adiabatic Gate (DRAG) published in PRL 103 110501, which was experimentally tested in arXiv:0908.1955v1. Here we show how this technique can be applied specifically to 2-level systems, selective qubit addressing, and in general to multi-channel leakage systems to vastly improve fidelities. In all these cases, the error corresponds to a dragging of the adiabatic frame used for the coherent rotation, which is proportional to the derivative and can easily be corrected using a second quadrature control. The pulse shapes obtained are smooth and very short in duration, corresponding to very few cycles of the unwanted fast oscillation.

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