Single-electron manipulation with resonant impurity states in silicon nanoelectronic circuits

J. Klocans[1], E. Potanina[1], G. Barinovs[1], and V. Kashcheyevs[1]

[1] *Department of Physics, University of Latvia, Riga*

Presenting Author: jevgenijsklocans@gmail.com elina.potanina@gmail.com

Steady decrease of the size of complementary metal–oxide–semiconductor devices entails the risk of failure for their future integration due to variability, which threatens the operation of circuits because of sample-to-sample fluctuations. The goal behind the project "Silicon at the Atomic and Molecular scale (SiAM)" is to turn this apparent limitation into an advantage by dopant implementation in a semiconductor host crystal, therefore bringing and consequently exploiting the benefits of the atomic and quantum nature of the quantum dot created. The main idea is to use the very sharp, deep and reproducible potential created by a dopant atom, resulting in a discrete level state system isolated from the noise coming from the surroundings, which opens doors for new profound functionalities to future information and communications technology systems.

In this study we present theoretical models developed to predict the overall current as a function of control voltage for different sets of the underlying physical parameters which will be measured experimentally within SiAM. The methods are based on solving the Master equation and illustrate the operation of a pure adiabatic electron pump [1] and the simulation of the output signal in a model with two atom impurities in series [2].

This work has been supported by European Commission through the Seventh Framework Programme (FP7) within project SiAM no. 610637.

References

[1] S.J. Ray, P. Clapera, X. Jehl, T. Charron, S. Djordjevic, L. Devoille, E. Potanina, G. Barinovs, V. Kashcheyevs Precision Electromagnetic Measurements 446-447 (2014)

[2] B. Roche, R.-P. Riwar, B. Voisin, E. Dupont-Ferrier, R. Wacquez, M. Vinet, M. Sanquer, J. Splettstoesser, X. Jehl Nature Communications **4** 1581 (2013)