Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Modeling Quantum and Coulomb Effects in Nanoscale Enhancement-Mode Tri-Gate III-V MOSFETs SAMEER AL-SIBIANI, KHADIJA KHAIR, SHAIKH AHMED, Department of Electrical and Computer Engineering, Southern Illinois University, Carbondale, IL — Because of limited benefits of strain engineering in extremely scaled silicon devices and lack of demonstration of a performance gain at the product level with nanowires, nanotubes, graphene, and other exotic channel materials, there is a strong motivation to continue device scaling using high-transport III-V (such as InGaAs and InAsSb) channel materials beyond the year 2020. However, there are several challenges with III-V MOSFETs prohibiting their use in high-performance and low-power logic applications. In this work, we investigate the performance of the tri-gate III-V FETs as compared to the planar counterpart, and show how quantum size quantization and random dopant fluctuations (RDF) affect the tri-gate FET characteristics and how to curb these issues. A 3-D fully *atomistic* quantum-corrected Monte Carlo device simulator has been used in this work. Space-quantization effects have been accounted for via a *parameter-free* effective potential scheme (and benchmarked against the NEGF approach in the ballistic limit). To treat full Coulomb (electron-ion and electron-electron) interactions, the simulator implements a real-space corrected Coulomb electron dynamics (ED) scheme. Also, the essential bandstructure parameters (bandgap, effective masses, and the density-of-states) have been computed using a 20-band nearest-neighbour $sp^3d^5s^*$ tight-binding scheme.

Shaikh Ahmed
Associate Professor of Electrical and Computer Engineering,
Southern Illinois University, Carbondale, IL

Date submitted: 15 Nov 2013 Electronic form version 1.4