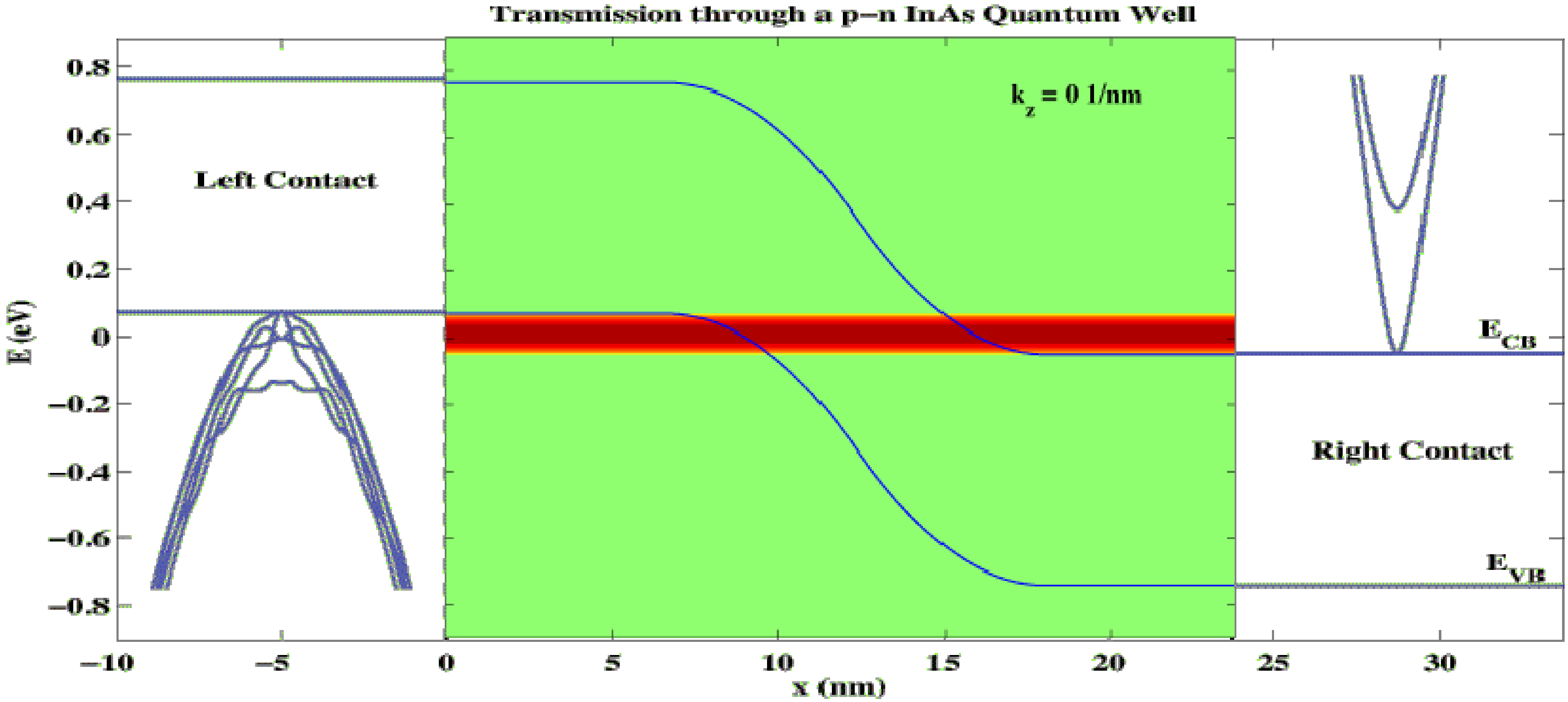
Band-To-Band-Tunneling in InAs Devices

Momentum-Energy-Resolved Transport in Full-Band Simulations



Objective:

- Demonstrate BTBT capability

Approach:

- UTB - InAs PIN diode quantization automatically included
- Compute energy and momentum transmission coefficient

Result:

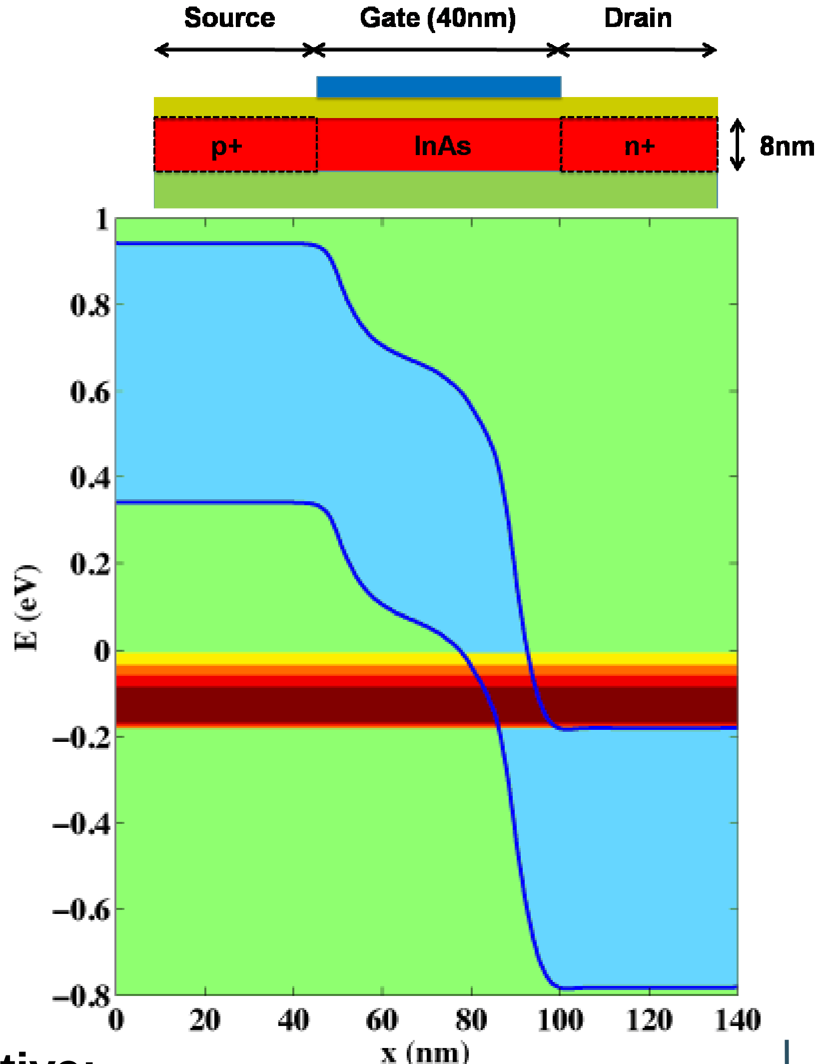
- Conduction band moves rapidly => determines k-cutoff.
- Complicated hole dispersion creates Fano-resonance like features in T.

Impact:

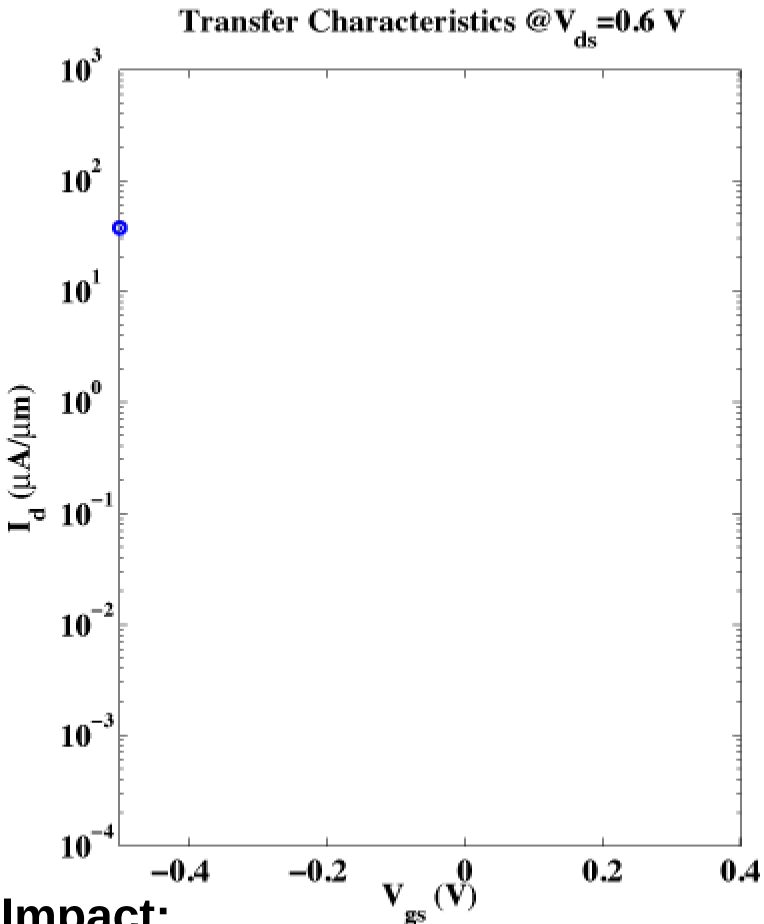
- Demonstrate explicit E-k-dependence

Band-To-Band-Tunneling in InAs Devices

Charge Self-consistent Full-Band Transport in Realistic Structure



- Bandgap raised from bulk 0.37=>0.6eV
- Doping $1\times10^{18}/cm^3$



Objective:

- Demonstrate BTBT capability

Approach:

- Full I-V calculation in OMEN

Impact:

- First full band / atomistic charge-self-consistent BTBT simulation
- Full ambipolar carrier treatment

nanoHUB online simulation and more — an NCN project

Gate Control and Sub-Threshold Swing in BTBT

Comparison of pin InAs pin Devices - SG-UTB / DG-UTB / NW

Objective:

- Low voltage, good turn-on/off switches
- Develop low sub-threshold swing FETs with band-to-band-tunneling (BTBT)
- Provide guidance to experiments

Approach:

- Utilized OMEN – atomistic, full band quantum transport simulator
- 3 diff. geom., InAs, 20nm gates. 6nm body/diameter, 1nm Oxide, 5e19/cm^3

Result – 3 different devices have:

- dramatically different sub-thresholds
- Slightly different gate controls

Impact:

- BTBTdevices much more sensitive to smooth band bending than expected
- gate all-around NW fairs best.

Authors:

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