DAVID K. FERRY

Regents' Professor Emeritus

School of Electrical, Computer, and Energy Engineering

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Graduate Faculty in the Department of Physics and the Materials Science and Engineering Program

Area of Expertise:

His research involves quantum physics, particularly with regard to the quantum-to-classical transition, two-dimensional materials, and quantum transport in mesoscopic device structures.

Education:

- BSEE, Texas Technological College, Lubbock, 1962
- MSEE, Texas Technological College, Lubbock, 1963
- Ph. D., University of Texas, Austin, 1966
- NSF Postdoctoral Fellow, University of Vienna, Austria, 1966-67

Honors:

- IEEE Cledo Brunetti Award, 1999, "for advances in nanoelectronics"
- Fellow, Institute of Physics (UK), 2008
- Fellow, Institute of Electrical and Electronics Engineers, 1987
- Fellow, American Physical Society, 1974
- ASU Graduate Mentor Award, 2001
- ASU Regents' Professor, 1988
- Halliburton Research Award, Colorado State, 1982
- Faculty Research Award, Texas Tech, 1973
- Admiral in the Texas Navy, 1973
- Tennessee Squire, 1970

Career in Brief

1966-67 Postdoctoral Researcher--University of Vienna and Boltzmann Institute for Solid State Research, Austria

1967-70 Assistant Professor, Texas Tech University

1970-73 Associate Professor, Texas Tech University

1973-77 Scientific Officer, Office of Naval Research, Arlington, VA

1977-83 Professor of Electrical Engineering, Colorado State University

1977-82 Head of Department of Electrical Engineering, Colorado State University

1983-1988 Professor of Electrical Engineering, Arizona State University

1983-1989 Director, Center for Solid State Electronics Research, Arizona State University

1988-2018 Regents' Professor, Arizona State University

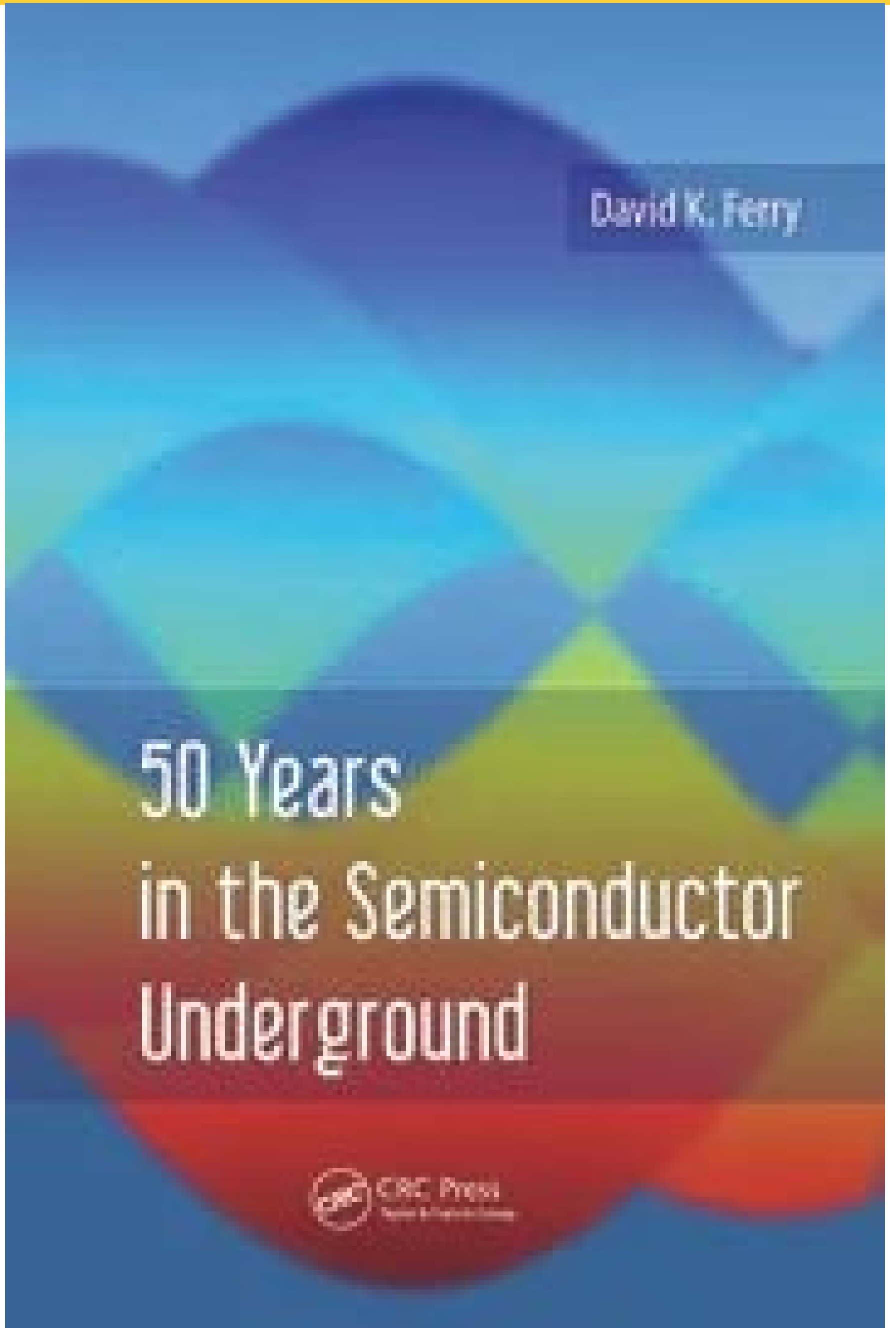
1989-1992 Chair of Electrical Engineering, Arizona State University

1993-1995 Associate Dean for Research, Fulton School of Engineering, Arizona State University

2018-present Regents' Professor Emeritus, Arizona State University

Books

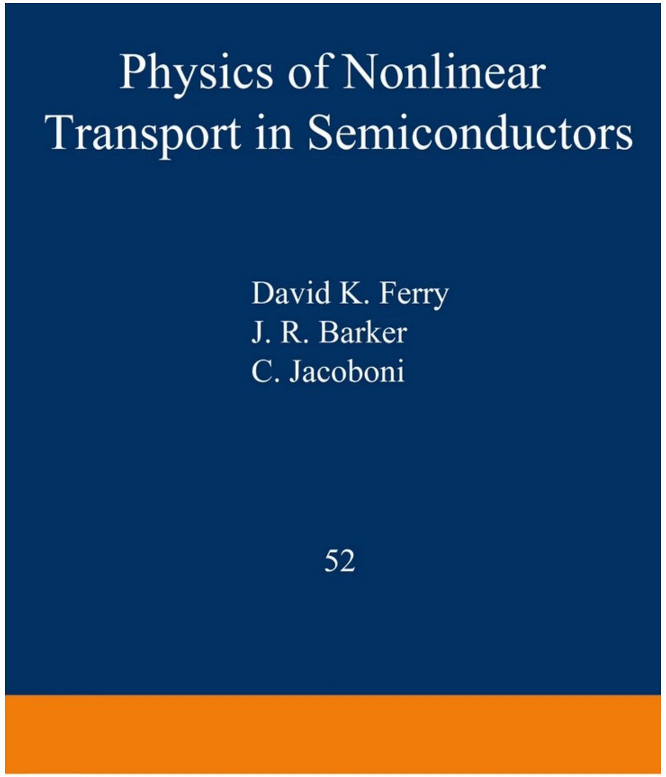
1. David K. Ferry and Stephen Goodnick *Transport in Nanostructures* (Cambridge University Press, Cambridge, 1997).
2. David K. Ferry, *Semiconductor Transport* (Taylor and Francis, London, 2001)
3. David K. Ferry and Jonathan Bird, *Electronic Materials and Devices* (Academic Press, San Diego, 2001).
4. David K. Ferry, *Semiconductors: Bonds and bands* (IOP Publishing, Bristol, 2013)
5. David K. Ferry, *50 Years in the Semiconductor Underground*, (Pan Stanford Publishing, 20150
6. Shunri Oda and David K. Ferry, *Nanoscale Silicon Devices* (CRC Press, New York, 2017).
7. David K. Ferry, *Quantum Transport in Semiconductors* (Pan Stanford Publishing, Singapore, 2017).
8. David K. Ferry and Mihail Nedjalkov, *The Wigner Function in Science and Technology* (IOP Publishing, Bristol, UK, 2018).
9. David K. Ferry, *Copenhagen Conspiracy* (Pan Stanford Publishing, Singapore, 2019)
10. David K. Ferry, *Semiconductors: Bonds and Bands*, 2nd edition (IOP Publishing, Bristol, UK, 2020).
11. David K. Ferry, *Transport in Semiconductor Mesoscopic Devices,* 2nd edition (IOP Publishing, Bristol, UK, 2020).
12. David K. Ferry, *Quantum Mechanics for Electrical Engineering*, 3rd Edition (Taylor and Francis, U.K., 2021).
13. David K. Ferry, *Hot Carriers in Semiconductors* (IOP Publishing, Bristol, UK, 2021).


David K. Ferry
50 Years
in the Semiconductor
Underground
CRC Press

ARIZONA STATE UNIVERSITY

Colorado State University

NATO Advanced Study Institute
Urbino 16-26 July 1979


Physics of Nonlinear
Transport in Semiconductors

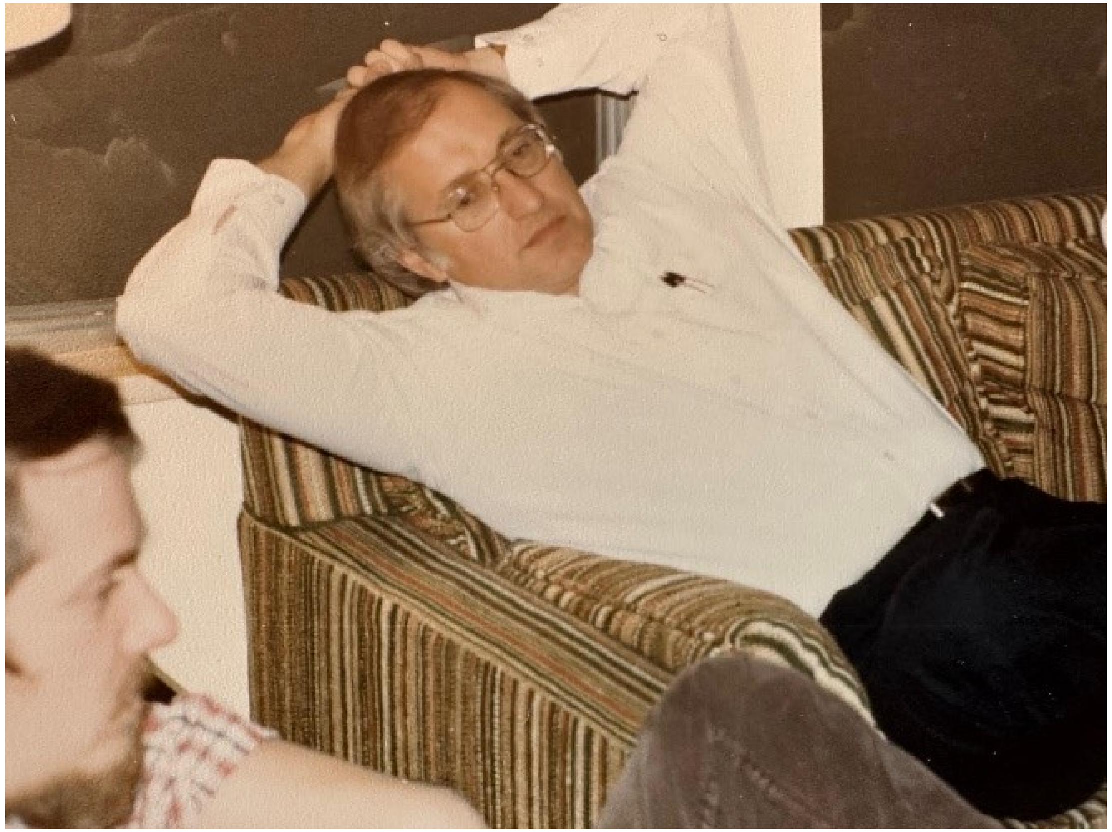
David K. Ferry
J. R. Barker
C. Jacoboni

52

Springer

Italian Army - NATO Missile Group
Oderzo June 1979-May 1980

Thanks God is Friday



Colorado State University

Lot's of excellent and nice people around, thanks also to uncle Larry !

Colorado State University

Numéro J. Phys. Colloques
Volume 42, Numéro **C7**, Octobre 1981
Third International Conference on Hot Carriers in Semiconductors
Page(s) C7-103 - C7-110
DOI https://doi.org/10.1051/jphyscol:1981710

Third International Conference on Hot Carriers in Semiconductors

J. Phys. Colloques ***42*** *(1981) C7-103-C7-110*
DOI: 10.1051/jphyscol:1981710

NON-EQUILIBRIUM HOT-CARRIER DIFFUSION PHENOMENON IN SEMICONDUCTORS II. AN EXPERIMENTAL MONTE CARLO APPROACH

P. Lugli[1], J. Zimmermann[2] et D.K. Ferry[1]

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[2] C.H.S., Greco Microondes, Université de Lille, Lille 1, France

ELSEVIER
Solid-State Electronics
Volume 26, Issue 3, March 1983, Pages 233-239

On the physics and modeling of small semiconductor devices—IV. Generalized, retarded transport in ensemble Monte Carlo techniques ☆

J. Zimmermann †, P. Lugli, D.K. Ferry

IEEE TRANSACTIONS ON ELECTRON DEVICES, VOL. ED-32, NO. 11, NOVEMBER 1985 2431

Degeneracy in the Ensemble Monte Carlo Method for High-Field Transport in Semiconductors

P. LUGLI AND D. K. FERRY, SENIOR MEMBER, IEEE

Colorado State University

IEEE TRANSACTIONS ON COMPUTER-AIDED DESIGN, VOL. CAD-4, NO. 4, OCTOBER 1985 541

Advantages of Collocation Methods Over Finite Differences in One-Dimensional Monte Carlo Simulations of Submicron Devices

UMBERTO RAVAIOLI, PAOLO LUGLI, MOHAMED A. OSMAN, STUDENT MEMBER, IEEE, AND DAVID K. FERRY, SENIOR MEMBER, IEEE

IEEE ELECTRON DEVICE LETTERS, VOL. EDL-6, NO. 1, JANUARY 1985 25

Investigation of Plasmon-Induced Losses in Quasi-Ballistic Transport

P. LUGLI AND D. K. FERRY

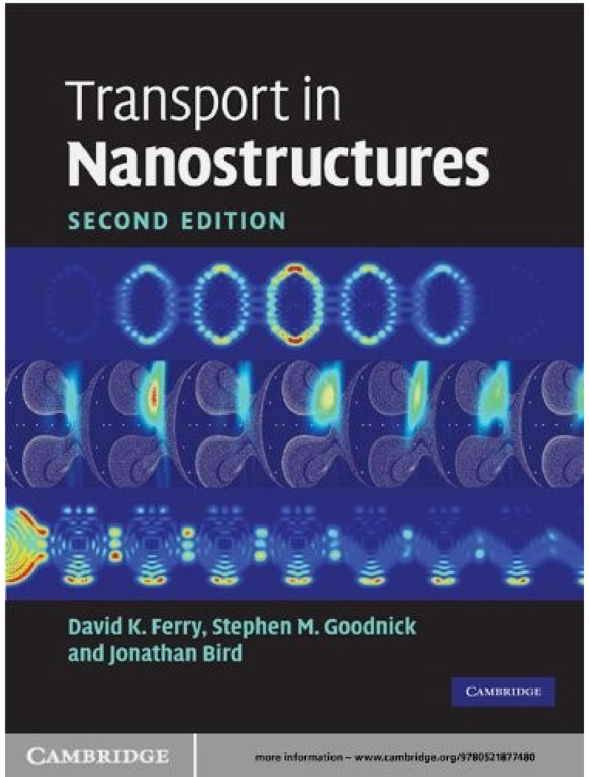
PHYSICAL REVIEW B VOLUME 32, NUMBER 12 15 DECEMBER 1985

Surface roughness at the Si(100)-SiO_2 interface

S. M. Goodnick, D. K. Ferry,* and C. W. Wilmsen
Department of Electrical Engineering, Colorado State University, Fort Collins, Colorado 80523

Z. Liliental,† D. Fathy,‡ and O. L. Krivanek
Center for Solid State Science, Arizona State University, Tempe, Arizona 85281

(Received 6 May 1985)



CSU

ASU

Montpellier: Hot Carriers

Colorado State University

Colorado State University - Arizona State University

Fantastic international connections through cooperations, schools and conferences

Arizona State University

Arizona State University

Hawaii

AHW, SIMD, NPMS, ISANN, WINDS…'A year without visiting Hawii is a year wasted..' DKF

John Barker-Dave Ferry

Thank you for making my dream come through!

(December 15, 1995)

Areas we worked together:

1991 – 1995: Low dimensional transport in silicon inversion layers using real-time Green's functions formalism

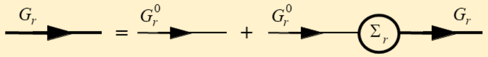
1995 – 1997: Schrödinger-Poisson solvers, Discrete impurity effects

1997 – : Monte Carlo device simulations, Transport in quantum confined systems using effective potential approach

Mobility and Collisional Broadening: nEGF

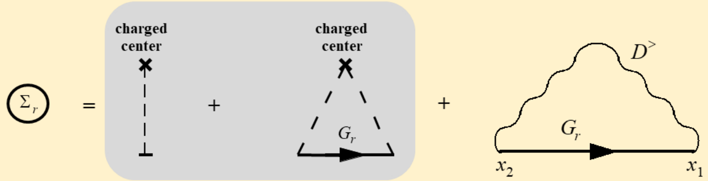
Calculated the impact of the ***collisional broadening of the states*** on the ***density of states function, scattering and the low field electron mobility***.

- **Dyson equation** for G_r



$$G_r = G_r^o + G_r^o \Sigma_r G_r$$

- Calculate Σ_r using **self-consistent Born approximation:**



$$\Sigma_n^r(\mathrm{k},\omega) = \sum_m \sum_{\mathrm{q}} \sum_i \left|U_{nm}^i(\mathrm{q})\right|^2 g_m^r(\mathrm{k}-\mathrm{q},\omega)$$

- Solve self-consistently for G_r

$$g_n^r(\mathrm{k},\omega) = \frac{1}{\hbar\omega - \varepsilon_{\mathrm{k}} - \varepsilon_n - [R_n(\mathrm{k},\omega) - i\Gamma_n(\mathrm{k},\omega)]}$$

$$\sigma_{2D} = \sigma_{2\mathrm{D}}^{Drude} + \sigma_{2\mathrm{D}}^{corr}$$

$$\sigma_{2\mathrm{D}} = 2\frac{e^2}{h}\sum_n \int d\omega \left(-\frac{\partial n_F}{\partial\omega}\right)\int_0^\infty \frac{d\varepsilon_{\mathrm{k}}}{2\pi}\varepsilon_{\mathrm{k}}\frac{a_n(\varepsilon_{\mathrm{k}},\omega)}{2\Gamma_n(\varepsilon_{\mathrm{k}},\omega)}\Big\{a_n(\varepsilon_{\mathrm{k}},\omega)\Gamma_n(\varepsilon_{\mathrm{k}},\omega) + \frac{m^*}{\hbar^2}\sum_m \int_0^\infty \frac{d\varepsilon_{\mathrm{q}}}{2\pi}\sqrt{\frac{\varepsilon_{\mathrm{q}}}{\varepsilon_{\mathrm{k}}}}\frac{a_m(\varepsilon_{\mathrm{q}},\omega)}{2\Gamma_m(\varepsilon_{\mathrm{q}},\omega)}\Lambda_m(\varepsilon_{\mathrm{q}},\omega)\int_0^{2\pi}\frac{d\varphi}{2\pi}\cos\varphi\, T_{nm}(\mathrm{k}-\mathrm{q})\Big\}$$

$$\Lambda_n(\varepsilon_{\mathrm{k}},\omega) = 1 + \sum_m \sum_{\mathrm{q}} \frac{\mathrm{k}\cdot\mathrm{q}}{k^2} T_{nm}(\mathrm{k}-\mathrm{q})\frac{a_m(\varepsilon_{\mathrm{q}},\omega)}{2\Gamma_m(\varepsilon_{\mathrm{q}},\omega)}\Lambda_m(\varepsilon_{\mathrm{q}},\omega)$$

$$\mu = \frac{\sigma_{2D}}{N_s e}$$

- D. Vasileska, P. Bordone, T. Eldridge and **D.K. Ferry**, “Calculation of the average interface field in inversion layers using zero-temperature Green’s functions formalism”, *J. Vac. Sci. Technol. B* 13, 1841-7 (1995).
- D. Vasileska, T. Eldridge and **D.K. Ferry**, “Quantum transport: Silicon inversion layers and InAlAs-InGaAs heterostructures”, *J. Vac. Sci. Technol. B* 14, 2780-5 (1996).

Universal Mobility Behavior

IEEE TRANSACTIONS ON ELECTRON DEVICES, VOL. 41, NO. 12, DECEMBER 1994

On the Universality of Inversion Layer Mobility in Si MOSFET's: Part I—Effects of Substrate Impurity Concentration

Shin-ichi Takagi, *Member, IEEE*, Akira Toriumi, Masao Iwase, and Hiroyuki Tango

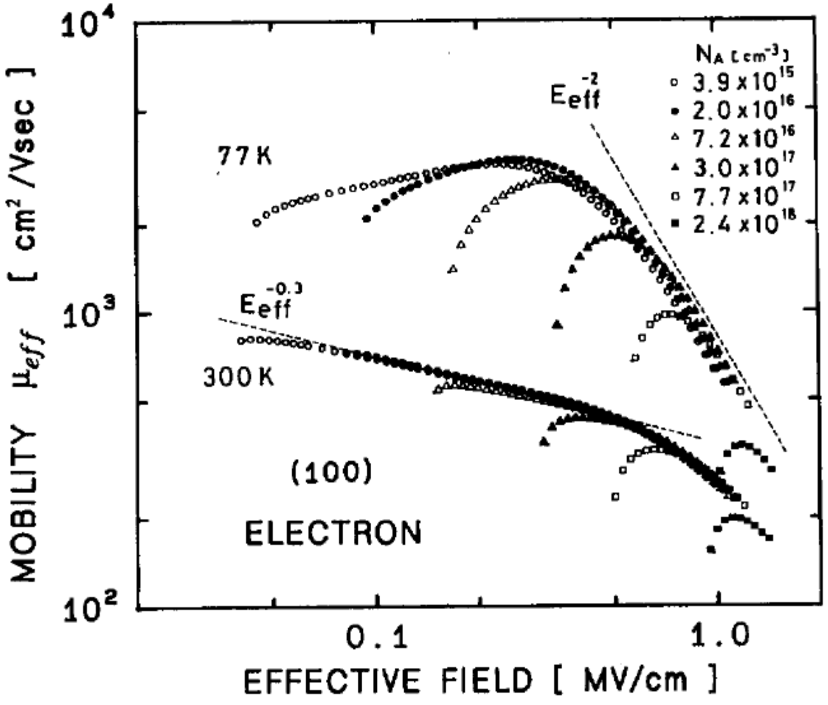
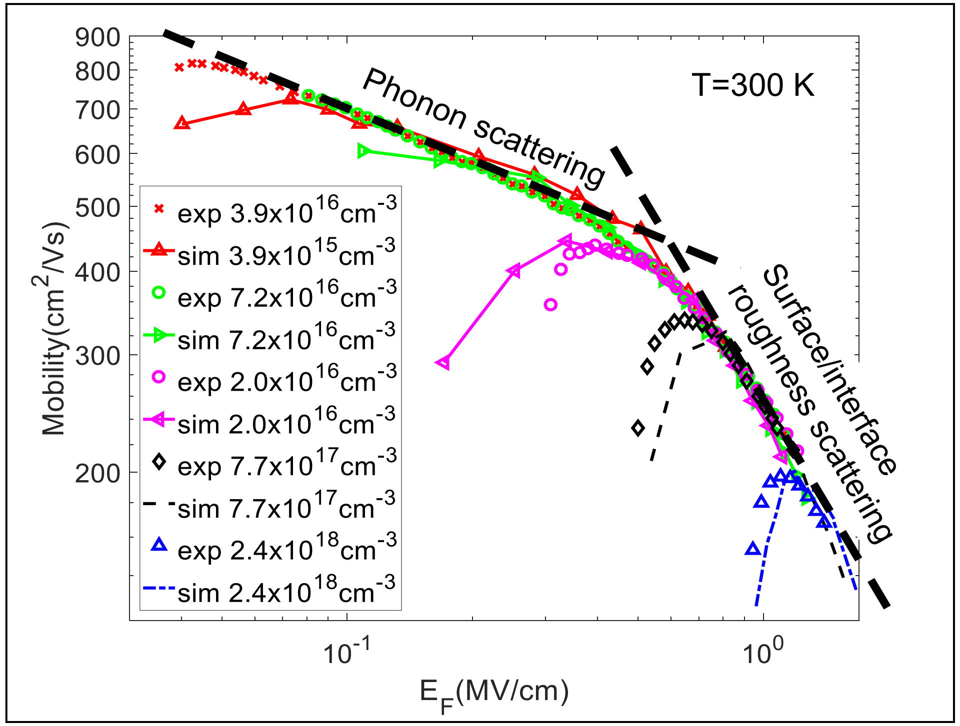
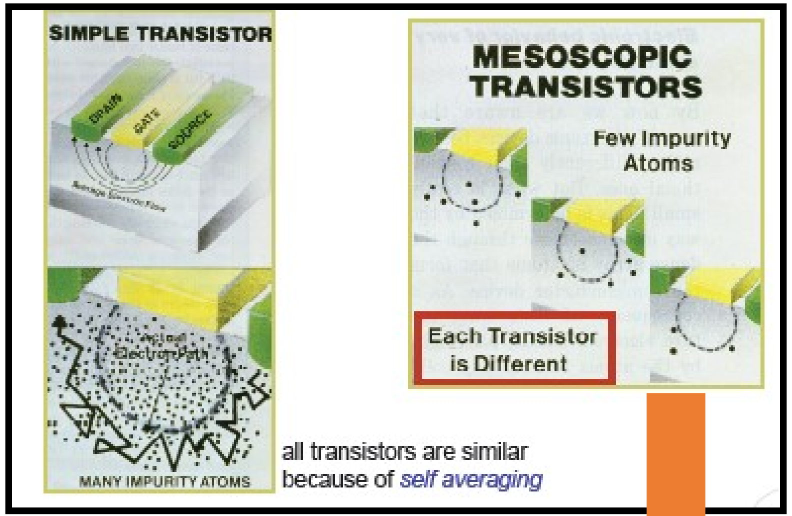


Fig. 1. Electron mobility in inversion layer at 300 K and 77 K versus effective field E_{eff}, as a parameter of substrate acceptor concentration, N_A. Here, E_{eff} is defined by $E_{\text{eff}} = q \cdot (N_{\text{dpl}} + \eta \cdot N_s)/\varepsilon_{\text{Si}}$ with η of 1/2.

- Vasileska, Dragica, *et al*. Journal of Vacuum Science & Technology B 13.4 (1995): 1841-7.
- D. Vasileska and D. K. Ferry, "Scaled silicon MOSFET's: Part I - Universal mobility behavior", IEEE Trans. Electron Devices 44, 577-83 (1997).
- G. Kannan and D. Vasileska, Journal of Applied Physics, Vol. 122, 114303 (2017).



Si MOSFETs: Random Dopant Fluctuations



- Wong and Taur: Theoretical predictions of device V_T fluctuations in 1993 [1].
- Mizuno and co-workers: Experimental demonstration of these fluctuations in 1994 [2].

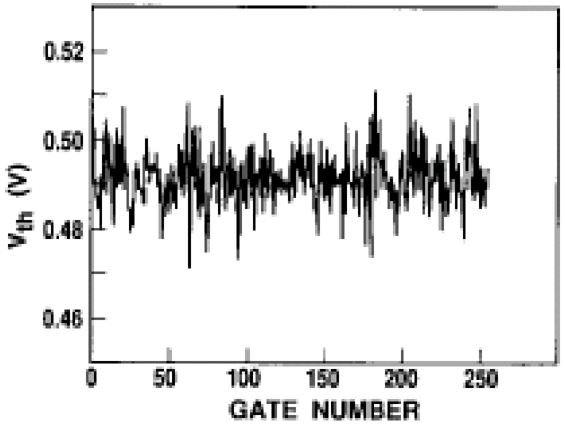
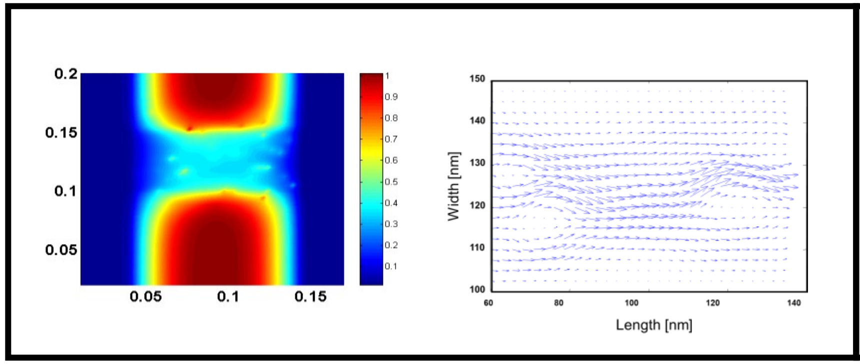
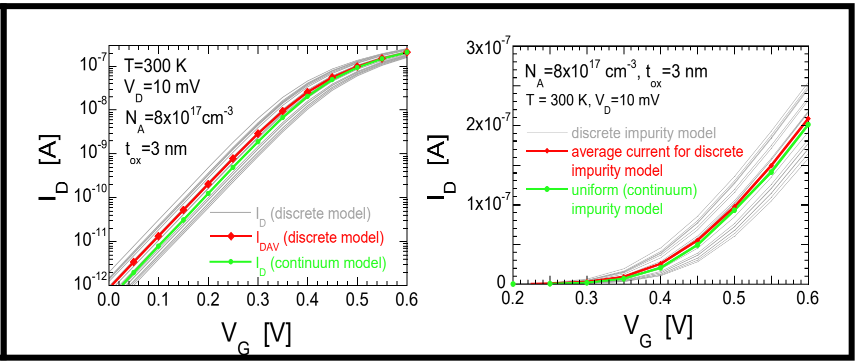


Fig. 4. Threshold voltage versus the gate number in 256 NMOSFET's, where $L_{ef} = 0.5\ \mu m$, $T_{ox} = 11nm$, and $\overline{N}_a = 7.1 \times 10^{16}\ cm^{-3}$. *(Reprinted from: T. Mizuno, J. Okamura, and A. Toriumi, "Experimental Study of Threshold Voltage Fluctuations Using an 8K MOSFET's Array," Technical Papers of Symposium on VLSI Technology, Kyoto, Japan, p. 41, 1993.)*

[1] H.-S. Wong and Y. Taur, *IEDM Technical Digest*, 705, 1993.
[2] T. Mizuno, J. Okamura and A. Toriumi, *IEEE Transactions on Electron Devices*: **41**, pp. 2216 – 2221 (1994).



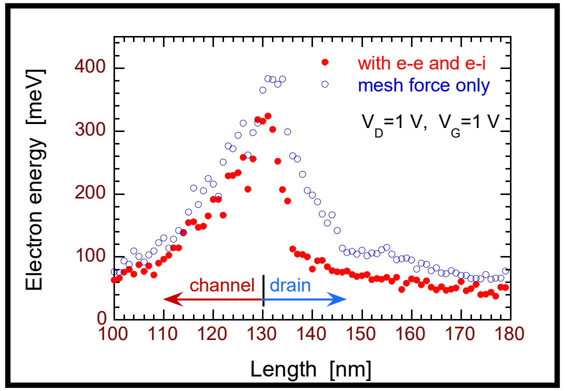


D. Vasileska et al., *VLSI Design* 8, Nos. 1-4, pp. 301-305 (1998).

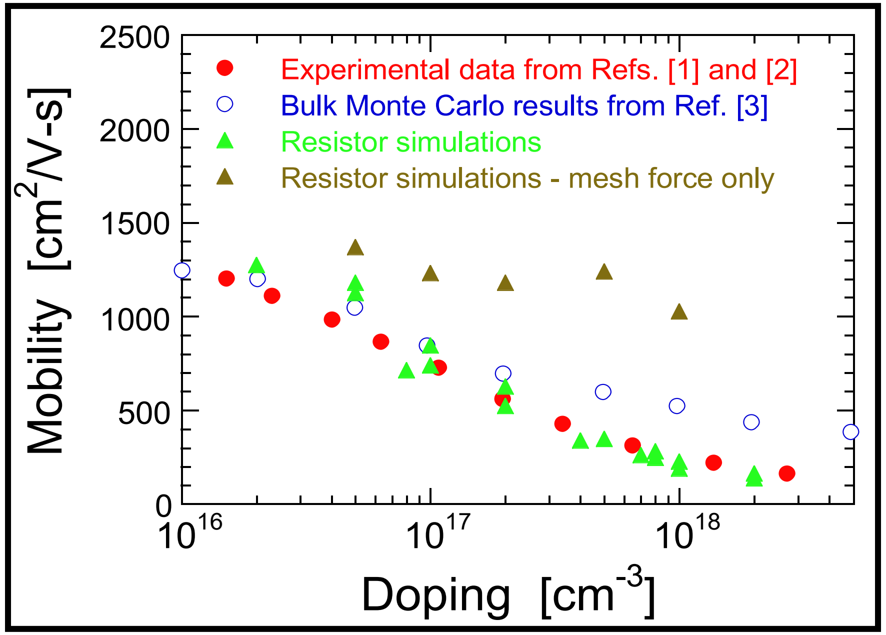
E-E and E-I Interactions in Monte Carlo Device Simulators

Coulomb forces treated in **real space**:

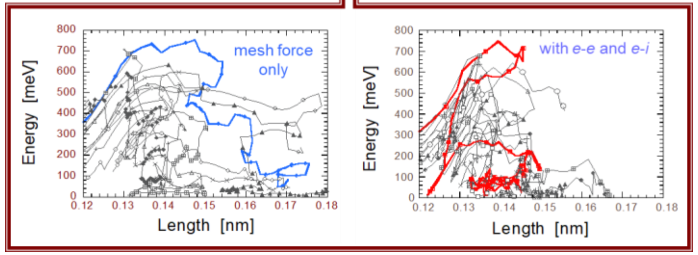
- **Corrected Coulomb Approach**
- P3M Method
- Multipole Method



W. J. Gross, D. Vasileska and **D.K. Ferry**, *VLSI Design*, Vol. 10, pp. 437-452 (2000).

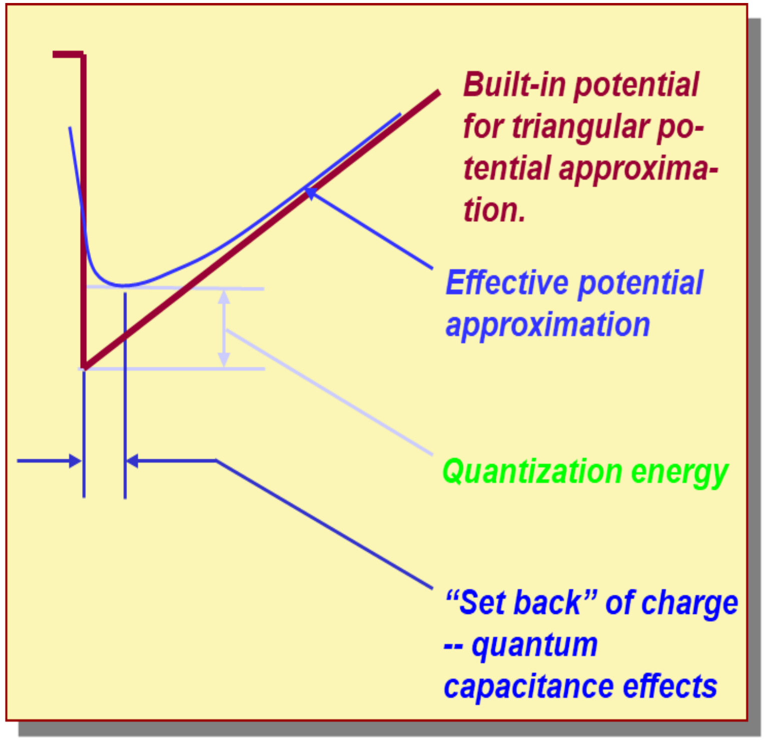


W. J. Gross, D. Vasileska and **D.K. Ferry**, "A Novel Approach for Introducing the Electron-Electron and Electron-Impurity Interactions in Particle-Based Simulations," *IEEE Electron Device Lett*. 20, No. 9, pp.463-465 (1999).



D. Vasileska, W. J. Gross, and **D.K. Ferry**, "Monte-Carlo particle-based simulations of deep-submicron n-MOSFETs with real-space treatment of electron-electron and electron-impurity interactions," *Superlattices and Microstructures*, Vol. 27, pp. 147-157 (2000).

Quantum Correction: Effective Potential



D. K. Ferry, *Superlatt. Microstruc.* **27**, 59 (2000).

In principle, the effective role of the potential can be rewritten in terms of the non-local density as:

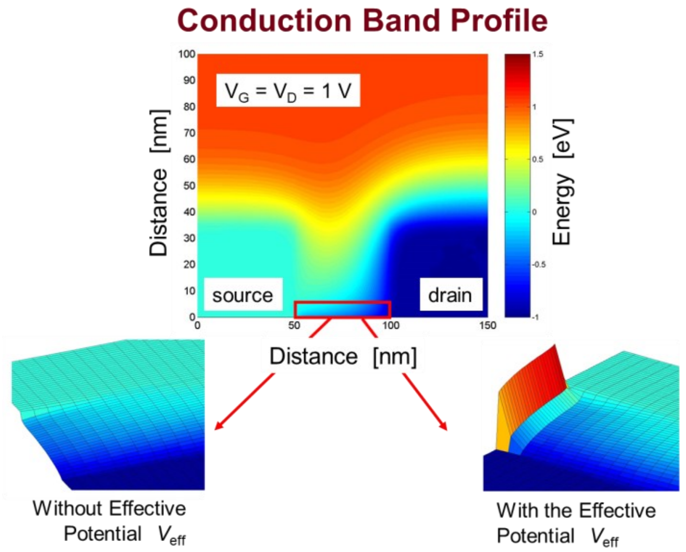
$$\bar{V} = \int d\boldsymbol{r} V(\boldsymbol{r}) \sum_i n_i(\boldsymbol{r})$$

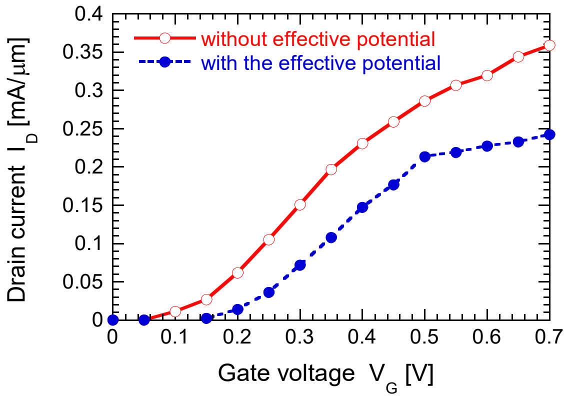
$$\sim \int d\boldsymbol{r} V(\boldsymbol{r}) \sum_i \int d\boldsymbol{r}' \exp\left(-\frac{|\boldsymbol{r}-\boldsymbol{r}'|^2}{\alpha^2}\right) \delta(\boldsymbol{r}'-\boldsymbol{r}_i)$$

$$\sim \sum_i \int d\boldsymbol{r} \delta(\boldsymbol{r}-\boldsymbol{r}_i) \int d\boldsymbol{r}' V(\boldsymbol{r}') \exp\left(-\frac{|\boldsymbol{r}-\boldsymbol{r}'|^2}{\alpha^2}\right)$$

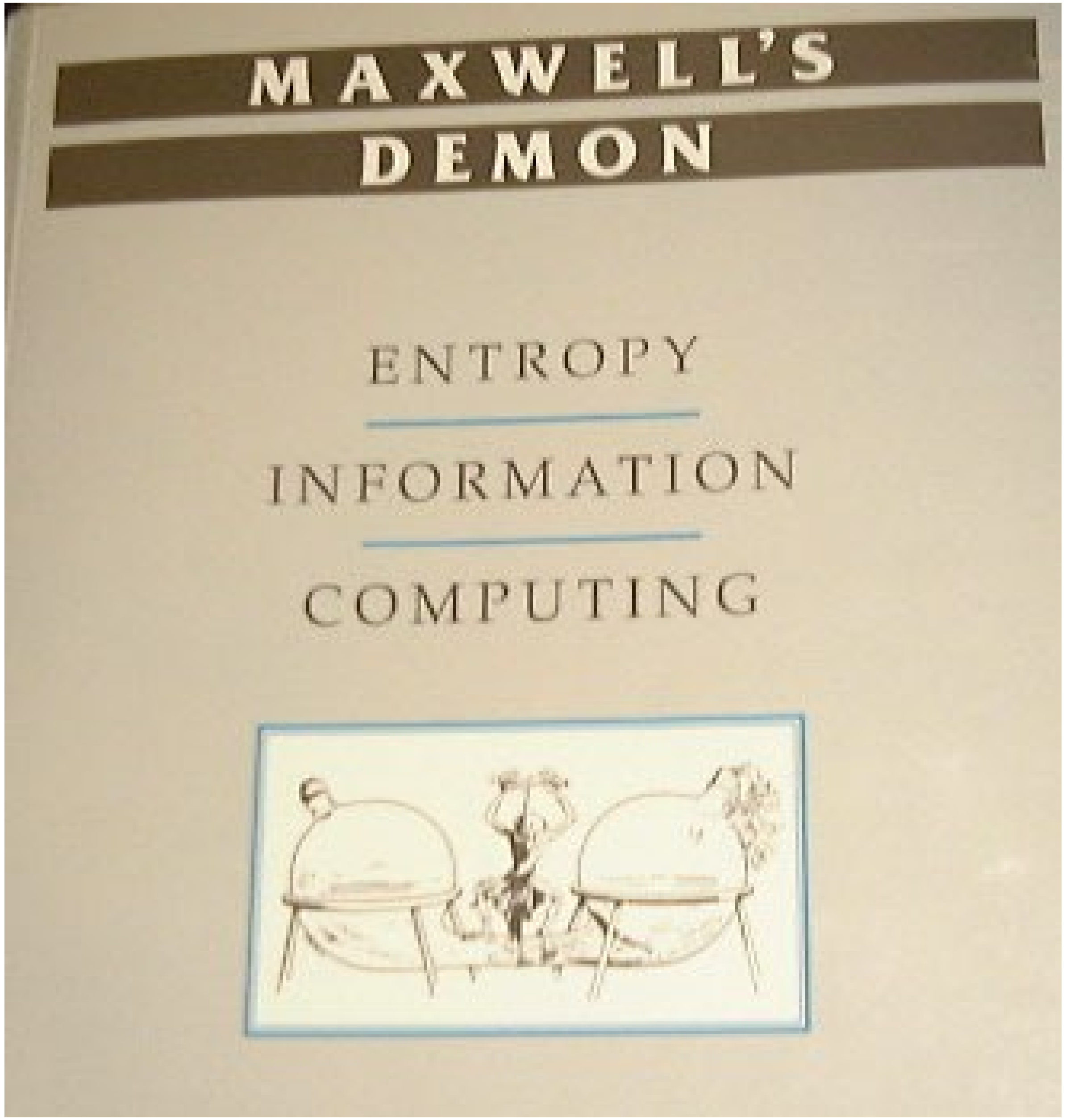
$$\sim \sum_i \int d\boldsymbol{r} \delta(\boldsymbol{r}-\boldsymbol{r}_i) V_{eff}(\boldsymbol{r})$$

Smoothed, effective potential





D. K. Ferry, R. Akis, and D. Vasileska, Quantum Effects in MOSFETs: Use of an Effective Potential in 3D Monte Carlo Simulation of Ultra-Short Channel Devices, IEDM Tech. Dig. (IEEE Press, New York, 2000) pp. 287-290.



Maxwell's Demon: Entropy, Information, Computing. H. Leff and A. F. Rex (IoP 1990).

Physics of Computation

- Computers, as Physical Objects, are subject to the Laws of Physics
- Do the Laws of Physics impose Limits on Computation?

Entropy and Information

- “Arrow of Time”
- Thermodynamics
- Entropy

INFORMATION IS PHYSICAL

There are no unavoidable energy consumption requirements per step in a computer. Related analysis has provided insights into the measurement process and the communications channel, and has prompted speculations about the nature of physical laws.

Rolf Landauer

Must information be discarded in computation, communication and the measurement process? This question has physical importance because discarding a bit of information requires energy dissipation of order kT. **Figure 1**

physical systems. A good many investigators have studied measures of complexity, attempting to quantify that intuitive notion. Much of this enterprise is motivated

unlimited registers or unlimited memory-addressing machinery. At any one step of a Turing machine computation, only a very limited number of bits in close functional and spatial relationship, are subject to change. The Turing machine embodies, in a striking manner, a requisite of a reasonable computer: The designer of the machine needs to understand only the function carried out

Rolf Landauer is an IBM Fellow at the Thomas J. Watson Research Center, in Yorktown Heights, New York

UNIVERSITY OF NOTRE DAME

Irreversibility and Heat Generation in the Computing Process

Abstract: It is argued that computing machines inevitably involve devices which perform logical functions that do not have a single-valued inverse. This logical irreversibility is associated with physical irreversibility and requires a minimal heat generation, per machine cycle, typically of the order of kT for each irreversible function. This dissipation serves the purpose of standardizing signals and making them independent of their exact logical history. Two simple, but representative, models of bistable devices are subjected to a more detailed analysis of switching kinetics to yield the relationship between speed and energy dissipation, and to estimate the effects of errors induced by thermal fluctuations.

1. Introduction

The search for faster and more compact computin cuits leads directly to the question: What are the ult physical limitations on the progress in this directio practice the limitations are likely to be set by the ne access to each logical element. At this time, howeve still hard to understand what physical requirement puts on the degrees of freedom which bear inform The existence of a storage medium as compact a genetic one indicates that one can go very far i direction of compactness, at least if we are prepar make sacrifices in the way of speed and random a

Without considering the question of access, how we can show, or at least very strongly suggest, that mation processing is inevitably accompanied by a c minimum amount of heat generation. In a genera this is not surprising. Computing, like all processes ceeding at a finite rate, must involve some dissip Our arguments, however, are more basic than this show that there is a minimum heat generation, inde ent of the rate of the process. Naturally the amou heat generation involved is many orders of magn smaller than the heat dissipation in any practically ceivable device. The relevant point, however, is tha dissipation has a real function and is not just an unn sary nuisance. The much larger amounts of dissipati practical devices may be serving the same function

Our conclusion about dissipation can be anticipa several ways, and our major contribution will be a ening of the concepts involved, in a fashion which give some insight into the physical requirements for cal devices. The simplest way of anticipating our co sion is to note that a binary device must have at leas

International Journal of Theoretical Physics, Vol. 21, No. 12, 1982

The Thermodynamics of Computation—a Review

Charles H. Bennett

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Received May 8, 1981

Computers may be thought of as engines for transforming free energy into waste heat and mathematical work. Existing electronic computers dissipate energy vastly in excess of the mean thermal energy kT, for purposes such as maintaining volatile storage devices in a bistable condition, synchronizing and standardizing signals, and maximizing switching speed. On the other hand, recent models due to Fredkin and Toffoli show that in principle a computer could compute at finite speed with zero energy dissipation and zero error. In these models, a simple

Dissipation in Computation

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(Received 8 June 1983)

The question of the energy dissipation in the computational process is considered. Contrary to previous studies, dissipation is found to be an integral part of computation. A complementarity is suggested between systems that are describable in thermodynamic terms and systems that can be used for computation.

PACS numbers: 89.80.+h, 89.70.+c, 06.50.-x

Every numerical computation, no matter how abstract, is ultimately bound to limits imposed by physical processes that occur in the real world. A question therefore arises as to whether or not the physical laws that govern the appropriate processes impose constraints on computation. This question has recently attracted considerable attention with regard to the minimum energy required for a bit manipulation.[1,2] All known computational systems, including biological ones, are dissipative, and it was suggested quite early that the computational (or physical) processes which really require energy dissipation lead to a minimum energy loss per step of[3,4]

$$kT \log_e 2. \qquad (1)$$

Landauer[3] arrived at (1) through an argument that most computation is logically irreversible and this necessarily imposes physical irreversibility *due to a loss of phase space*. The earliest ap-

sion[8] that computation can be carried out at no expense of energy, although the information-theory arguments have never been refuted.

In this paper, we point out that logical irreversibility is irrelevant for the question of the energy requirements of computation, and that the efforts based upon logical reversibility lack a physical basis. In reconsidering the concepts of computation and measurement, we conclude that computation requires a nonequilibrium system and requires dissipation. Our approach is to consider the energy requirements of single bit operations rather than the overall logical structure of the computation.

The physics of computation involves an element of measurement and interpretation at its very foundation. While the time evolution of any system can in principle be viewed as representing a numerical process, computational systems are those which implement a Turing machine,[9] the

Dissipation in Computation

Computational steps which inevitably require a minimal energy dissipation are those which discard information, and do not have a unique logical inverse.[1] Reference 1 pointed out that logic functions which lose information can be embedded in more complex functions which do have an inverse. A proper method for utilizing this embedding did not come until Bennett's invention of reversible computation,[2,3] later elaborated by other authors, cited by Landauer.[4] Wheeler and Zurek[5] give an authoritative summary of reversible computation. Porod *et al.*[6] (PGFP hereafter) take issue with all this literature.[1–5] PGFP is confined to general arguments and does not explain, in detail, where the specific reversible computer proposals, e.g., that of Likharev,[7] go astray. We will try to rebut a few PGFP points. Some of these points will be identified by quotations from Ref. 6, and refuted, largely, by citing the literature. We discuss only the case of classical and noisy computers, with viscous friction, at a temperature $T \neq 0$.

PGFP repeatedly refer to measurement, and its supposed dissipation, as an unavoidable ingredient in *each* computational step. From Ref. 1, "In fact the arguments dealing with the measurement process do not define *measurement* very well, and avoid the very essential question: When is a system *A* coupled to a system *B* performing a measurement? The mere fact that two physical systems are coupled does not in itself require dissipation." Reference 3 gives a discussion of the measurement process, which does justice to the reservation just stated. Reference 5 confirms the possibility of reversible computation in a book devoted to the theory of measurements. PGFP go on, "The amount of energy dissipated . . . has to increase for increasing accuracy." Rebuttal of this same mistake, by an earlier author,[10] was given in Ref. 11.

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Received 23 March 1984

Porod *et al.* Respond: The school of dissipationless computation[1] assumes that there are two distinct sources of dissipation in computation: (1) dissipation due to the erasure of information; (2) dissipation due to thermal noise. Supposedly, thermodynamically reversible computation can be achieved by avoiding the operations which discard informa-

but finite, speeds.

Measurement, which is required for each bit operation, must be described by an application of information theory (or statistical mechanics), which indicates a dissipation because Brownian motion affects all kinds of measuring devices. Landauer is correct that merely coupling two systems together

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ENERGY BARRIERS, DEMONS, AND MINIMUM ENERGY OPERATION OF ELECTRONIC DEVICES

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The presence of thermal noise dictates that an energy barrier is needed to preserve a binary state. Therefore, all electronic devices contain at least one energy barrier to control electron flow. The barrier properties determine the operating characteristics of electronic devices. Furthermore, changes in the barrier shape require changes in charge density. Operation of all charge transport devices includes charging/discharging capacitances to change barrier height. We analyze energy dissipation for several schemes of charging capacitors. A basic assumption of Reversible Computing is that the computing system is completely isolated from the thermal bath. An isolated system is a mathematical abstraction never perfectly realized in practice. Errors due to thermal excitations are equivalent to information erasure, and thus computation dissipates energy. Another source of energy dissipation is due to the need of measurement and control. To analyze this side of the problem, the Maxwell's Demon is a useful abstraction. We hold that apparent "energy savings" in models of adiabatic circuits result from neglecting the total energy needed by other parts of the system to implement the circuit.

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Underground with a *Heart*

Thank YOU, Dave!

nd Joy Barker

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Lucien Shifren

I spent 5 long long years in the group but was involved with Prof. Ferry for a year as an undergrad too. So I actually had time to escape after meeting him for the first time, but chose not to. Although I completely hate the oppressive heat of Arizona, I loved my time at ASU and especially my time in graduate school. Looking back, while I have moved into more business and strategic roles, it is not the physics and the deep philosophical conversation that are most important in my life, it was the attitude I learnt. Pick a big problem, start picking away at it, don't b*!*$t, work hard, there is no time for h*!%&$t and never, ever, under any circumstances get involved with p*!&#t, the worst of all the s*&%@s (yes folks, the man taught me his s*##!t hierarchy).

I have two favorite stories from grad school. Probably my favorite story is sitting down for lunch with Prof. Ferry and Klaus von Klitzing in the atrium of a building in UIUC, I cannot remember if it was IWCE or HCIS, one of the two. Ferry and von Klitzing were chatting and some guy comes up and starts to huck Ferry about something. It's not library quiet, it is cafeteria noise levels. He pisses Ferry off and Ferry unleashing at full volume telling this dude where to go. I remember looking around the room, everyone was just sitting wide eyed, mouth opened. Not his students, we were all tucking into our lunch, did not phase us in the least. He made us tough.

My other story is with Prof. Ferry's obsession with Mexican food. He took me to a Mexican restaurant in Kyoto Japan. It was horrible. Everything about it was horrible. It was so horrible, I still talk about it. What a great memory😊