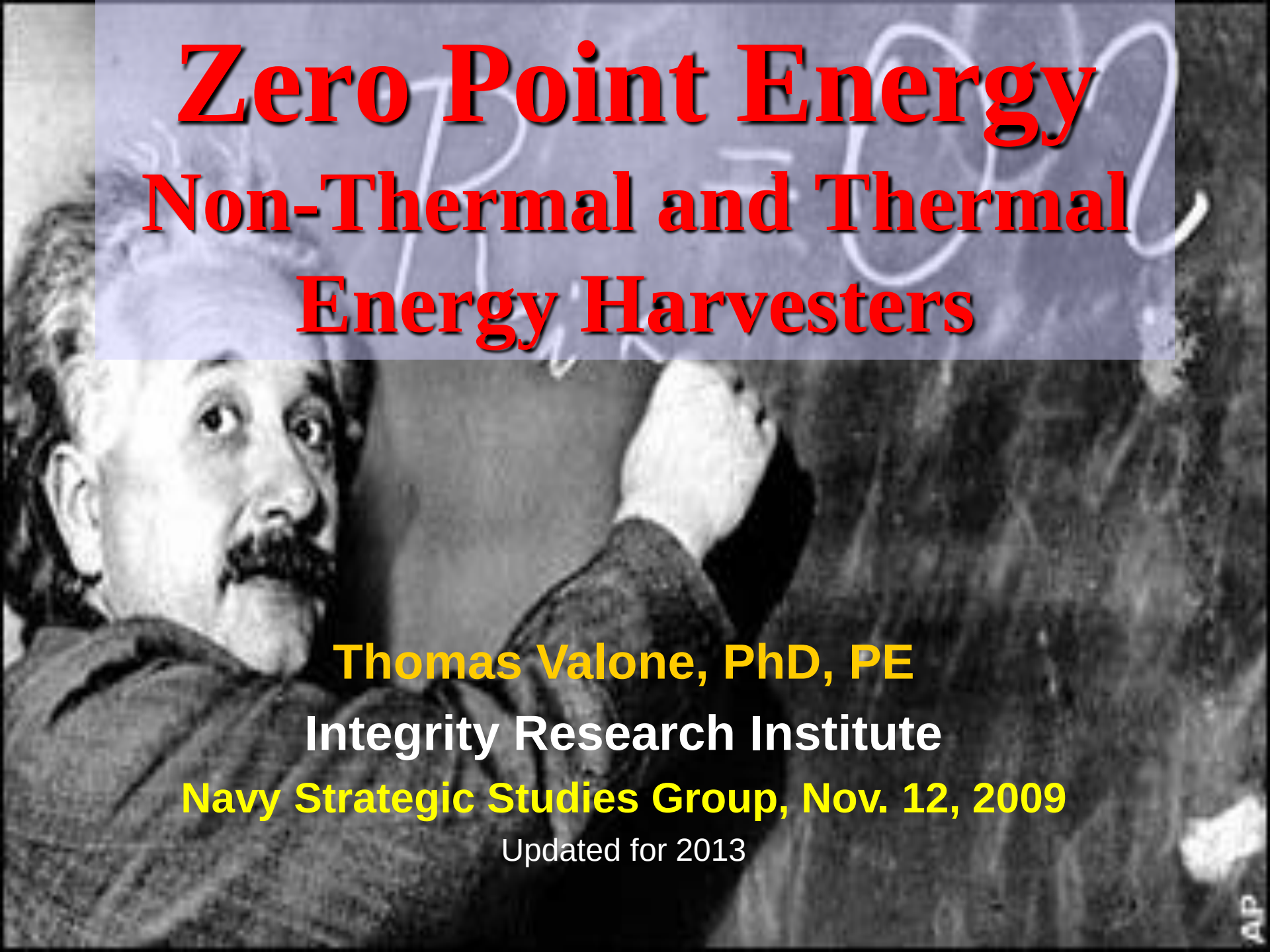
Zero Point Energy
Non-Thermal and Thermal Energy Harvesters



Thomas Valone, PhD, PE

Integrity Research Institute

Navy Strategic Studies Group, Nov. 12, 2009

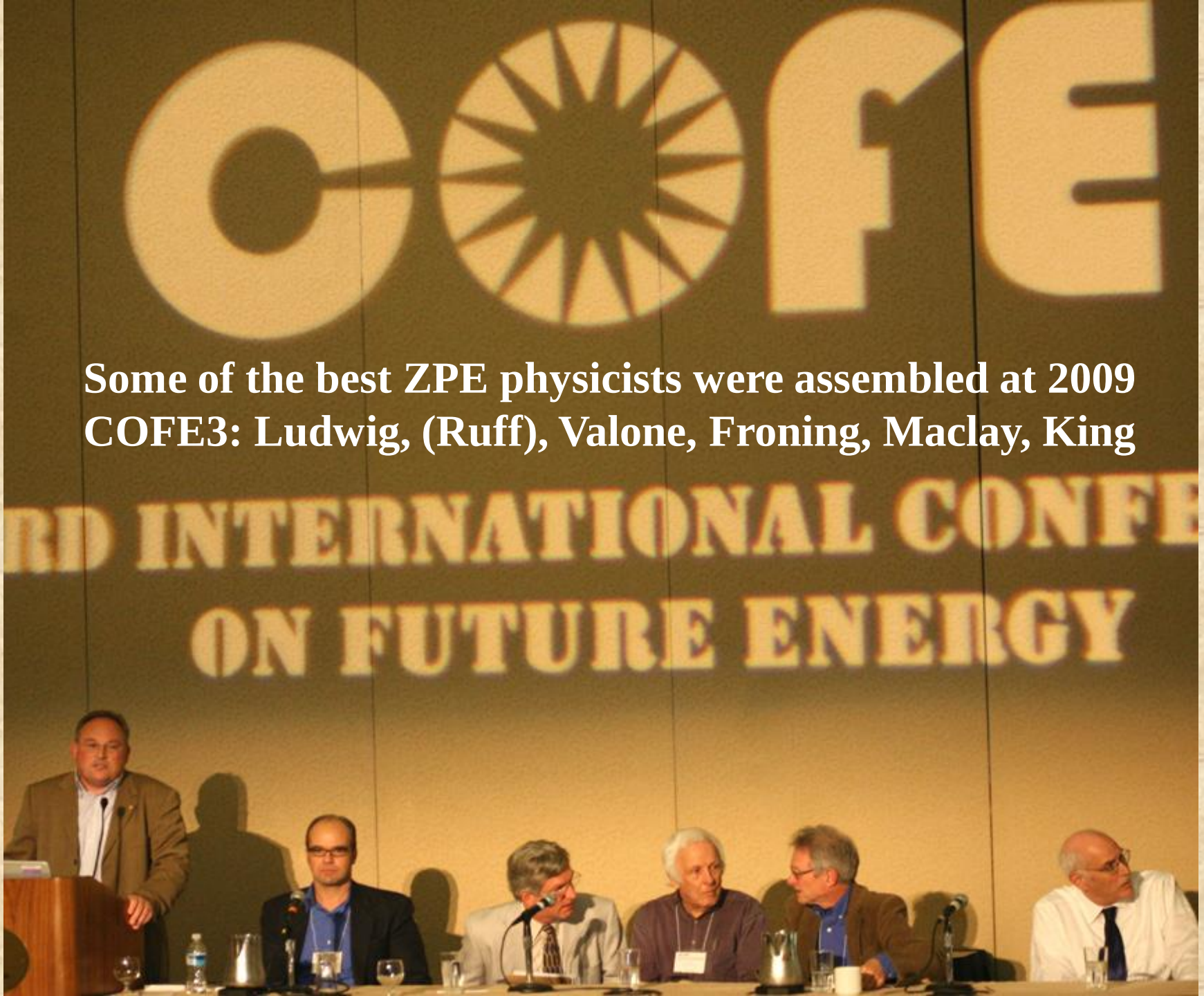
Updated for 2013

Future Energy Surge of 2009

SPESIF 2009

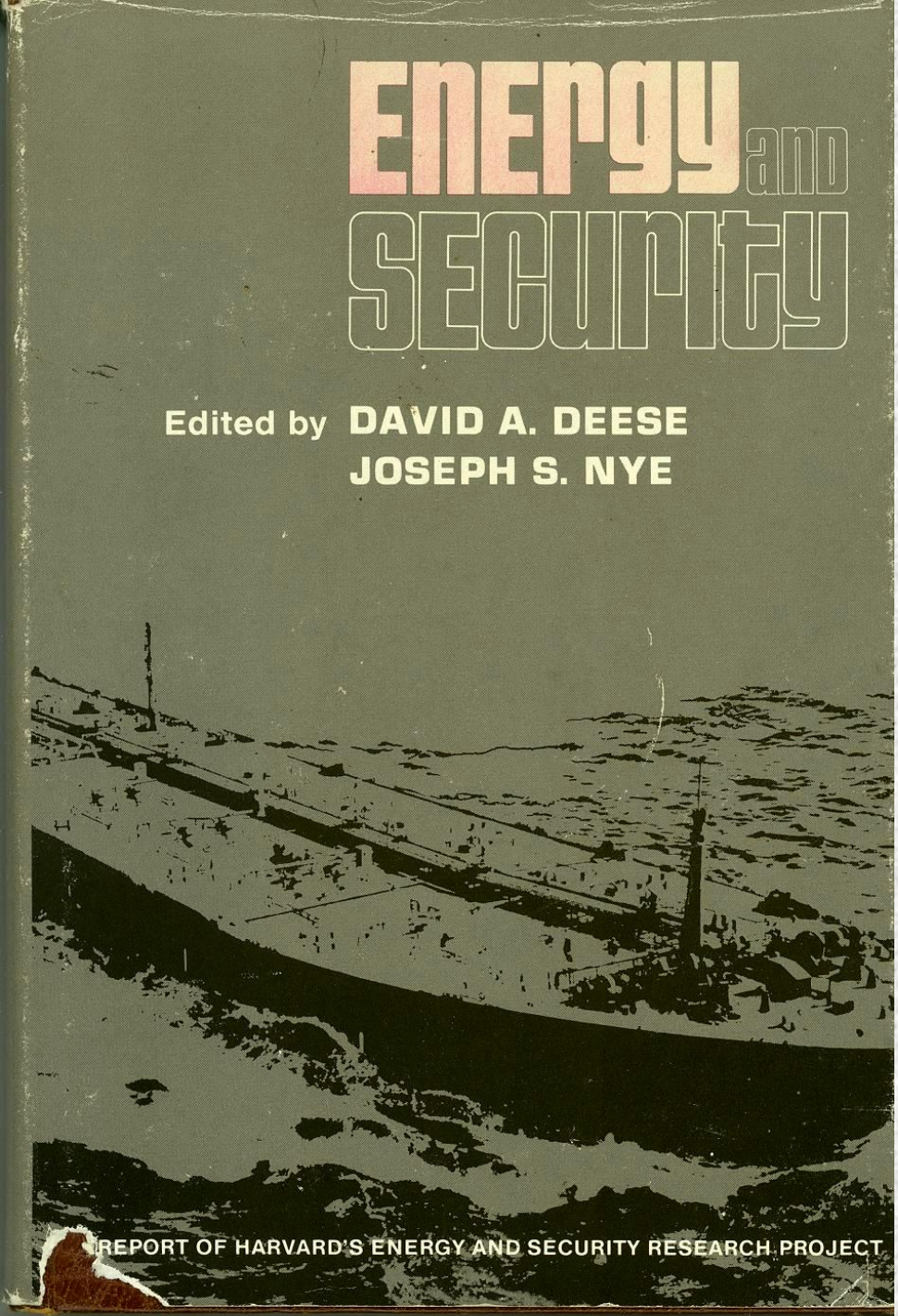
- World Future Energy Summit, Abu Dhabi, Jan. 19-21, 2009
- SPESIF Future Energy Source Workshop, Feb. 24-26, 2009
- Future Energy Forum, Bilboa, Spain, June 9-11, 2009
- Conference on Future Energy, Washington DC, Oct. 9-11, 2009 (third in a series, tenth anniversary)

IntegrityResearchInstitute.org



Some of the best ZPE physicists were assembled at 2009 COFE3: Ludwig, (Ruff), Valone, Froning, Maclay, King

IRI Future Energy Projects

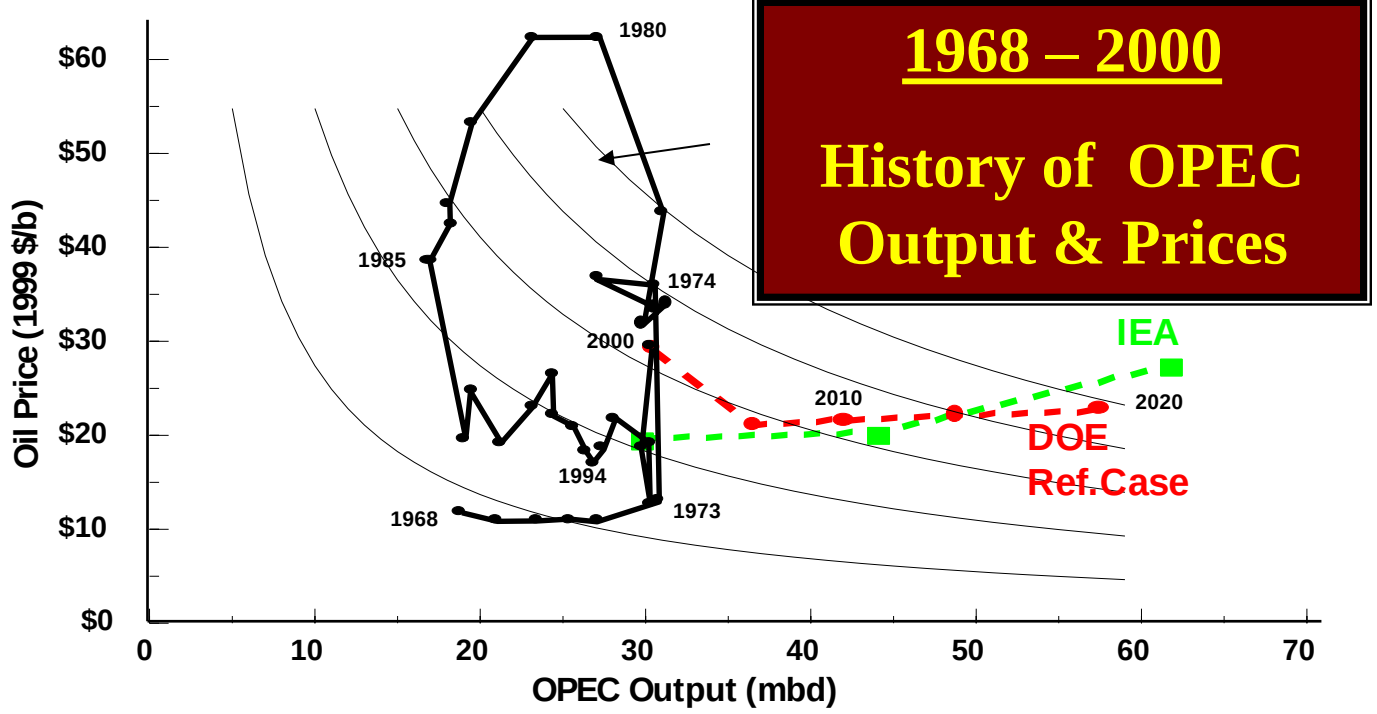


Published in 1981, mostly about oil, cites oil import quota of 1959 and a decade later: price controls

• President Jimmy Carter, 1979 – "Clear and present danger to national security"

• **IEA predicts that OPEC oil production <u>will not rise above 1970s level of 30 Mb/d</u>**

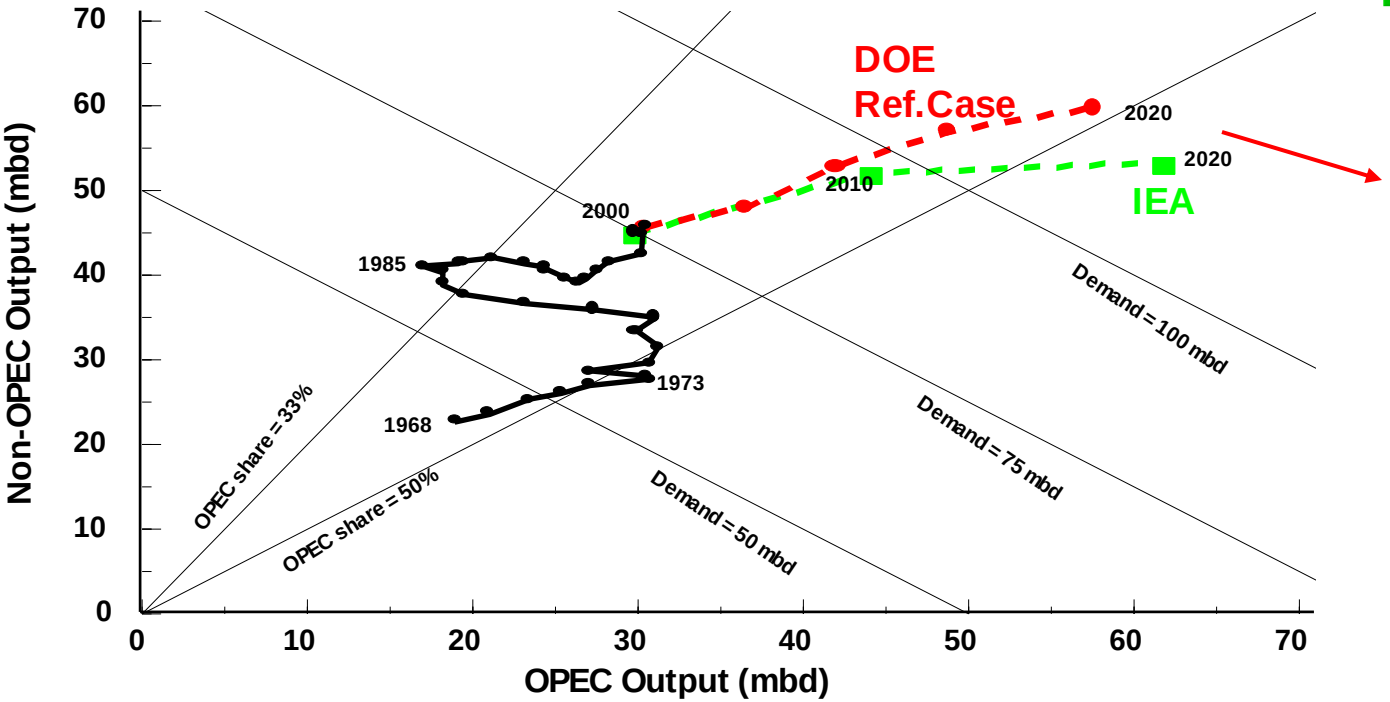
• <u>Solutions recommended</u>: stockpiles, demand restraint, conservation, non-OPEC oil, synthetic fuels, nuclear and solar energy, or else, **political and military coercion, "break OPEC"**



IEA & DOE Reference Case OPEC projections.

Dr. Dermot Gately, NYU
(DOE-EIA AEO 2001)

mbd = million barrels per day

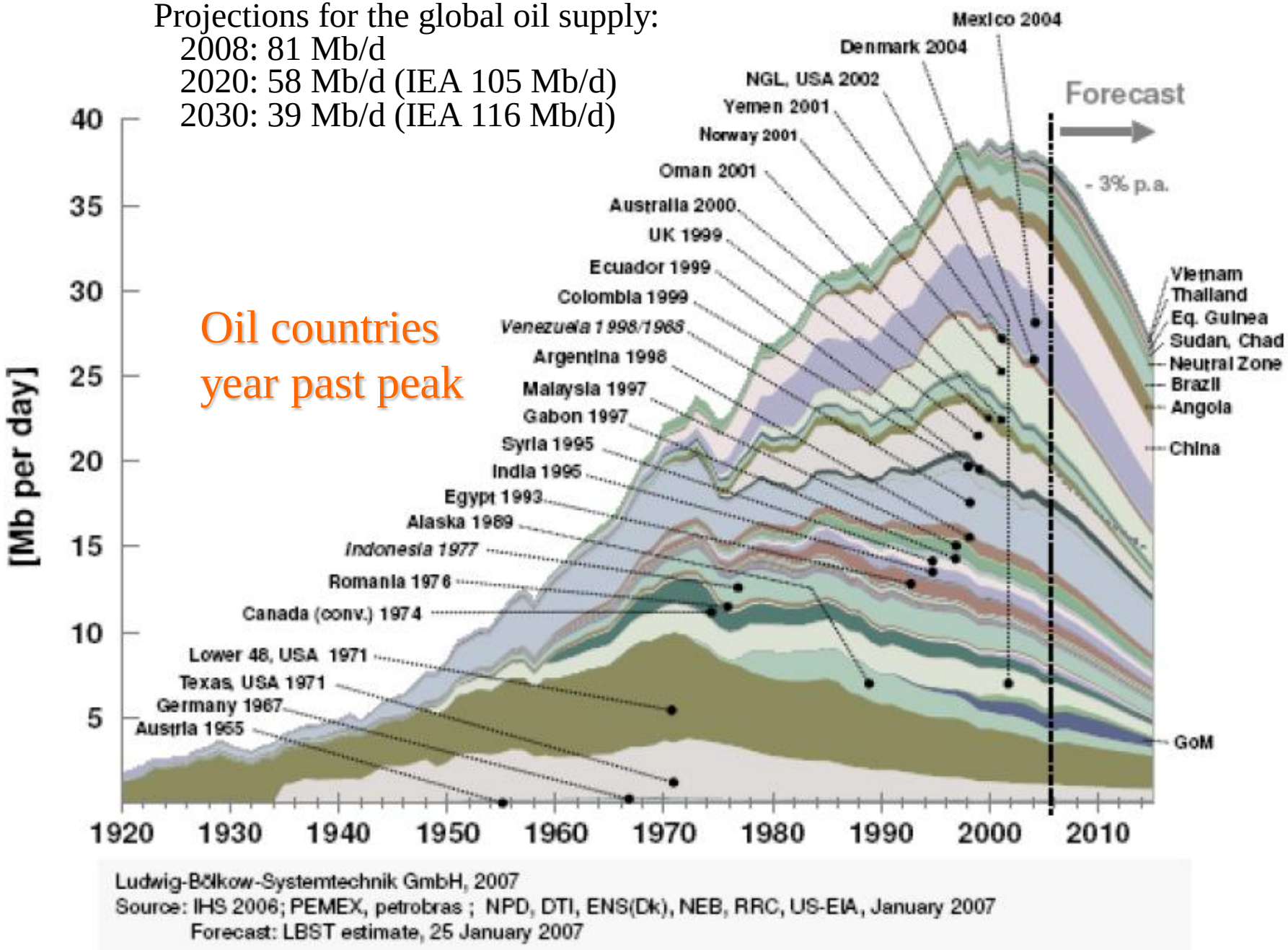


Both require huge increases in OPEC output.

Below is the world's oil production by country:

www.energywatchgroup.org

Projections for the global oil supply:
2008: 81 Mb/d
2020: 58 Mb/d (IEA 105 Mb/d)
2030: 39 Mb/d (IEA 116 Mb/d)



Ludwig-Bölkow-Systemtechnik GmbH, 2007
Source: IHS 2006; PEMEX, petrobras ; NPD, DTI, ENS(Dk), NEB, RRC, US-EIA, January 2007
Forecast: LBST estimate, 25 January 2007

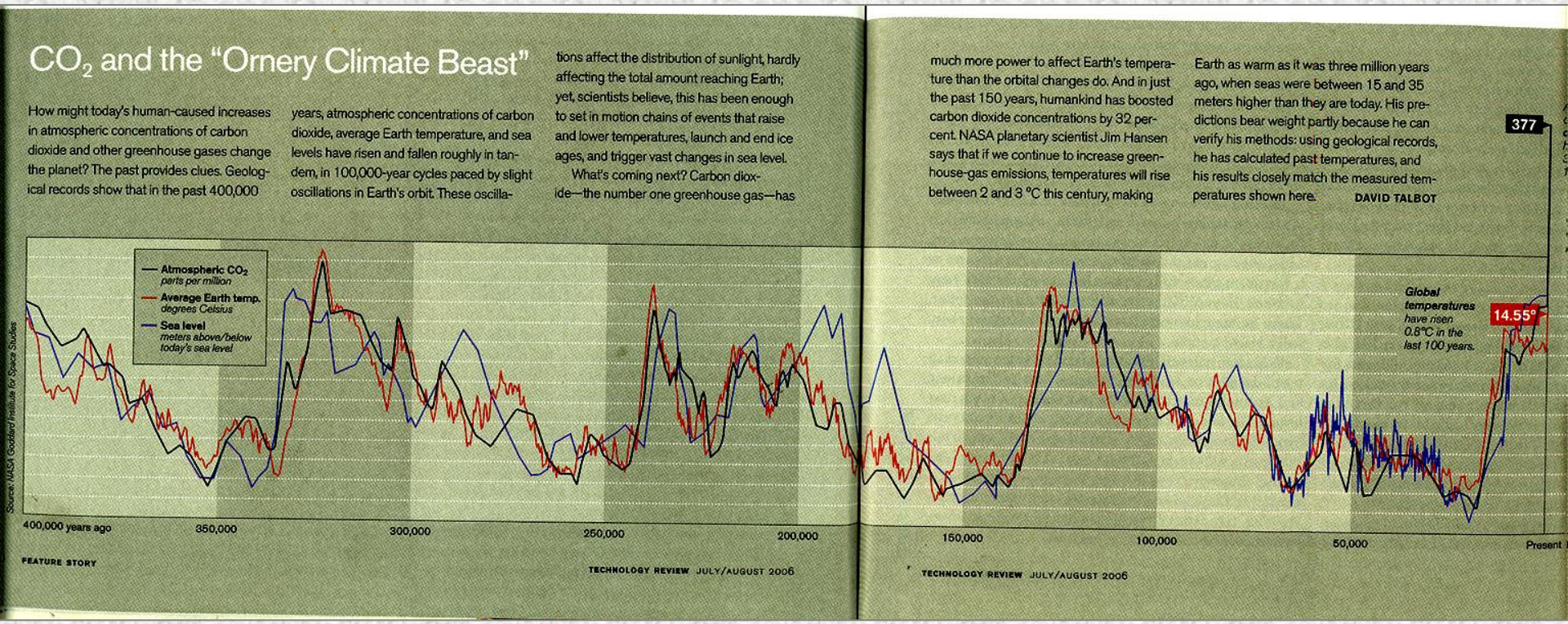
"We're pretending that business as usual will supply all our needs. But there's an impending oil crisis we're basically seeing, that will actually bite us sooner than we're expecting it and it's better to prepare for it now."

Tom Valone, June 25, 2002 - CNN Moneyline


Miscellaneous Box Sets
Jazz & Blues Box Sets
Mark Twain
NOW

Earth's Most Recent 400,000 Year Climate History

credit: Jim Hansen, NASA Goddard Inst. for Space Studies



CO_2 and the "Ornery Climate Beast"

How might today's human-caused increases in atmospheric concentrations of carbon dioxide and other greenhouse gases change the planet? The past provides clues. Geological records show that in the past 400,000 years, atmospheric concentrations of carbon dioxide, average Earth temperature, and sea levels have risen and fallen roughly in tandem, in 100,000-year cycles paced by slight oscillations in Earth's orbit. These oscillations affect the distribution of sunlight, hardly affecting the total amount reaching Earth; yet, scientists believe, this has been enough to set in motion chains of events that raise and lower temperatures, launch and end ice ages, and trigger vast changes in sea level.

What's coming next? Carbon dioxide—the number one greenhouse gas—has much more power to affect Earth's temperature than the orbital changes do. And in just the past 150 years, humankind has boosted carbon dioxide concentrations by 32 percent. NASA planetary scientist Jim Hansen says that if we continue to increase greenhouse-gas emissions, temperatures will rise between 2 and 3 °C this century, making Earth as warm as it was three million years ago, when seas were between 15 and 35 meters higher than they are today. His predictions bear weight partly because he can verify his methods: using geological records, he has calculated past temperatures, and his results closely match the measured temperatures shown here. DAVID TALBOT

MIT's *Technology Review*, July/August, 2006

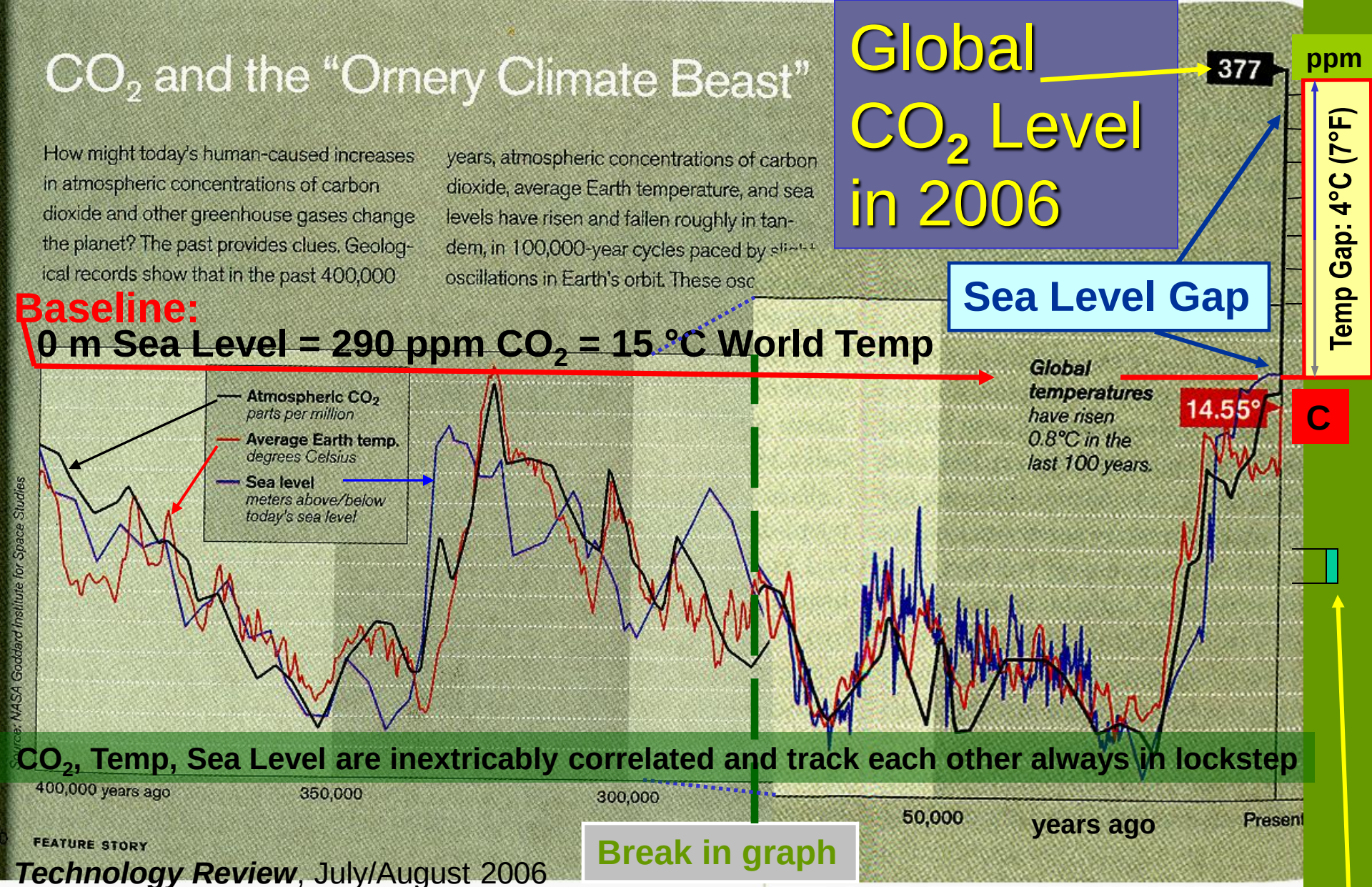
CO_2 and the "Ornery Climate Beast"

How might today's human-caused increases in atmospheric concentrations of carbon dioxide and other greenhouse gases change the planet? The past provides clues. Geological records show that in the past 400,000 years, atmospheric concentrations of carbon dioxide, average Earth temperature, and sea levels have risen and fallen roughly in tandem, in 100,000-year cycles paced by slight oscillations in Earth's orbit. These osc

Global CO_2 Level in 2006

Baseline:
0 m Sea Level = 290 ppm CO_2 = 15 °C World Temp

Sea Level Gap



CO_2, Temp, Sea Level are inextricably correlated and track each other always in lockstep

FEATURE STORY

Technology Review, July/August 2006

Break in graph

Projected Sea Level Rise is 80 meters

KEY to graph: 10 ppm = 0.5°C = 10 meters

- - - Graph enhancements by Thomas Valone, PhD, PE
November, 2006

A WORLD 4 °C WARMER

It may happen in our lifetime. Shanta Barley investigates what life will be like

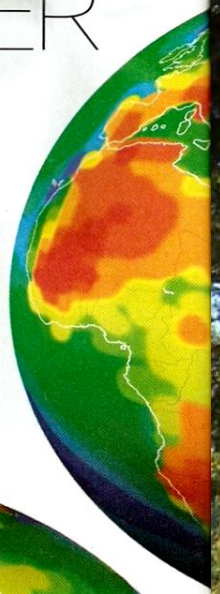
BY 2055, climate change is likely to have warmed the world by a dangerous 4 °C unless we stop pumping greenhouse gases into the atmosphere the way we do now. This is the startling conclusion of a study by the UK Met Office, unveiled at a conference in Oxford this week.

Why so soon? Because temperature rises caused by greenhouse gas emissions are expected to trigger dangerous feedback loops, which will release ever increasing amounts of greenhouse gases. The nature and scale of these feedback loops is a subject of vigorous debate among climate scientists, but warmer oceans, for instance, may liberate more dissolved CO_2, and plants may decay faster in a warmer climate. The Met Office ran 17 different models with these feedbacks. All concluded a 4 °C world by 2055 was likely if emissions continue to rise. Even if we are lucky, we are still likely to hit 4 °C by 2070.

What will a 4 °C world look like? Brace yourself: the picture painted by the 130 climate researchers at the Oxford conference is not pretty. An average global increase of 4 °C translates to a rise of up to 15 °C at the North Pole. Summers in parts of the Arctic would be as balmy as California's Napa valley. Sea levels would rise by up to 1.4 metres, according to Stefan Rahmstorf at the Potsdam Institute for Climate Impact Research, Germany. Even the less pessimistic estimate of a 0.65-metre rise by 2100 would put at least 190 million people a year at risk from floods, says Rahmstorf's colleague Jochen Hinkel.

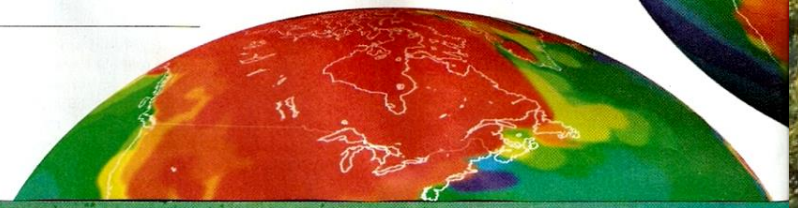
The glimmer of hope? It doesn't have to be this way. If politicians at the UN climate change talks in December agree to cut emissions by 3 per cent every year, the world can limit temperature rise to a "safe" 2 °C, the Met Office says.

To find out more about a world that's 4 °C warmer, visit www.newscientist.com/article/dn17864



The Amazon – gone

In a 4°C world, climate change, deforestation and fires spreading from degraded land into pristine forest will conspire to destroy over 83 per cent of the Amazon rainforest by 2100, according to climatologist Wolfgang Cramer at the Potsdam Institute for Climate Impact Research in Germany. His climate models show global warming alone



PRIZE FIGHT
Time to revamp the Nobels

PHANTOM STORMS
How weather leaks into space

MY LITTLE ZEBRA
We should domesticate more animals

NewScientist

WEEKLY October 3 - 9, 2009

Oct. 3-9, 2009

Future Earth

National Security and Climate Change
CNA.org, 2007

NATIONAL SECURITY AND THE THREAT OF CLIMATE CHANGE

To the reader,

During our decades of experience in the U.S. military, we have addressed many national security challenges, from containment and deterrence of the Soviet nuclear threat during the Cold War to terrorism and extremism in recent years.

Global climate change presents a new and very different type of national security challenge.

Over many months and meetings, we met with some of the world's leading climate scientists, business leaders, and others studying climate change. We viewed their work through the lens of our military experience as warfighters, planners, and leaders. Our discussions have been lively, informative, and very sobering.

Science Times

The New York Times

Jan 21, 1997

TUESDAY, JANUARY 21, 1997

Physicists Confirm Power of Nothing, Measuring Force of Quantum 'Foam'

Fluctuations in the vacuum are the universal pulse of existence.

By MALCOLM W. BROWNE

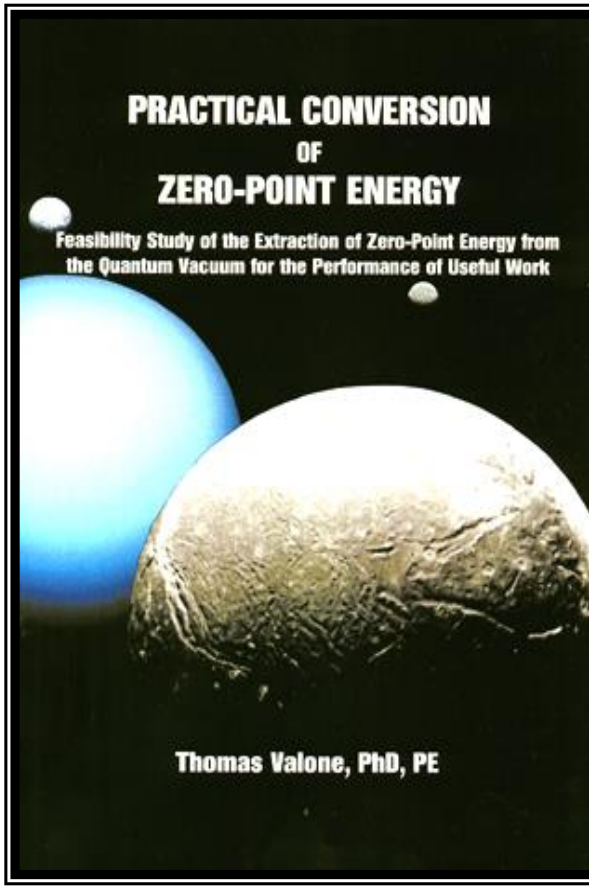
FOR a half century, physicists have known that there is no such thing as absolute nothingness, and that the vacuum of empty space, devoid of even a single atom of matter, seethes with subtle activity. Now, with the help of a pair of metal plates and a fine wire, a scientist has directly measured the force exerted by fleeting fluctuations in the vacuum that pace the universal pulse of existence.

The sensitive experiment performed at the University of Washington in Seattle by Dr. Steve K. Lamoreaux, an atomic physicist who is now at Los Alamos National Laboratory, was described in a recent issue of the journal Physical Review Letters. Dr. Lamoreaux's results almost perfectly matched theoretical predictions based on quantum electrodynamics, a theory that touches on many of the riddles of existence and on the origin and fate of the universe.

The theory has been wonderfully accurate in predicting the results of subatomic particle experiments, and it has also been the basis of speculations verging on science fiction. One of the wilder ones is the possibility that the universal vacuum — the ubiquitous empty space of the universe — might actually be a false vacuum.

If that were so, something might cause the present-day universal vacuum to collapse to a different vacuum of a lower energy. The effect, propagating at the speed of light, would be the annihilation of all matter in the universe. There would be no warning for humankind; the earth and its inhabitants would simply cease to exist at

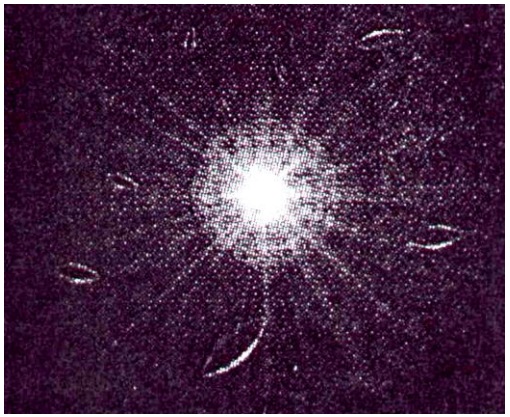
Continued on Page C6



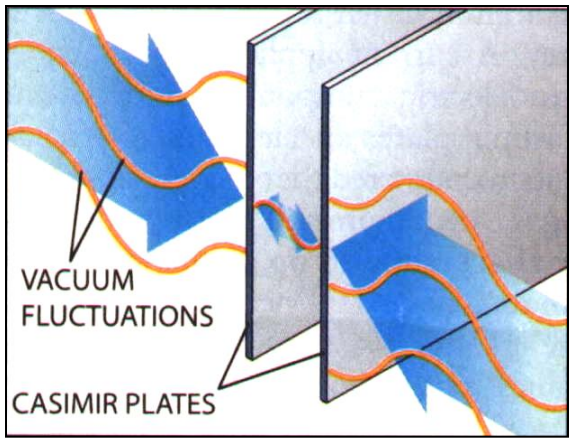
The Quantum Vacuum

Quantum fluctuations of the vacuum create virtual particles (real for an instant) that produce shielding & mechanical force

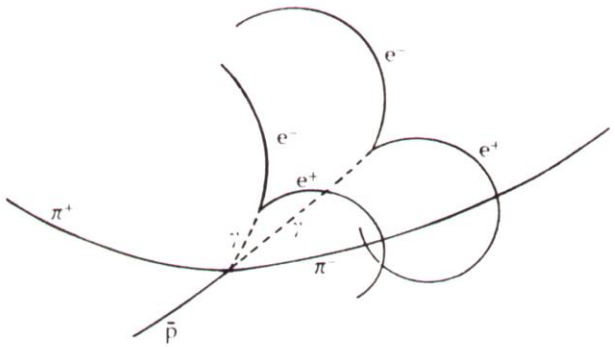
- Zero-point energy is not conserved
- Helium stays liquid < 1°K
- ZPE density = 220 erg/cc in optical region



Koltick experiment

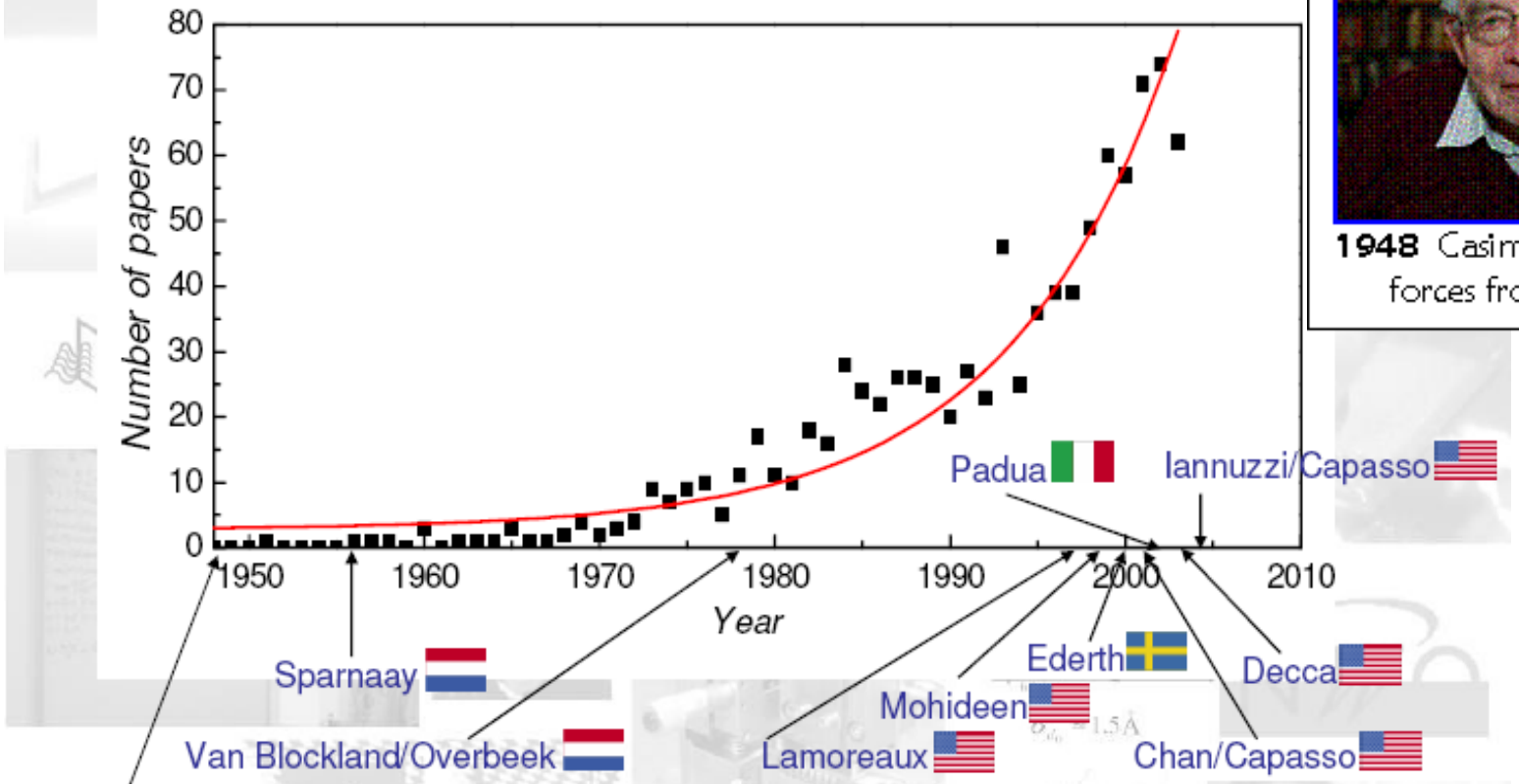


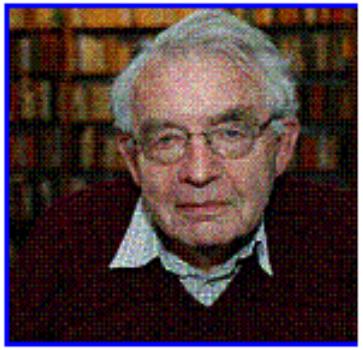
Casimir force pushes



Casimir Made ZPE Popular

The Casimir effect: history of a paper





1948 Casimir predicts forces from ZPE

H. B. G. Casimir, *Proc. K. Ned. Akad. Wet.* **51** (1948) 793

Feasibility of Extracting ZPE

Thomas Valone, PhD Thesis: Kennedy-Western Univ., Sept., 2003

Zero Point Energy

(Emerging science, 1948...)

What?

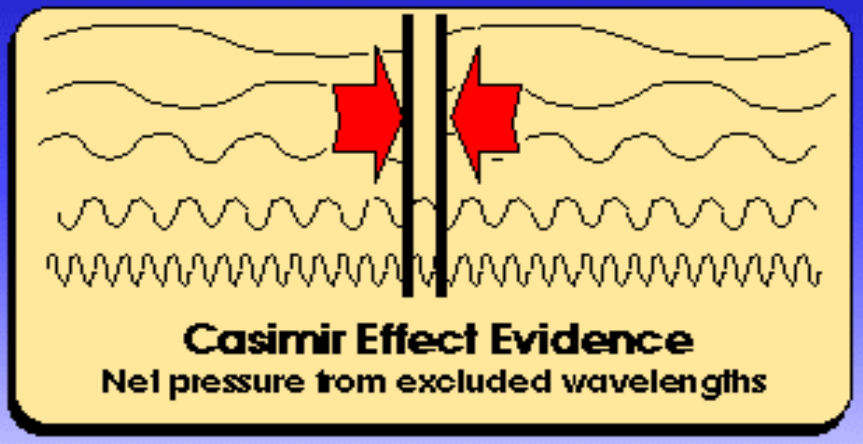
- Random Electromagnetic waves remain after all energy is removed
- Enormous energy density: 10^{24} to 10^{58} Joules/m^3
- Theorized to indirectly cause gravity and inertia

Why?

- As an energy source?
- As a reactive medium?

Evidence?

- Casimir Effect
- Plank blackbody spectrum
- quantum effects



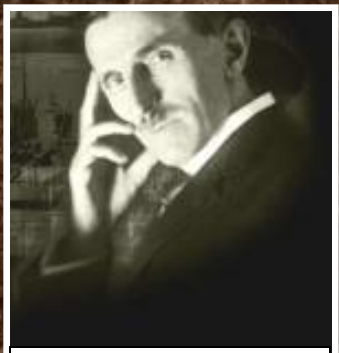
Casimir Effect Evidence

Net pressure from excluded wavelengths

www.grc.nasa.gov

CD-94-68607

The Men Who Made ZPE



1891 Tesla predicts ZPE existence

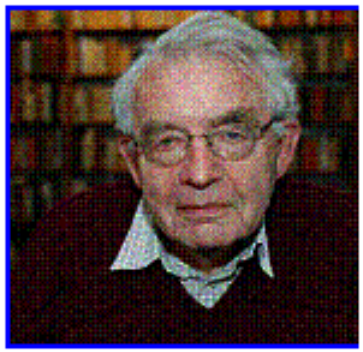
1912 Planck discovers ½hf

1913 Einstein uses ZPE term

1927 Heisenberg is very uncertain

1928 Dirac posits positron

1947 Lamb measures ZPE



1948 Casimir predicts forces from ZPE

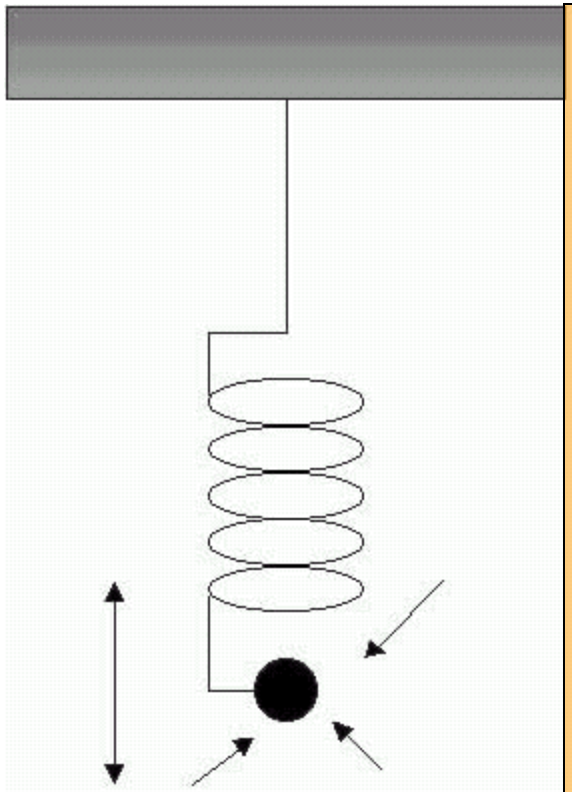
1963 Feynmann diagrams ZPE

1996 Mead gets a ZPE patent

1999 Pinto invents a ZPE engine

Valone, ***Zero Point Energy: The Fuel of the Future***

Zero-Point Energy Basics



- **1912 Planck's 2nd radiation law:**
- $E(f,T) = \frac{1}{2}hf + hf/(e^{hf/kT} - 1)$
- Energy of elementary radiator
- First term (lowest energy) = ZPE
- Birth of concept of ZPE
- ZPE = random fluctuation
  photons, particles and fields

Note: f = frequency; h = Planck's constant = 6.6×10^{-34} joule-sec

The Quantum Vacuum

Introduction to Quantum Electrodynamics
(the best textbook on ZPE) by Peter Milonni

- Virtual photons carry momentum hk/π
- Quantum vacuum and radiation reaction induce spontaneous emission (50% share)
- Effects cancel in the lower atomic state: spontaneous absorption = 0
- Fluctuation-dissipation theorem: If system provides irreversible energy flow, then fluctuations must come too
- ZPE = universe in size of proton
- Davies-Unruh: uniform acceleration is same as thermal bath where $T = ha/4\pi^2kc$
- Electron has finite size; no runaway solutions to Abraham-Lorenz
- Atom can "see" mirror nearby: instant affect on spontaneous emission rate

PHYSICAL REVIEW A VOLUME 49, NUMBER 2 FEBRUARY 1994

Inertia as a zero-point-field Lorentz force

Bernhard Haisch
Lockheed Palo Alto Research Laboratory, Division 91-30, Building 252, 3251 Hanover Street, Palo Alto, California 94304
and Max-Planck-Institut für Extraterrestrische Physik, D-85740 Garching, Germany

PHYSICAL REVIEW D VOLUME 35, NUMBER 10 15 MAY 1987

Ground state of hydrogen as a zero-point-fluctuation-determined state

H. E. Puthoff
Institute for Advanced Studies at Austin, Austin, Texas 78746
(Received 22 December 1986)

PHYSICAL REVIEW E VOLUME 48, NUMBER 2 AUGUST 1993

Extracting energy and heat from the vacuum

Daniel C. Cole
IBM Corporation, Essex Junction, Vermont 05452-4299

Harold E. Puthoff
Institute for Advanced Studies at Austin, 4030 Braker Lane West, Suite 300, Austin, Texas 78759-5329
(Received 22 March 1993)

J. PHYS. A (GEN. PHYS.), 1969, SER. 2, VOL. 2. PRINTED IN GREAT BRITAIN

A note on the role of zero-point energy in evolutionary cosmology

N. KUMAR†
Physics Department, University of British Columbia, Vancouver, B.C., Canada
MS. received 21*st June* 1968, *in revised form* 18*th November* 1968

Abstract. Following a suggestion originally due to McCrea, a physical vaccum is regarded as the ground state of a certain quantized field obeying Bose statistics. Under certain assumptions regarding the physical nature of the zero-point energy (assumed to be essentially positive) associated with the Bose field, the latter is found

United States Air Force Research Laboratory
Propulsion Directorate

Dr. Franklin B. Mead, Jr.
Senior Scientist
Advanced Concepts & Enigmatic Sciences

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FAX: (805) 275-5471
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Edwards AFB, CA
93524-7002

US005590031A

United States Patent [19]
Mead, Jr. et al.

[11] **Patent Number: 5,590,031**
[45] **Date of Patent: Dec. 31, 1996**

[54] **SYSTEM FOR CONVERTING ELECTROMAGNETIC RADIATION ENERGY TO ELECTRICAL ENERGY**

[76] Inventors: **Franklin B. Mead, Jr.**, 44536 Avenida Del Sol, Lancaster, Calif. 93535; **Jack Nachamkin**, 12314 Teri Dr., Poway, Calif. 92064

[21] Appl. No.: **281,271**

[22] Filed: **Jul. 27, 1994**

[51] **Int. Cl.**[6] **H02M 1/00**
[52] **U.S. Cl.** **363/8**; 363/178; 342/6
[58] **Field of Search** 363/8, 13, 178; 342/6, 61, 73, 173, 175

[56] **References Cited**

U.S. PATENT DOCUMENTS

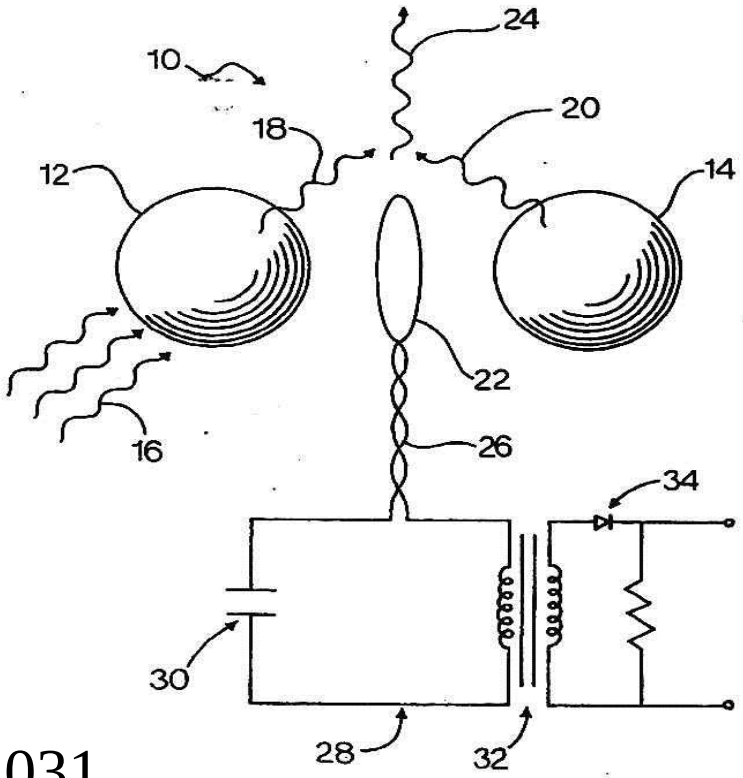
3,882,503	5/1975	Gamara	343/100 R
4,725,847	2/1988	Poirier	343/840
5,008,677	4/1991	Trigon et al.	342/17

Primary Examiner—Peter S. Wong
Assistant Examiner—Adolf Berhane
Attorney, Agent, or Firm—Chris Papageorge

[57] **ABSTRACT**

A system is disclosed for converting high frequency zero point electromagnetic radiation energy to electrical energy. The system includes a pair of dielectric structures which are positioned proximal to each other and which receive incident zero point electromagnetic radiation. The volumetric sizes of the structures are selected so that they resonate at a frequency of the incident radiation. The volumetric sizes of the structures are also slightly different so that the secondary radiation emitted therefrom at resonance interfere with each other producing a beat frequency radiation which is at a much lower frequency than that of the incident radiation and which is amenable to conversion to electrical energy. An antenna receives the beat frequency radiation. The beat frequency radiation from the antenna is transmitted to a converter via a conductor or waveguide and converted to electrical energy having a desired voltage and waveform.

14 Claims, 8 Drawing Sheets



ZPE patent 5,590,031

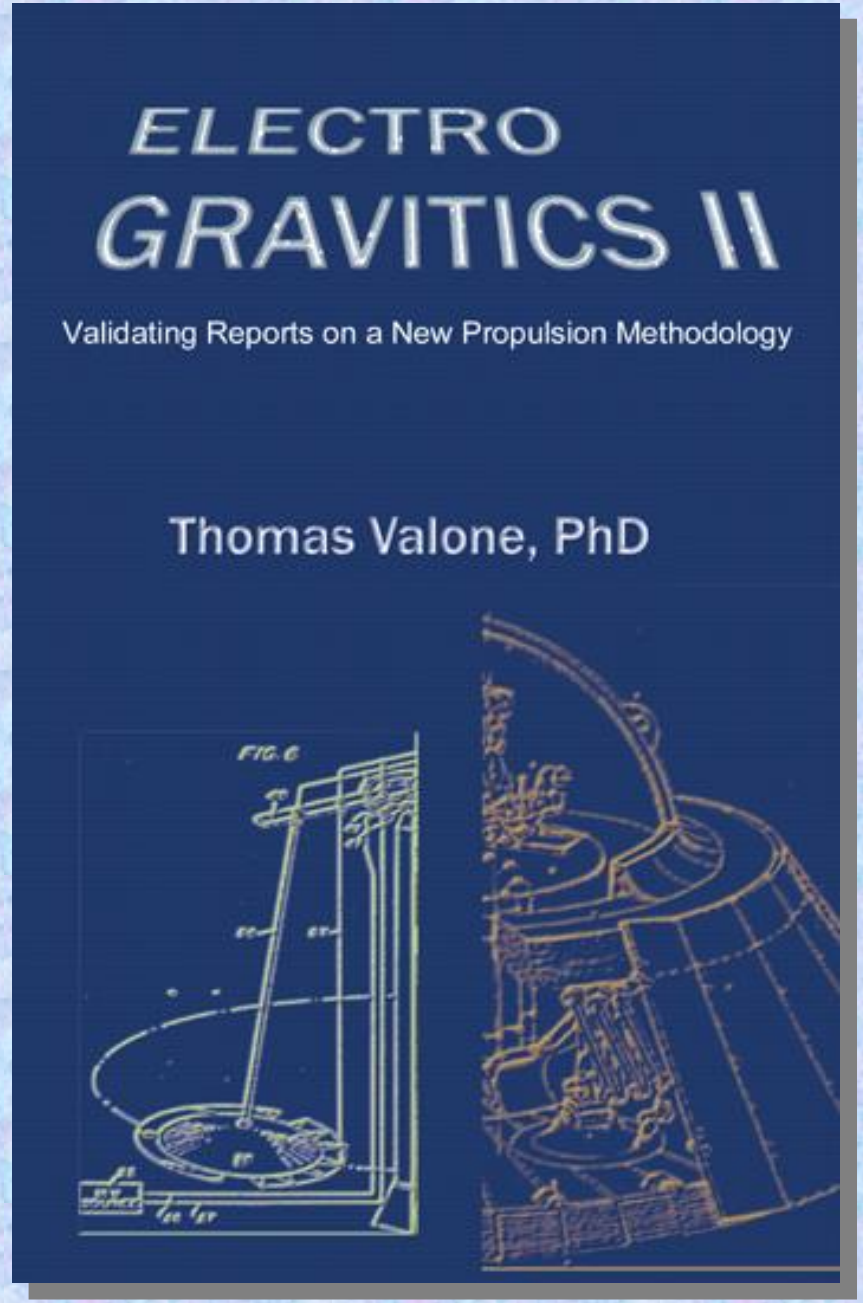
PROPULSION

IRI Program

Current Research

Second Volume

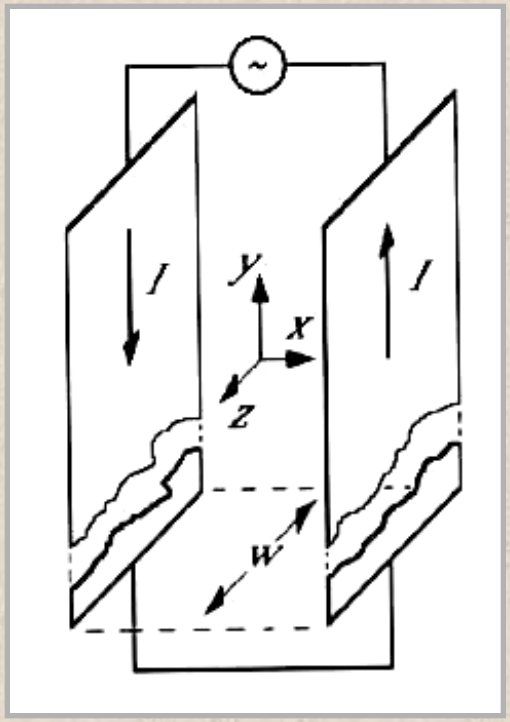
- AFL report
- Honda Lab report
- T.T.Brown biography
- McCandlish Norton AFB hovercraft report
- *Valone interpretation of electrokinetic equation and its force predictions*
- Recent related patents



Electrokinetic Equation

$$\mathrm{E} = \frac{1}{4\pi\varepsilon_o}\int\left\{\frac{\rho}{r^2}+\frac{1}{rc}\frac{\partial\rho}{\partial t}\right\}\mathrm{r}\,dv' + \mathrm{E}_k$$

$$\mathrm{A} = -\int \mathrm{E}_k dt + const.$$



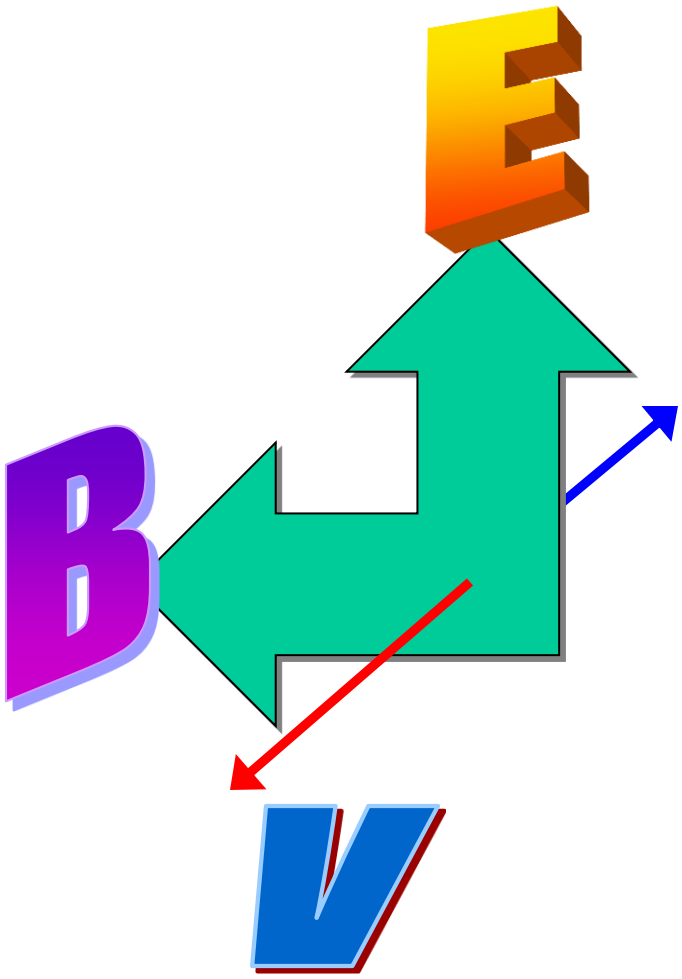
$$\mathrm{E}_k = -\frac{1}{4\pi\varepsilon_o c^2}\int\frac{1}{r}\left[\frac{\partial \mathrm{J}}{\partial t}\right]dv'$$

$$\mathrm{E}_k = -\mu_o \frac{\partial I}{\partial t}\frac{x}{w}\mathrm{j}$$

for AC currents

Causality, Electromagnetic Induction and Gravitation, Jefimenko, 2000

Motion from ZPE Vacuum Fluctuations



- Quantum vacuum creates momentum difference (red vs. blue) in dielectric media and thus motion **V**
- Let **E** = 100 kV/m and **B** = 17 Tesla (or 170 kG). Then, **V = 50 microns/sec**
- Feigel is the first physicist to use ZPE to satisfy energy conservation
- Phys. Rev. Lett., Vol. 92, 2004

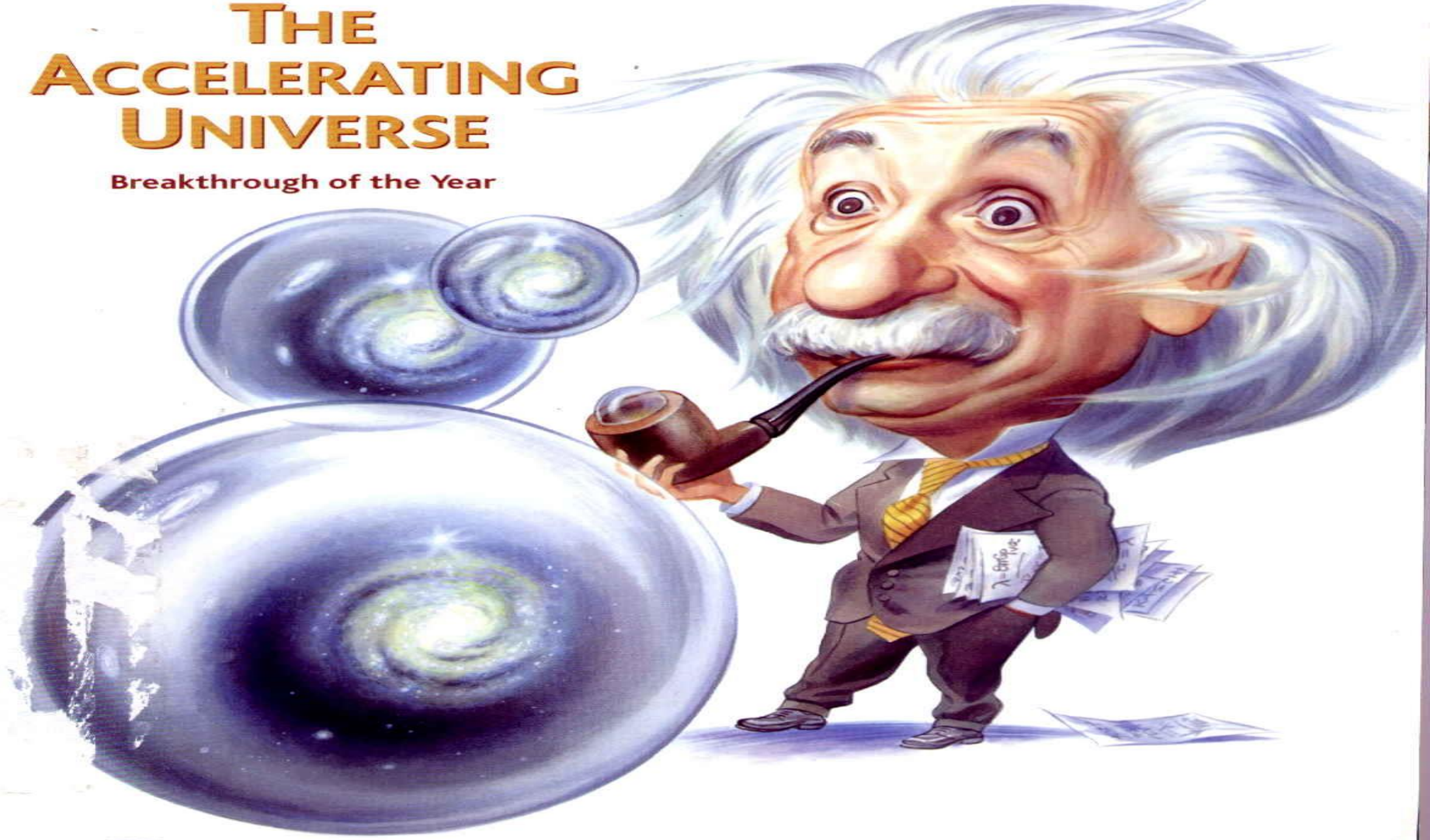
18 December 1998

Science

Vol. 282 No. 5397
Pages 2141–2336 $7

THE ACCELERATING UNIVERSE

Breakthrough of the Year



AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PHYSICAL REVIEW A VOLUME 49, NUMBER 2 FEBRUARY 1994

Inertia as a zero-point-field Lorentz force

Bernhard Haisch
Lockheed Palo Alto Research Laboratory, Division 91-30, Building 252, 3251 Hanover Street, Palo Alto, California 94304
and Max-Planck-Institut für Extraterrestrische Physik, D-85740 Garching, Germany

Alfonso Rueda
Department of Electrical Engineering, California State University, Long Beach, California 90840

H. E. Puthoff
Institute for Advanced Studies at Austin, 4030 Braker Lane West, Suite 300, Austin, Texas 78759
(Received 8 February 1993)

Under the hypothesis that ordinary matter is ultimately made of subelementary constitutive primary

"The ZPF will exert a magnetic Lorentz force..."

Resistance to acceleration results from Davies-Unruh effect

(acceleration-caused flux of radiation scattering)

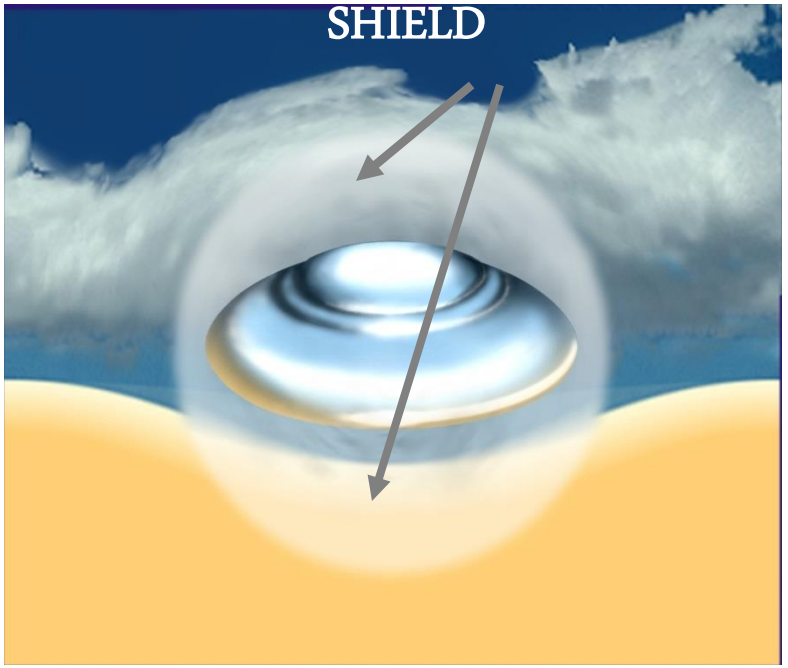
$$F = (e/c)\, v(t) \times B_{ZP}(0,t) = -[\Gamma \hbar \omega^2 / 2\pi c^2]a$$

BENEFITS OF INERTIAL SHIELDING

Force = (inertial mass) • acceleration

A discovery worthy of research and development

F = ma depends only on inertial mass, not on gravitational mass

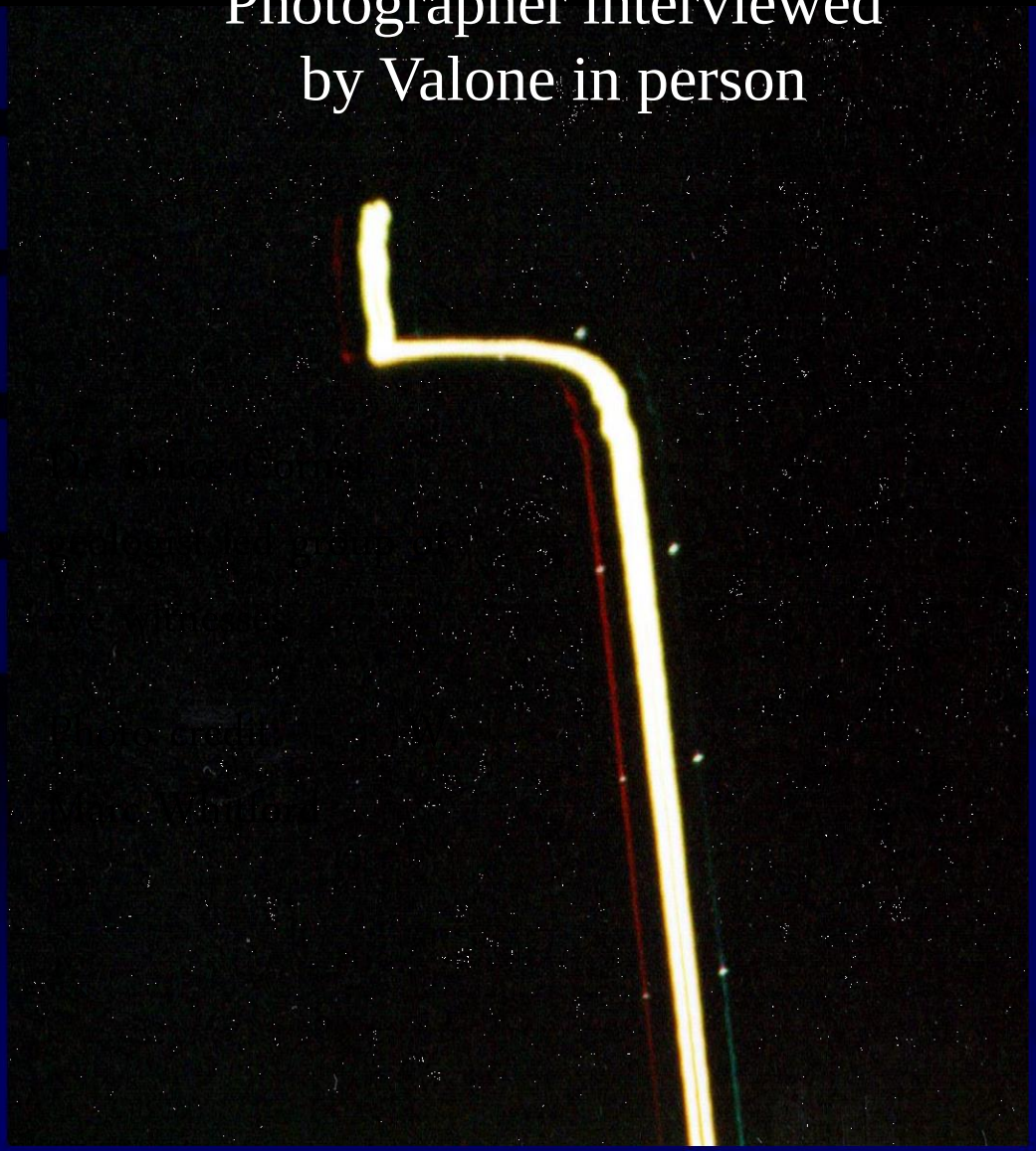


SHIELD INERTIA (m → 0) AND "a" INCREASES ASTRONOMICALLY

"Inertia as a zero-point Lorentz field" Haisch, *Phys. Rev. A*, V.49, N.2, 1994

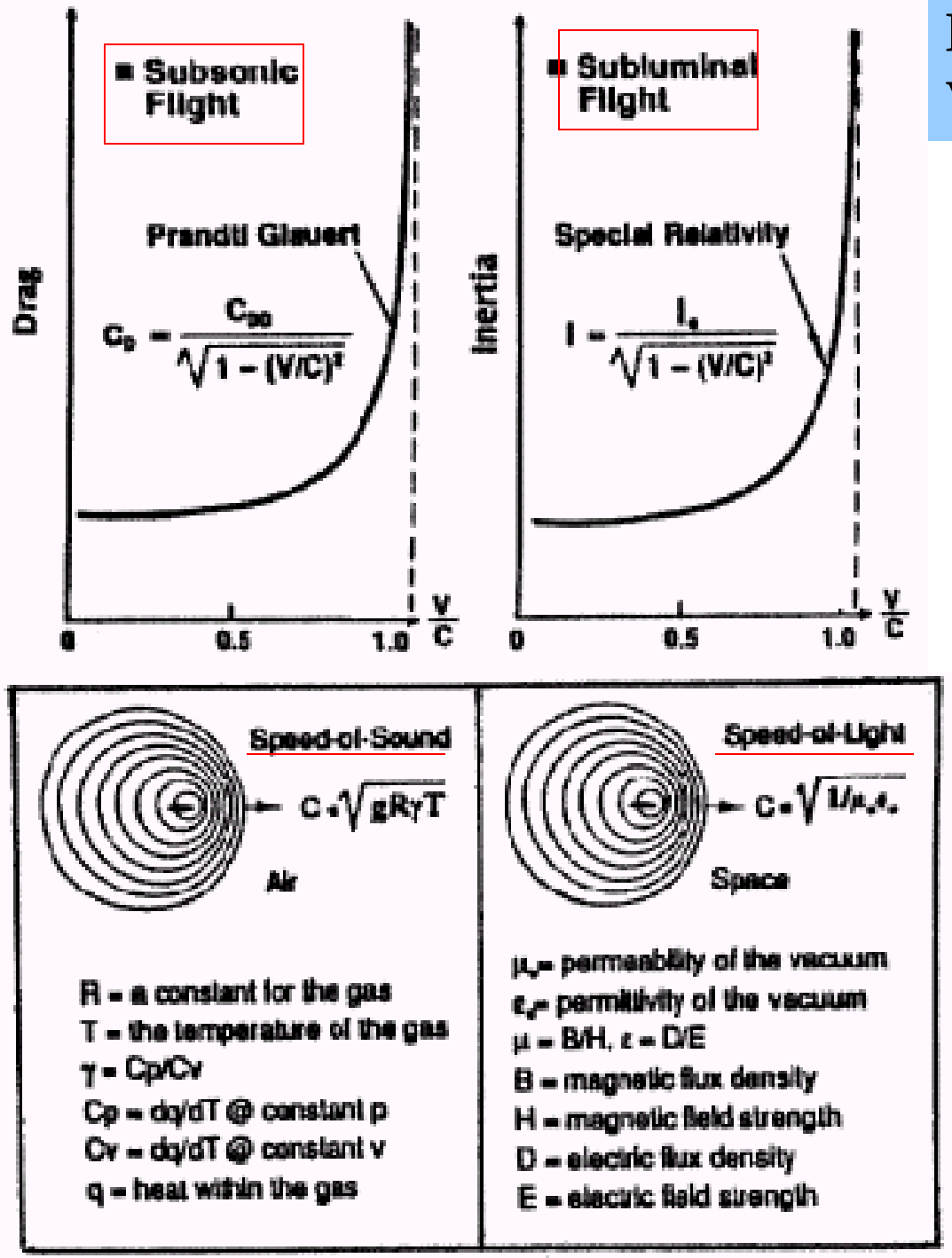
Black Projects Have Inertial Shielding

Photographer interviewed
by Valone in person



- Pine Bush near Stewart AFB
- Delta-shaped aircraft
- Two mobile white headlights
- Steady red, green lights and blinking yellow lights on tips of craft
- No visible contrail
- Abrupt change of direction
- Ability to hover motionless
- Inverse Doppler effect
- Audible but low engine noise

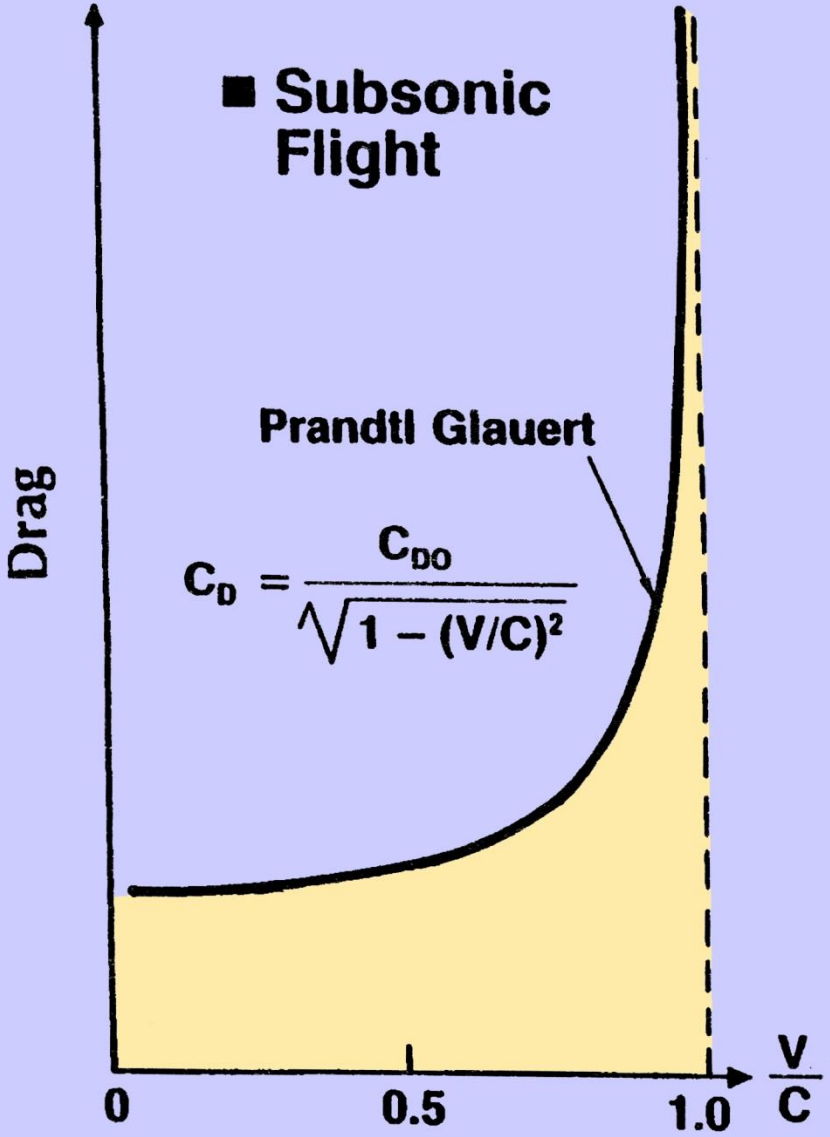
Hydrodynamic Model of Vehicle Interactions with ZPF

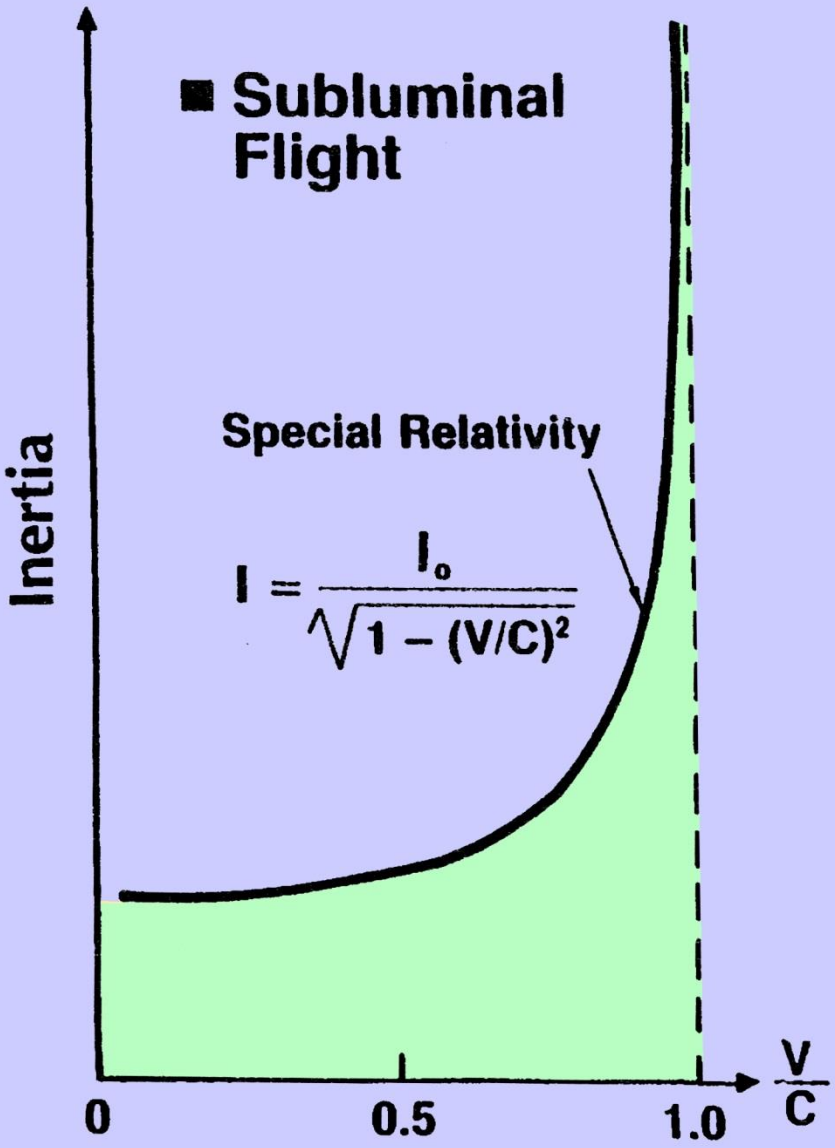


- Resistance vs. speed for sound and for light is same
- speed of light $c = (\mu_o\varepsilon_o)^{-½}$
- sound speed $c = (qR\gamma T)^{½}$
- Aerodynamic viscous drag is compared to the Lorentz force exerted by the ZPF
- $\mu_o\varepsilon_o$ and Einstein-Hopf drag $F = - R v$ can be reduced by nonabelian electromagnetic fields with a toroid

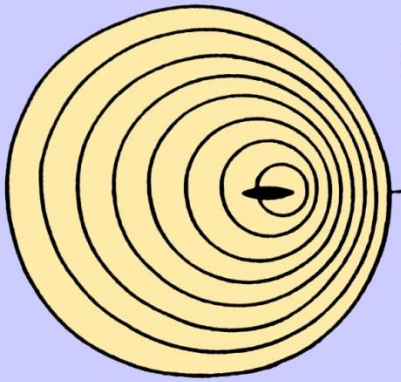
Fronig, 38th JPC, AIAA-2002-3925

Flight Resistance Increase with Speed





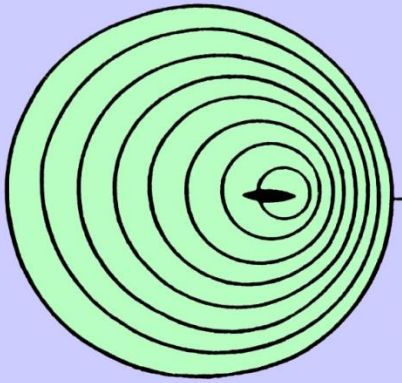
Speeds of Acoustic and Electromagnetic Wave Fronts in Air and Space



Speed-of-Sound

$$C = \sqrt{gR\gamma T}$$

Air



Speed-of-Light

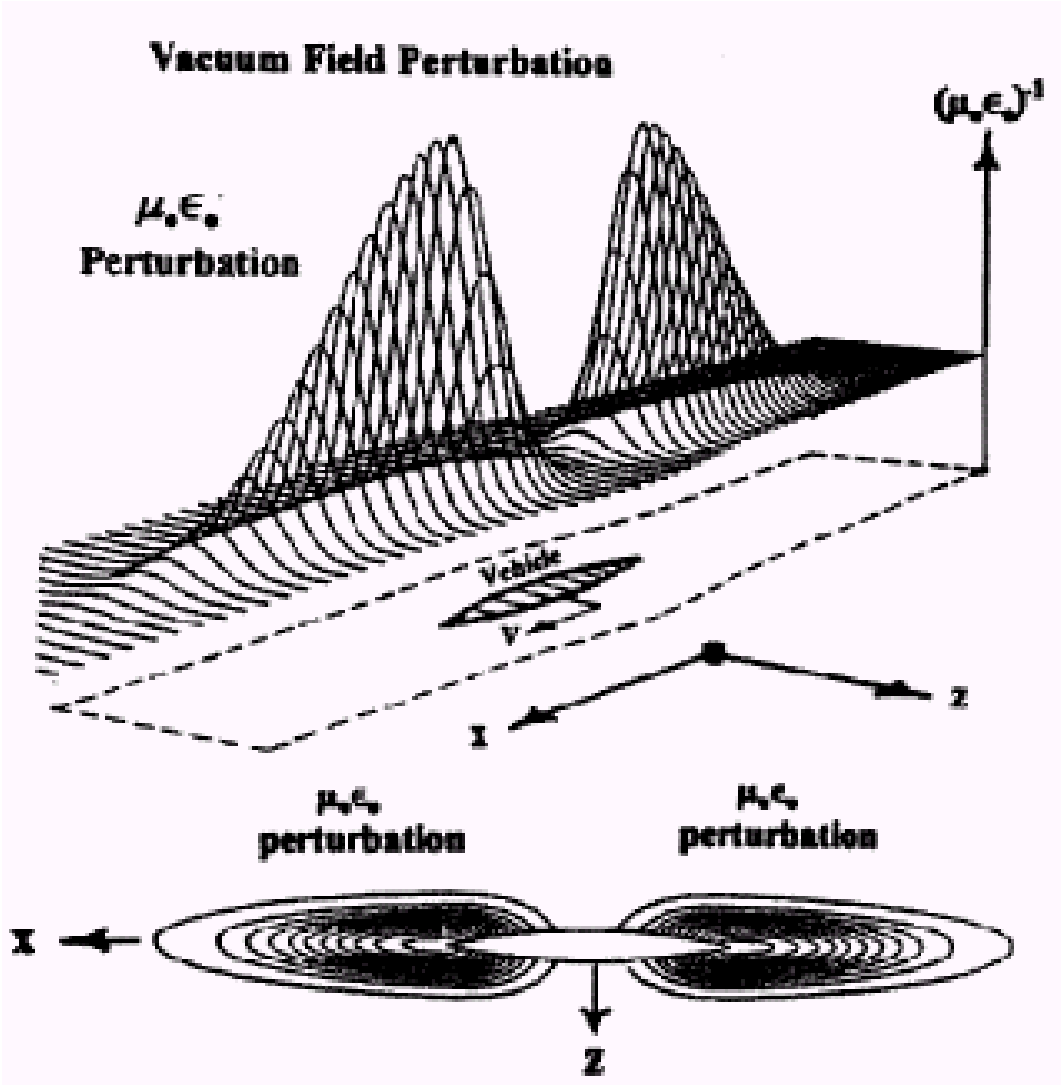
$$C = \sqrt{1/\mu_o \epsilon_o}$$

Space

R = a constant for the gas
T = the temperature of the gas
γ = Cp/Cv
Cp = dq/dT @ constant p
Cv = dq/dT @ constant v
q = heat within the gas

μ_o= permeability of the vacuum
ε_o= permittivity of the vacuum
μ = B/H, ε = D/E
B = magnetic flux density
H = magnetic field strength
D = electric flux density
E = electric field strength

Superluminal Saucer



- Fronig solved Euler eq of fluid dynamics with vacuum perturbed by toroidal EM field
- ZPF loses its drag when T ⇨ 0 K
- Only directional accelerating recoil left
- Transfers energy from ZPF to vehicle

Aviation Week & Space Technology, March 1, 2004

To the Stars

Zero point energy emerges from realm of science fiction, may be key to deep-space travel

WILLIAM B. SCOTT/AUSTIN, TEX.

At least two large aerospa
panies and one U.S. I
Dept. agency are betti
"zero point energy" coul
next breakthrough in ae
vehicle propulsion, and are t
those bets with seed money for
search.

If their efforts pay off, ZPE
powerplants might enable Mach
ers, quiet 1,200-seat hypersoni
ers that fly at 100-mi. altitudes
12,000 mi. in about 70 min., and
trips to the Moon.

ONE OF THOSE companies, B
tems, launched "Project Greeng
1986 "to provide a focus for resea
novel propulsion systems and th
to power them," said R.A.
Evans, the project leader, in a
technical paper last year. Al-
though funding levels have
been modest, Greenglow is
exploring ZPE as one element

PE-relat-

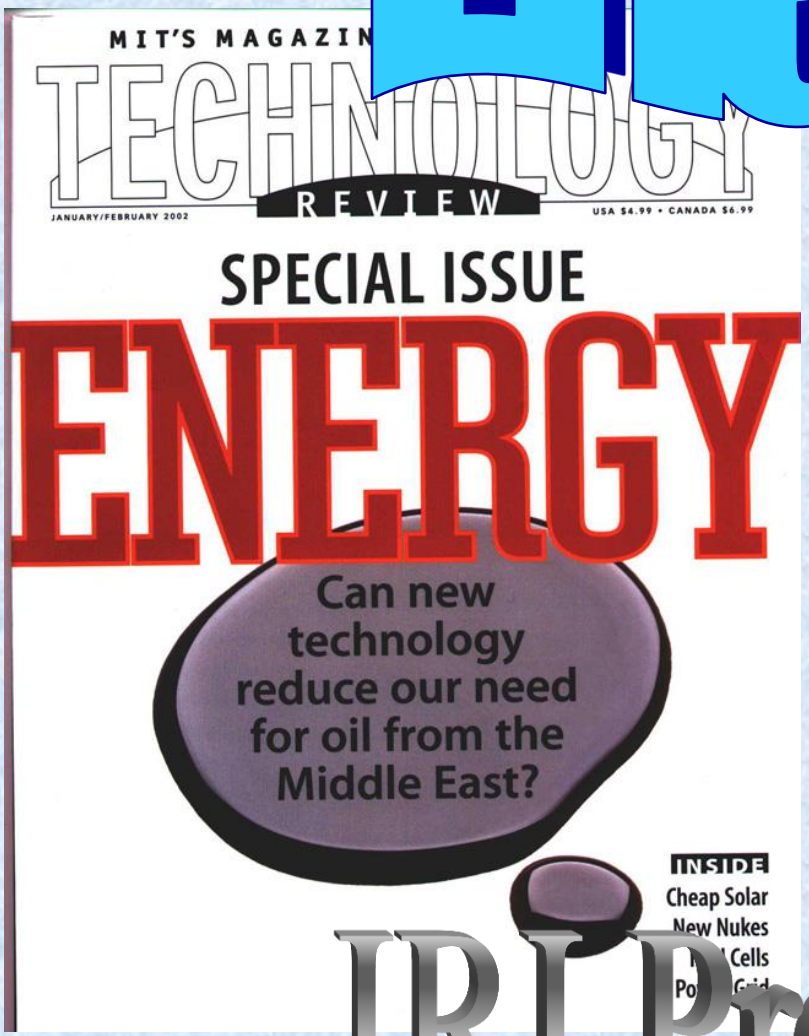
energy is
d is diffi-
minded to
by metic-

NASA BPP/LES BOSSINAS

Spacecraft capable of interstellar travel will approach the speed of light, and may have to extract energy from the vacuum of space. However, researchers could be years or decades from achieving the breakthroughs necessary to build such a propulsion system.

cowatts or
That st
searchers,
some crit
tion. Still,
ernment

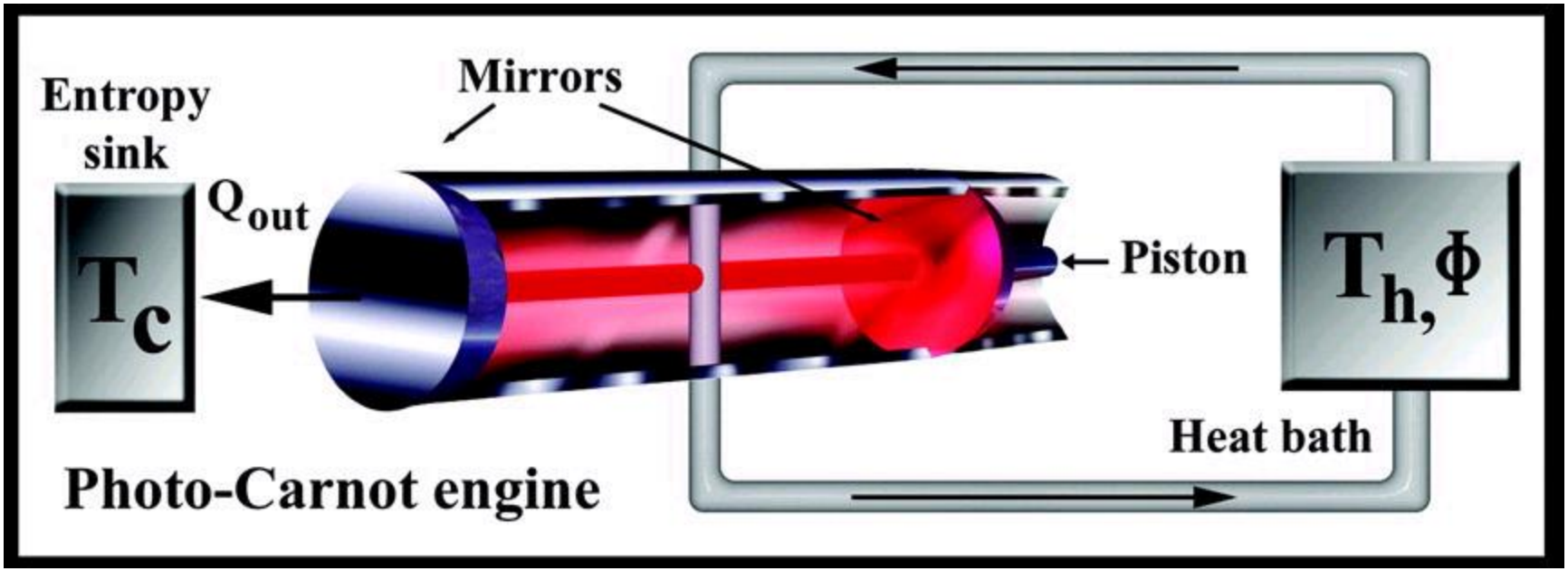
Energy



IRI Program

Work from a Single Heat Bath

Quantum Coherence Expands the Second Law of Thermodynamics



"Working fluid" is radiation pressure from a microlaser which drives piston

Efficiency exceeds a classical engine even when $T_c = T_h$

Ref.: Scully, *Science*, V. 299, Issue 5608, 2003, p. 862

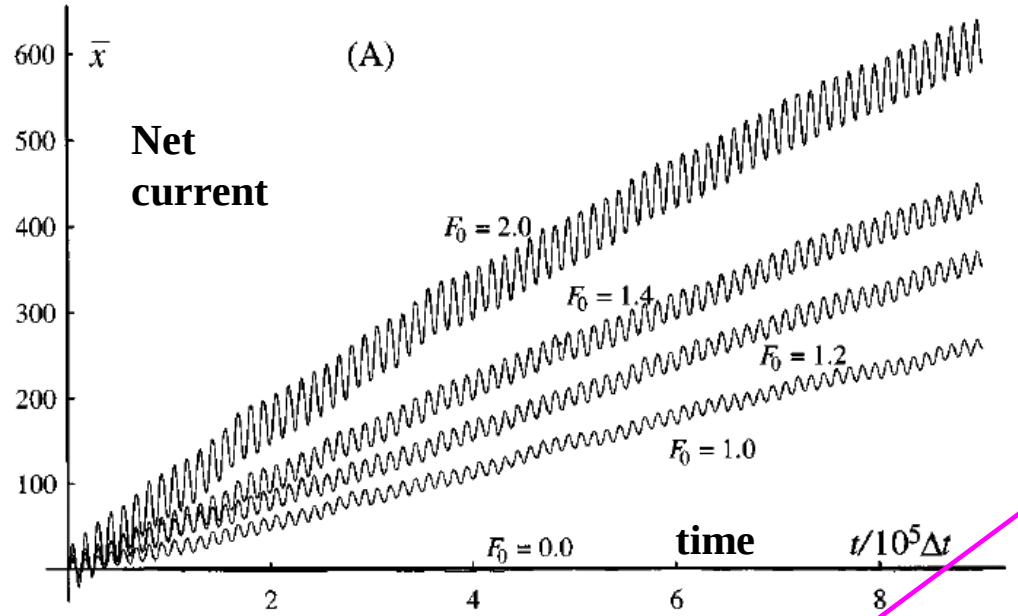
Fluctuation - Dissipation Theorem

A Systems Theory Basis for Zero-Point Energy

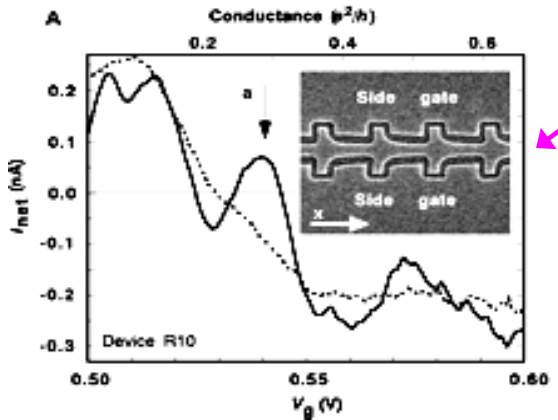
- Generalized Nyquist relation (for **Johnson noise**)
- $\mathbf{< V^2 > = 2/\pi \int R(\omega)\, E(\omega,T)\, d\omega}$ where $\omega = 2\pi f$
- The existence of a radiation resistance R *necessitates a randomly fluctuating electric field V in the vacuum*.
- E(ω,T) is average Planck energy at temperature T
- **Irreversible, dissipative process = spontaneously fluctuating force coupled to it in equilibrium**

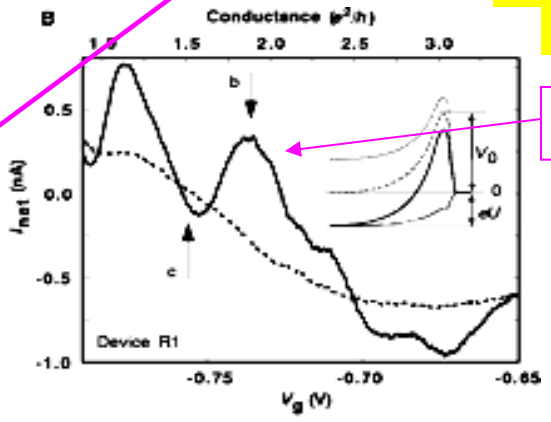
Callen and Welton, "Irreversibility and Generalized Noise" Phys. Rev., 83, 1951, p.34

Fluctuation-Driven Electricity



- Fluctuation theorem* predicts <u>negative work</u>
- Periodic boundaries
- Quantum ratchets
- Rectifies thermal noise
- Operate at T = 5 K
- Input avg. force = 0





Temp. dependent current reversal

"Experimental Tunneling Ratchets"
Linke, *Science*, 286, 1999

***Crooks, *Phys. Rev. E*, 60, 1999**

Casimir energies for spherically symmetric cavities

Guido Cognola 1, Emilio Elizalde 2,3,4 and Klaus Kirsten 5,6

J. Phys. A: Math. Gen. **34** (14 September 2001) 7311-7327

"All the most common situations, including scalar and spinor fields, the electromagnetic field and various boundary conditions are treated with the uppermost accuracy."

The Casimir energy for a rectangular cavity at finite temperature

Hongbo Cheng

J. Phys. A: Math. Gen. **35** (8 March 2002) 2205-2212

"…We also find the ***temperature influences*** on choosing edges which lead to the Casimir energy being positive or negative."

PHYSICAL REVIEW B **67**, 035301 (2003)

Full-frequency voltage noise spectral density of a single-electron transistor

Andreas Käck and Göran Wendin

We calculate the full-frequency spectral density of voltage fluctuations in a single-electron transistor (SET), used as an electrometer biased above the Coulomb threshold so that the current through the SET is carried by sequential tunneling events. We consider both a normal-state SET and a superconducting SET. The whole spectrum, from low-frequency telegraph noise to quantum noise at frequencies comparable to the SET charging energy ($E_C/\hbar$) to high-frequency Nyquist noise, is described. We take the energy exchange between the SET

Brownian Refrigerator

C. Van den Broeck
Hasselt University, B-3590 Diepenbeek, Belgium

ternative, and arguably more promising approach, would be to utilize thermal fluctuations rather than fighting them. A well-documented example is the Brownian motor [1,2], which generates power through the rectification of thermal fluctuations. In this Letter, we present a novel method of microscopic cooling based on a Brownian motor in which, almost paradoxically, thermal fluctuations themselves can be harnessed to reduce the thermal jitter in one part of the system.

Movement and fluctuations of the vacuum

Davies-Unruh Effect

Marc-Thierry Jaekel and Serge Reynaud

Rep. Prog. Phys. **60** (September 1997) 863-887

"The choice of Rindler representation, commonly used in general relativity, transforms vacuum fluctuations into thermal fluctuations…"

Simulation of the surface temperature profile of a heated slab-shaped sample in the Casimir conduction regime A G Every and J Cooper

J. Phys.: Condens. Matter **2** (16 April 1990) 3659-3666

"Noteworthy findings … existence of a finite thermal gradient in regions where there is no net heat flux."

Repulsive Casimir Forces O. Kenneth, I. Klich, A. Mann, and M. Revzen Phys. Rev. Lett. **89**, 033001 (2002)

"We discuss repulsive Casimir forces between dielectric materials with nontrivial magnetic susceptibility... Indeed repulsive Casimir forces may be found in a large range of parameters, and we suggest that the effect may be realized in known materials. The phenomenon of repulsive Casimir forces may be of importance both for experimental study and for nanomachinery applications… for large permittivity and permeability, the transition between attractive and repulsive behavior depends only on the impedance $Z = (\mu / \varepsilon)^{1/2}$

In addition we show that at high temperatures there is always attraction, and thus in some cases, the force changes sign as the temperature is increased."

This article demonstrates that a push-pull oscillating engine is possible--only a variable ambient temperature input required.

For d = 1 nm

F > 200 lb/ ft^2

F > 1.5 lb/in^2

PHYSICAL REVIEW B VOLUME 30, NUMBER 4 15 AUGUST 1984

Extracting electrical energy from the vacuum by cohesion of charged foliated conductors

Robert L. Forward
*Hughes Research Laboratories, Malibu, California 90265**
and Air Force Rocket Propulsion Laboratory, Edwards Air Force Base, California 93523
(Received 23 November 1983; revised manuscript received 16 April 1984)

Any pair of conducting plates at close distances (< 1 μm) experience an attractive Casimir force that is due to the electromagnetic zero-point fluctuations of the vacuum. A "vacuum-fluctuation battery" can be constructed by using the Casimir force to do work on a stack of charged conducting plates. By applying a charge of the same polarity to each conducting plate, a repulsive electrostatic force will be produced that opposes the Casimir force. If the applied electrostatic force is adjusted to be always slightly less than the Casimir force, the plates will move toward each other and the Casimir force will add energy to the electric field between the plates. The battery can be recharged by making the electrical forces slightly stronger than the Casimir force to reexpand the foliated conductor.

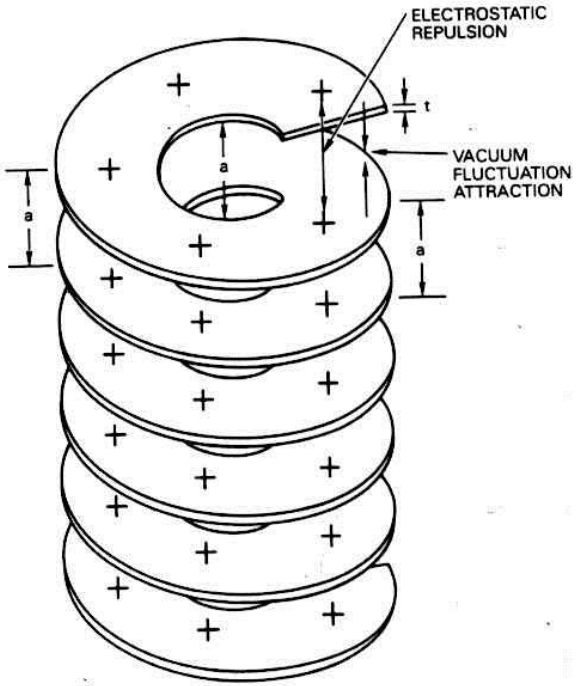


FIG. 1. Spiral design for a vacuum-fluctuation battery.

Robert L. Forward

- Casimir $F = -\pi hc / (480 d^4)$
- $F = -.013 / d^4$ dynes/cm^2
- Coulomb $F_{Co} = +1/8\pi (V^2 / d^2)$
- for d = 1 micron, $F_{Co} = F$ …… when V = 17 mV
- Very little voltage is needed but really only good for electron storage battery

1999 Pinto invents a ZPE engine

Pinto Casimir Engine

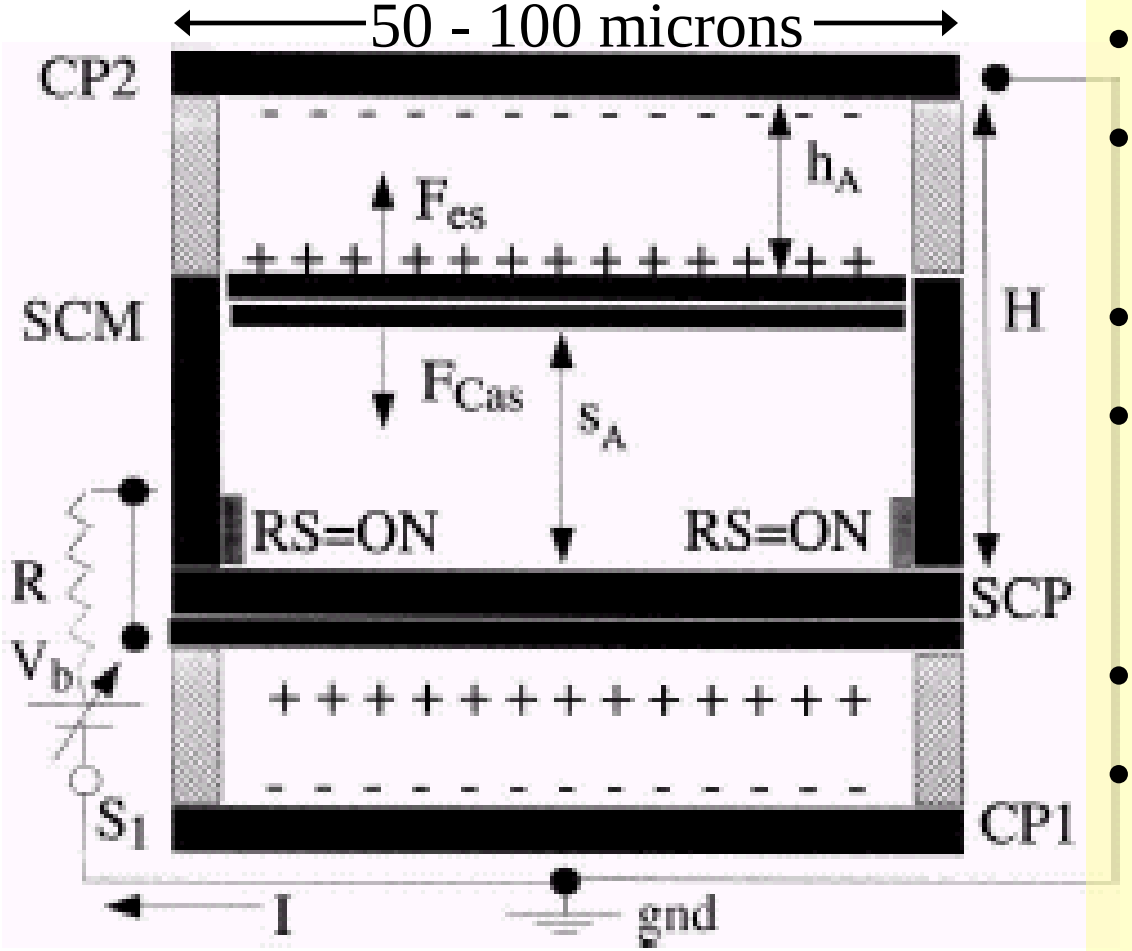
PHYSICAL REVIEW B VOLUME 60, NUMBER 21 1 DECEMBER 1999-I

Engine cycle of an optically controlled vacuum energy transducer

F. Pinto*
Jet Propulsion Laboratory, MS 301-150, California Institute of Technology, Pasadena, California 91109-8099
(Received 28 May 1999; revised manuscript received 14 July 1999)

An idealized system composed of two parallel, semiconducting boundaries separated by an empty gap of variable width is considered. A gedanken experiment is discussed to show that, in general, the total work done by the Casimir force along a closed path that includes appropriate transformations does not vanish. It is shown that, in the limit of an engine cycle bringing the two boundaries to a relatively small distance, positive net exchange of energy associated with the Casimir force field could quite possibly be achieved. Viable technological implementations of this idealized system are analyzed in some quantitative detail, in particular, in the case of doped and undoped *c*-Si boundaries. For the purpose of direct experimentation, measurements with both macroscopic and microelectromechanical devices are suggested. A full theoretical and experimental study of systems of this kind on every scale will greatly contribute to a much deeper understanding of the nature of the Casimir force and associated concepts, including the possible manipulation of semiconducting nanostructures and the noninvasive optical characterization of semiconducting samples. In the event of no other alternative explanations, one should conclude that major technological advances in the area of endless, by-product free-energy production could be achieved. [S0163-1829(99)05345-X]

Casimir Engine - Pinto



- Uses microlasers (RS)
- Similar to Forward's "parking ramp"
- Movable and fixed
- optically controlled vacuum energy transducer @ 10 kHz
- Power = 0.5 nW
- 10 microjoules/cm^2 for every cycle

Pinto, Phys. Rev.B, 60, 21, 1999, p.4457

(12) **United States Patent**
Haisch et al.

(10) **Patent No.: US 7,379,286 B2**
(45) **Date of Patent: May 27, 2008**

(54) **QUANTUM VACUUM ENERGY EXTRACTION**

(75) Inventors: **Bernard Haisch**, Redwood City, CA (US); **Garret Moddel**, Boulder, CO (US)

(73) Assignee: **Jovion Corporation**, Menlo Park, CA (US)

Cole, D. C. and Zou, Yi 2003, Quantum Mechanical Ground State of Hydrogen Obtained from Classical Electrodynamics, Physics Letters A, vol. 317, No. 1-2, pp. 14-20 (Oct. 13, 2003), quant-ph/0307154.

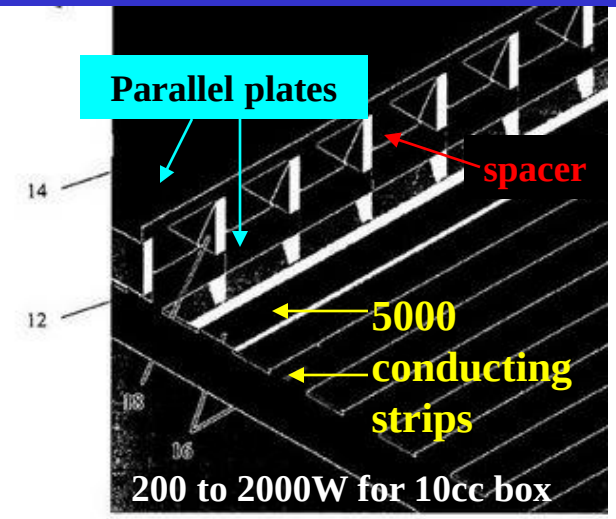
(Continued)

Primary Examiner—Nikita Wells
(74) *Attorney, Agent, or Firm*—Pritzkau Patent Group, LLC

1994 Haisch blames ZPE for inertia

A system is disclosed for converting energy from the electromagnetic quantum vacuum available at any point in the universe to usable energy in the form of heat, electricity, mechanical energy or other forms of power. By suppressing electromagnetic quantum vacuum energy at appropriate frequencies a change may be effected in the electron energy levels which will result in the emission or release of energy. Mode suppression of electromagnetic quantum vacuum radiation is known to take place in Casimir cavities. A Casimir cavity refers to any region in which electromagnetic modes are suppressed or restricted. When atoms enter into suitable micro Casimir cavities a decrease in the orbital energies of electrons in atoms will thus occur. Such energy will be captured in the claimed devices. Upon emergence form such micro Casimir cavities the atoms will be re-energized by the ambient electromagnetic quantum vacuum.

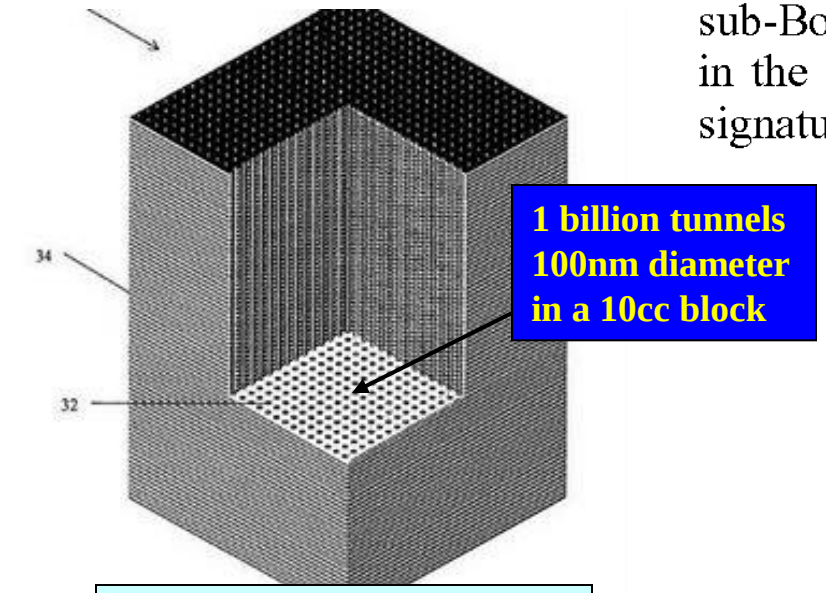
Casimir Engine - Haisch

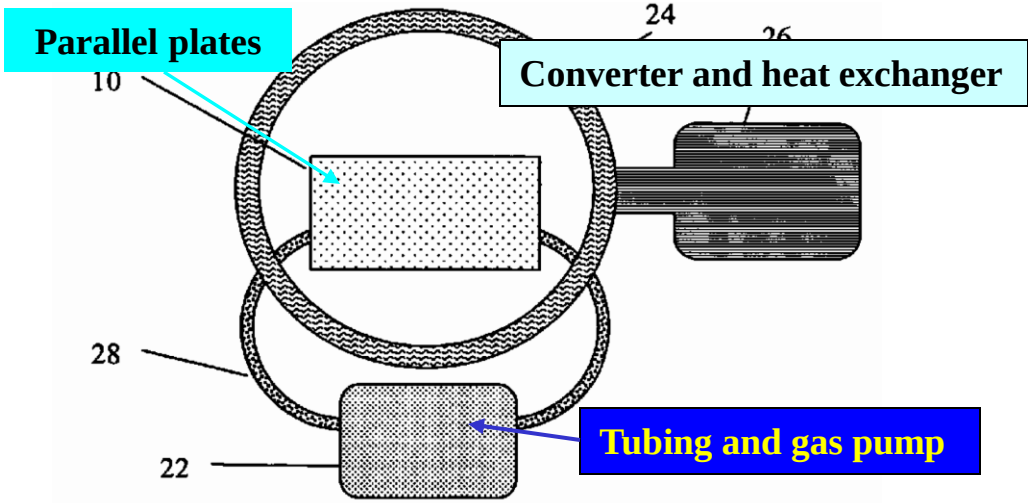


Haisch-Jovian patent 7,379,286

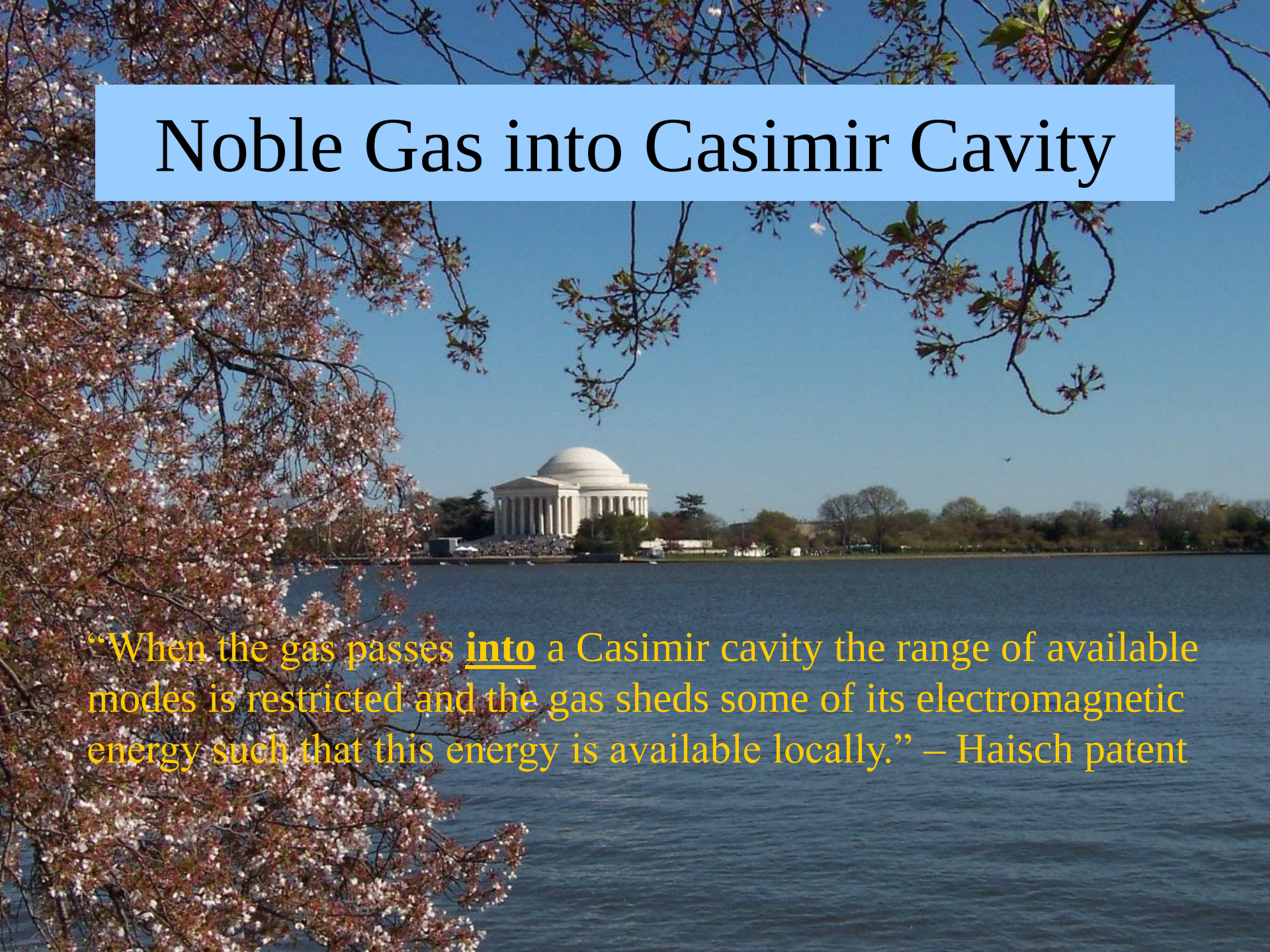
It is reasonable to expect that a 0.1 microns Casimir cavity would result in a release of 1 to 10 eV for each injection of a He, Ne, Ar, Kr or Xe atom into such a cavity.

Since the frequency of this orbit is 6.6×10^{15} s^{-1}, no matter how quickly the atom is injected into a Casimir cavity the process will be a slow one as experienced by the orbiting electron. We therefore assume that the decay to a new sub-Bohr ground state will involve gradual release of energy in the form of heat, rather than a sudden optical radiation signature.





Noble Gas into Casimir Cavity



"When the gas passes **into** a Casimir cavity the range of available modes is restricted and the gas sheds some of its electromagnetic energy such that this energy is available locally." – Haisch patent

Casimir Cavity Operation

"When the gas once again flows out from the Casimir cavity, the gas's atomic electronic orbital state energy is recharged from quantum mechanical vacuum fields. Thus energy is *harvested globally and delivered locally*." -- Haisch patent

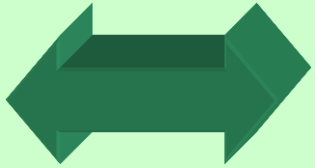
Haisch ZPE Conclusion

"We are in effect extracting energy locally and replenishing it globally. Imagine extracting thimbles-full of water from the ocean. Yes, the ocean is being depleted thereby, but no practical consequences ensue" -- **Haisch, Jovian patent #7,379,286**

"Repulsive Casimir Forces"

O. Kenneth, I. Klich, A. Mann, and M. Revzen

Phys. Rev. Lett. **89**, 033001 (2002)



"We discuss repulsive Casimir forces between dielectric materials with nontrivial magnetic susceptibility... Indeed repulsive Casimir forces may be found in a large range of parameters, and we suggest that the effect may be realized in known materials. The phenomenon of repulsive Casimir forces may be of importance both for experimental study and for nanomachinery applications… for large permitivity and permeability, the transition between attractive and repulsive behavior depends only on the impedance $Z = (\mu / \varepsilon)^{1/2}$

In addition we show that at high temperatures there is always attraction, and thus in some cases, the force changes sign as the temperature is increased."

Electron Charge Clusters were #2 on **National Critical Issue List** by the *Interagency Technology Assessment Group* in the 1980s

Energy Conversion From The Exotic Vacuum

by
Ken Shoulders[1] and Dr. Jack Sarfatti[2]

2004 paper

Abstract

A connection is shown between electron clusters, or EVs, and energy conversion processes yielding thermal energy in excess of the input energy used to form the electron cluster. This energy conversion process is traced to all known forms of cold fusion claims for over-unity or excess energy production. A theory of like charge binding as well as highly effective nuclear acceleration using the charge cluster is presented based on local gravity coupling arising from manipulation of the Exotic Vacuum.

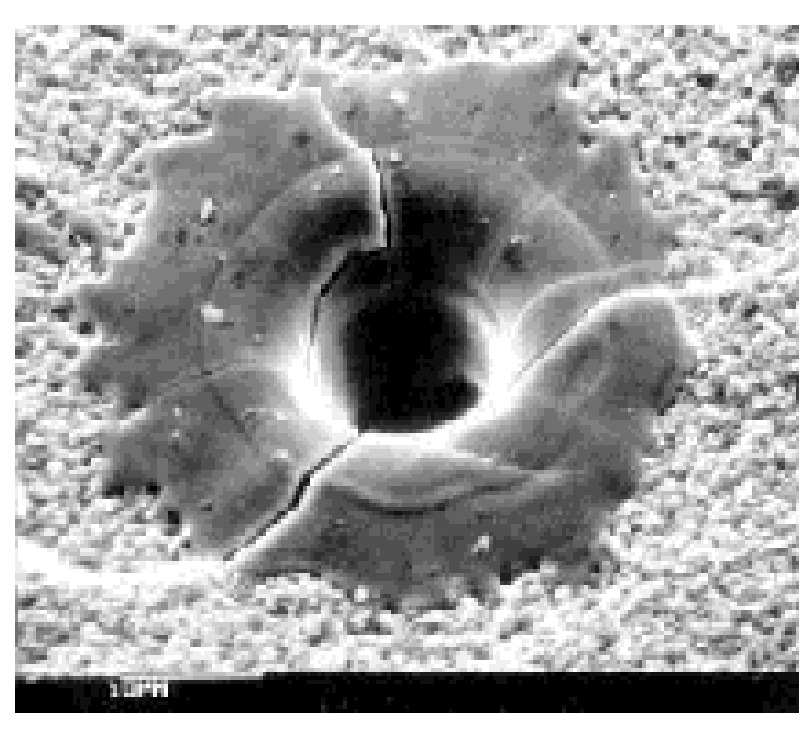
Prologue

In earlier papers by Shoulders [3,4,5,6,7,8], it was shown that electrons could be clustered far beyond the densities normally allowed by classical considerations of charge repulsion. This dense state of charge clustering has produced a range of electronic devices with properties surpassing those of any other known technology. In addition, many new manifestations of anomalous energy production were shown on a laboratory scale. Although these energy gain measurements satisfied the numerous tests applied to them, they were unsupported by any theory due to their extreme divergence from classical considerations.

During the search for a highly advanced space propulsion system, Sarfatti [2] originated a theory covering many aspects of a new physics based on manipulation of the exotic vacuum that appeared relevant to the measured energy gain arising from charge clusters, or EVs, herein called Exotic Vacuum Objects, or EVOs. This writing is the first attempt to combine theory with practice on this new frontier of both physics and engineering as applied to new energy production methods. From present observations, it appears likely that future considerations will cover not only energy production processes but totally new experimental propulsion methods as well.

Electron Charge Cluster Technology

***J. Appl. Phys*. 82(11), 1997, 5862**
***Galilean Elec*. May/June 1998, 43**
***Infinite Energy* Jan/Feb 1997, 62**



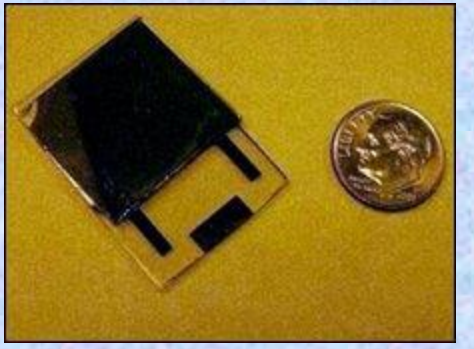
10 micron hole in leaded glass

- **Ken Shoulders**, inventor #5,018,180, #5,123,039
- 100 billion electrons (e-) with 100,000 positive ions achieve extraordinary kinetic energy with only 20 microjoules input
- **nine times overunity**
- convert e- bundles to heat & useful work #5,208,844
- *Proceedings of COFE* 1999

Tiny Nuclear Battery Unveiled

BBC News, October 9, 2009

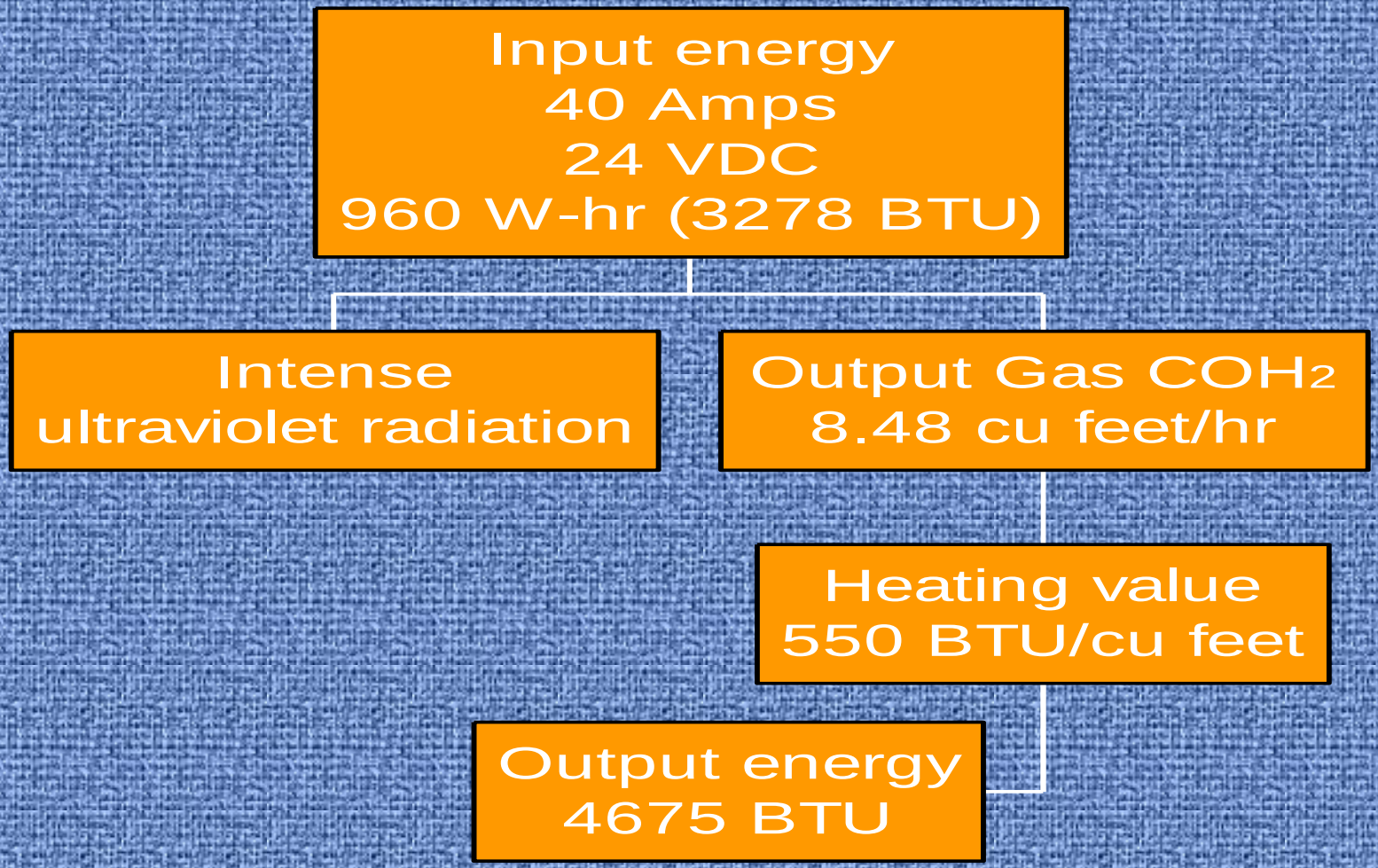
- **University of Missouri team hopes to make nuclear batteries much smaller still.**
- Researchers have demonstrated a penny-sized "nuclear battery" that produces energy from the decay of radioisotopes.
- **As radioactive substances decay, they release charged particles that when properly harvested can create an electrical current.**
- Nuclear batteries have been in use for military and aerospace applications, but are typically far larger.
- **The University of Missouri team says that the batteries hold A MILLION TIMES AS MUCH CHARGE AS STANDARD BATTERIES.**
- **Liquid semiconductor captures charges**
- ***"Lasts hundreds of years or more"***



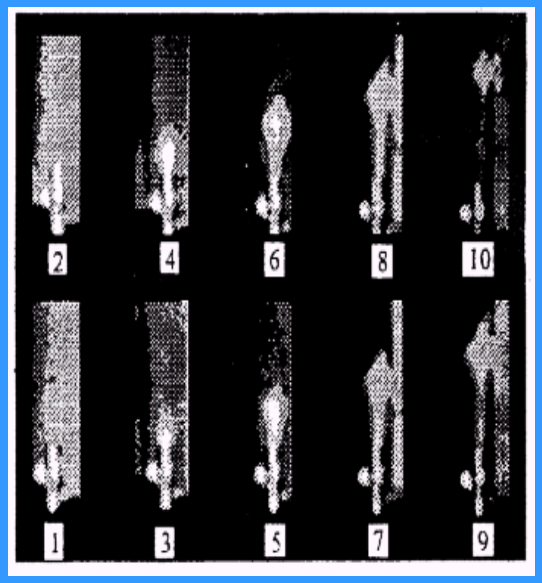
Key to team success can work for EVOs

DAVID WALLMAN's Carbon Arc Biomass Gasification Demo at COFE1

Carbon Arc Gasification of Biomass Solutions



Electric Arc Discharge Generator



High speed photography

- Rapid release of bond energy
- Fog plume travels 1000 m/s
- Can punch hole in 1/4” thick sheet of aluminum
- Requires high turbine speed to put energy to use or a plasma engine
- **150% - 300% average efficiency**
- Dr. Peter Graneau, inventor

J. Plasma Physics (2000), *vol.* 63, *part* 2, *pp.* 115–128. Printed in the United Kingdom

Arc-liberated chemical energy exceeds electrical input energy

PETER GRANEAU,[1] NEAL GRANEAU,[2]
GEORGE HATHAWAY[3] and RICHARD L. HULL[4]

[1] Centre for Electromagnetics Research, Northeastern University, Boston, MA 02115, USA
[2] Department of Engineering Science, University of Oxford, Oxford OX1 3PJ, UK
[3] Hathaway Consulting Services, 39 Kendal Avenue, Toronto, Ontario, Canada M5R 1L5
[4] Tesla Coil Builders of Richmond, 7103 Hermitage Road, Richmond, VA 23228, USA

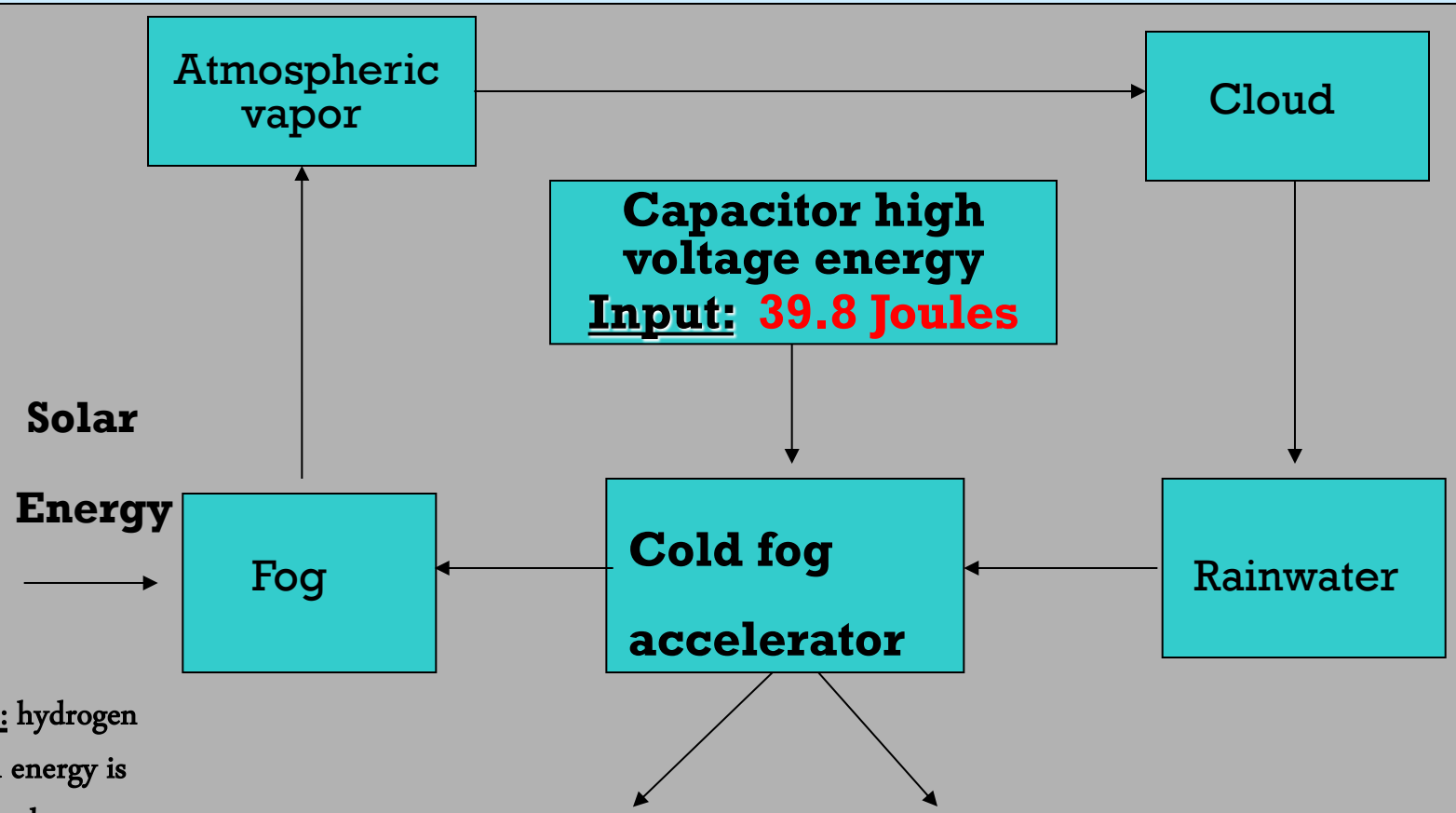
(Received 11 December 1998 and in revised form 5 August 1999)

Abstract. This paper reports the first experimental results in which the kinetic energy of cold fog, generated in a water arc plasma, exceeds the electrical

COLD FOG ACCELERATOR

RELEASES INTERMOLECULAR BOND ENERGY (2.3 kJ / g)

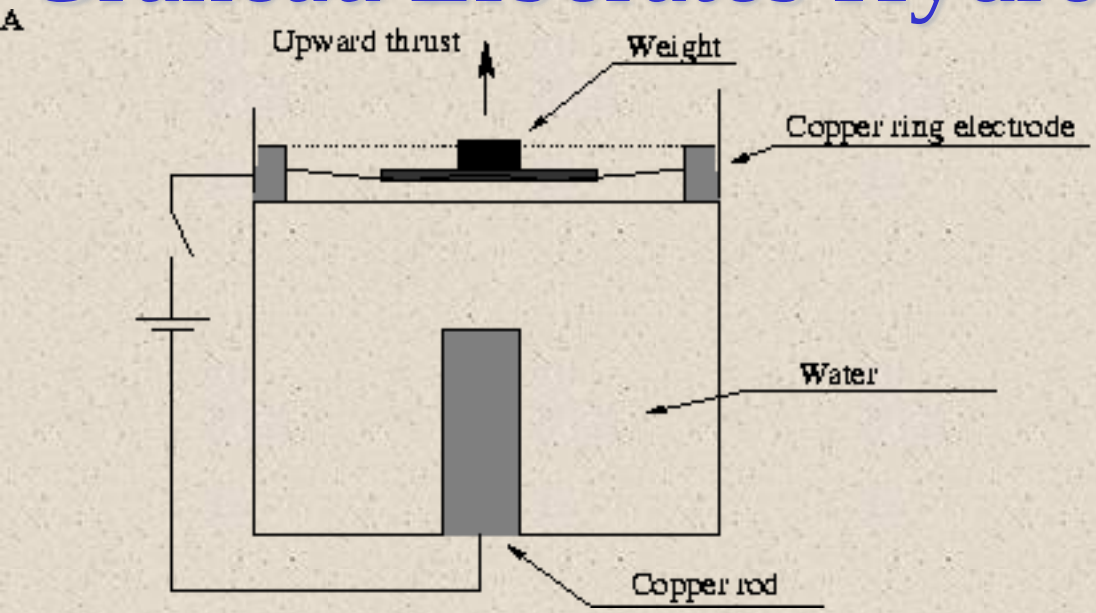
Discovered by Dr. Peter Graneau, Northeastern University

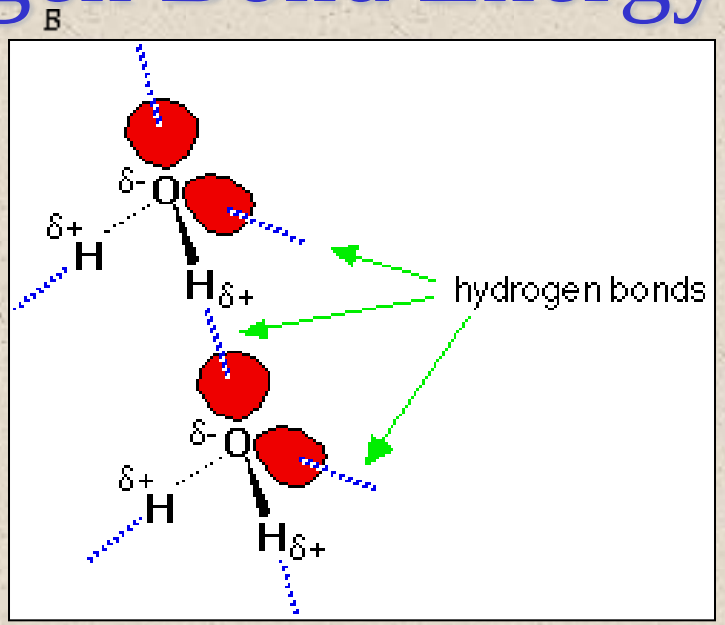


Note: hydrogen bond energy is released

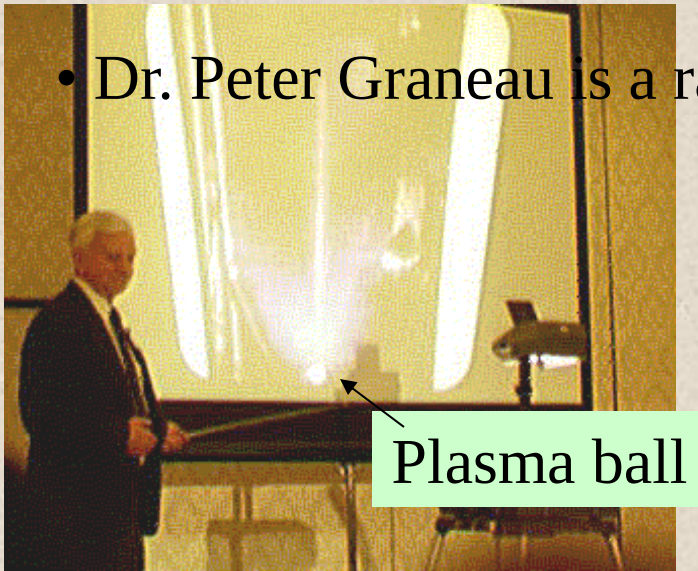
J Plasma Physics (1998) Vol 60;4: 775-786

Graneau Liberates Hydrogen Bond Energy?





- 1 kA – 25 kA discharge drives piston into air with kiloNewton forces
- Dr. Peter Graneau is a railgun expert



Plasma ball at base of water arc

Requires energy input to break bond:

Bond type	Dissociation energy (kcal)[3]
Covalent	400
Hydrogen bonds	12-16 ←
Dipole-dipole	2.0 - 0.5
London Van der Waals Forces	<1 AKA Dispersion Forces

Inhomogeneous Magnetic Fields

The Stern–Gerlach Experiment and Electron Spin

***Modern Physics*, Schaumm's Outline Series, Gautreau , McGraw Hill, 1978**

In the *Stern–Gerlach experiment*, performed in 1921, a beam of silver atoms having zero total orbital angular momentum passes through an *inhomogeneous* magnetic field and strikes a photographic plate, as shown in Fig. 21-1. Any deflection of the beam when the magnetic field is turned on is measured on the photographic plate.

Their experimental setup: The magnetic field B is more intense near the pointed surface at the top than near the flat surface below, creating a slope in a graph of B vs. z , which is the gradient dB/dz.

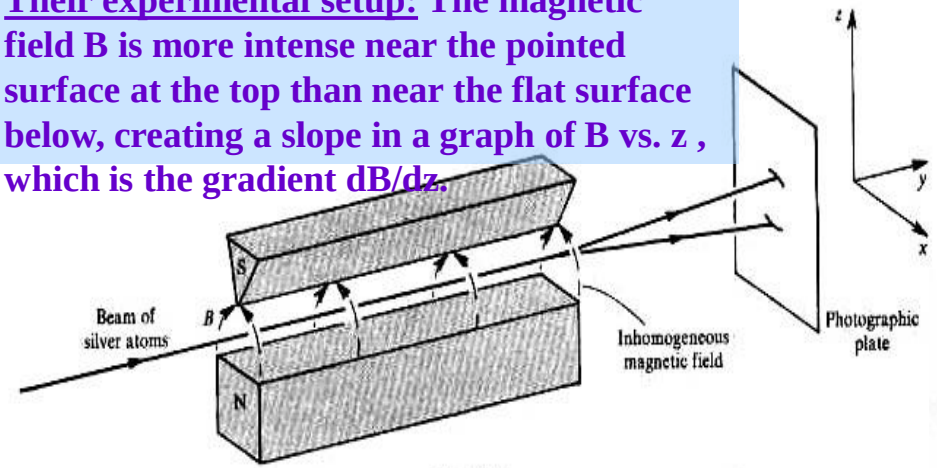
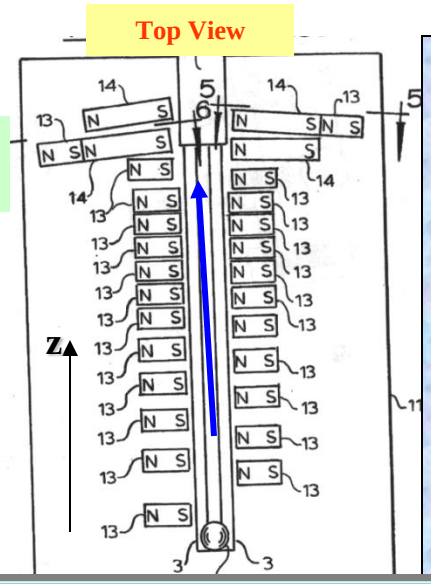


Fig. 21-1

The purpose of the *inhomogeneous* magnetic field is to produce a deflecting force on any magnetic moments that are present in the beam. If a homogeneous magnetic field were used, each magnetic moment would experience only a torque and no deflecting force. In an inhomogeneous magnetic field, however, a net deflecting force will be exerted on each magnetic moment μ_z. For the situation of Fig. 21-1,

$$F_z = \mu_z \cos\theta \frac{dB}{dz} \qquad (21.1)$$

where θ is the angle between μ_z and **B**, and dB/dz is the gradient of the inhomogeneous field



The net Force created on the ball bearing = the magnetic field gradient multiplied by the induced magnetic moment, as with the Stern-Gerlach Experiment

Hartman Patent #4,215,330

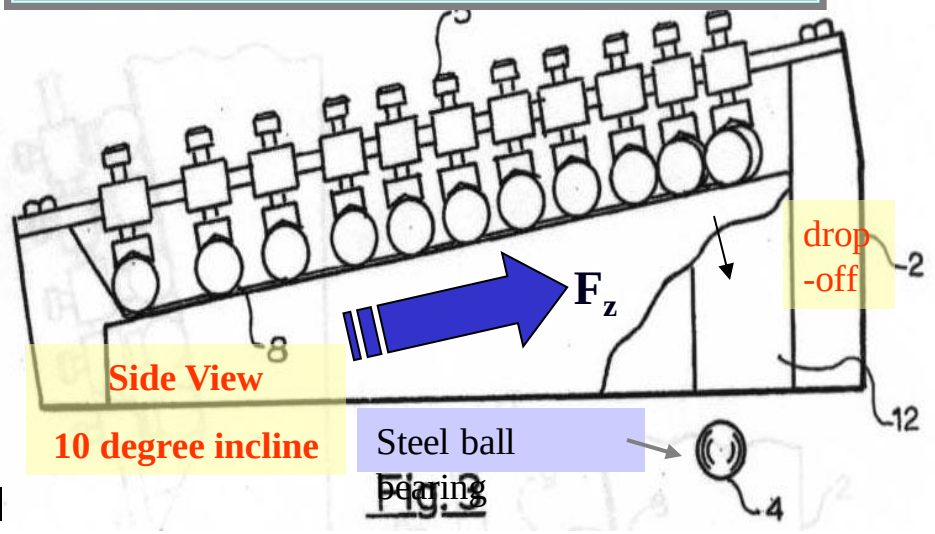
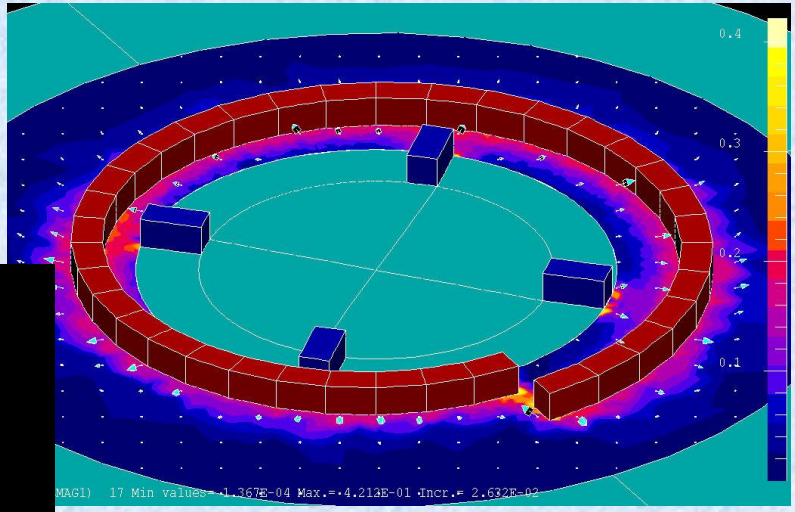
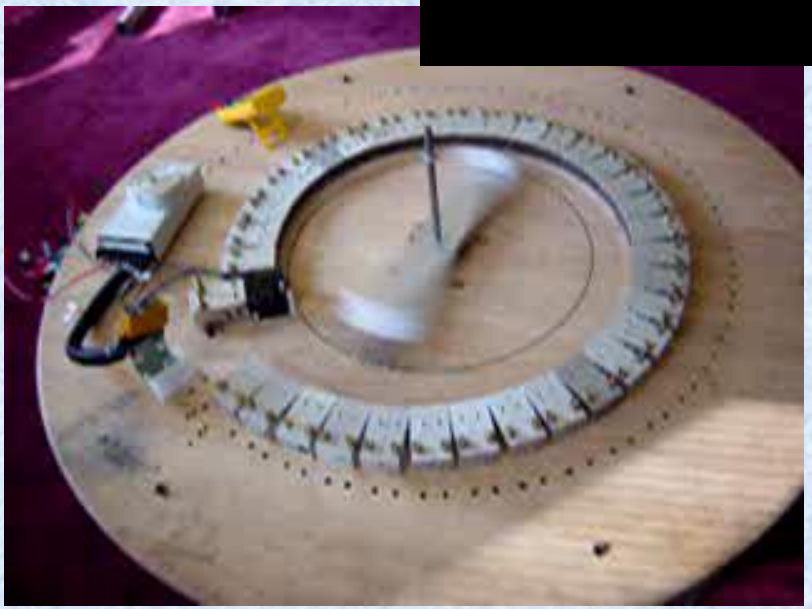


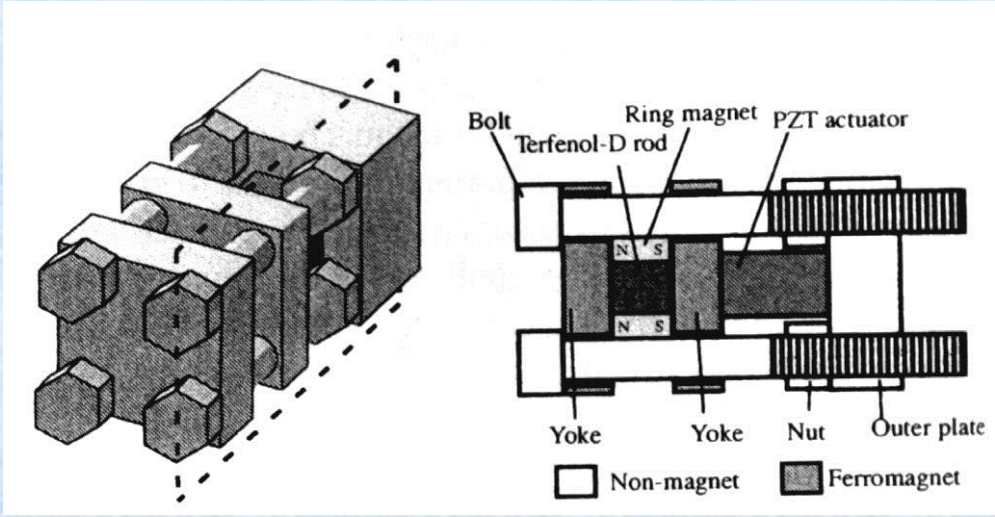
Fig. 3

Spiral Permanent Magnet Motor Project



RI improved Spiral Wankel Motor design: Weigand-MS-PZT switch with no external electricity

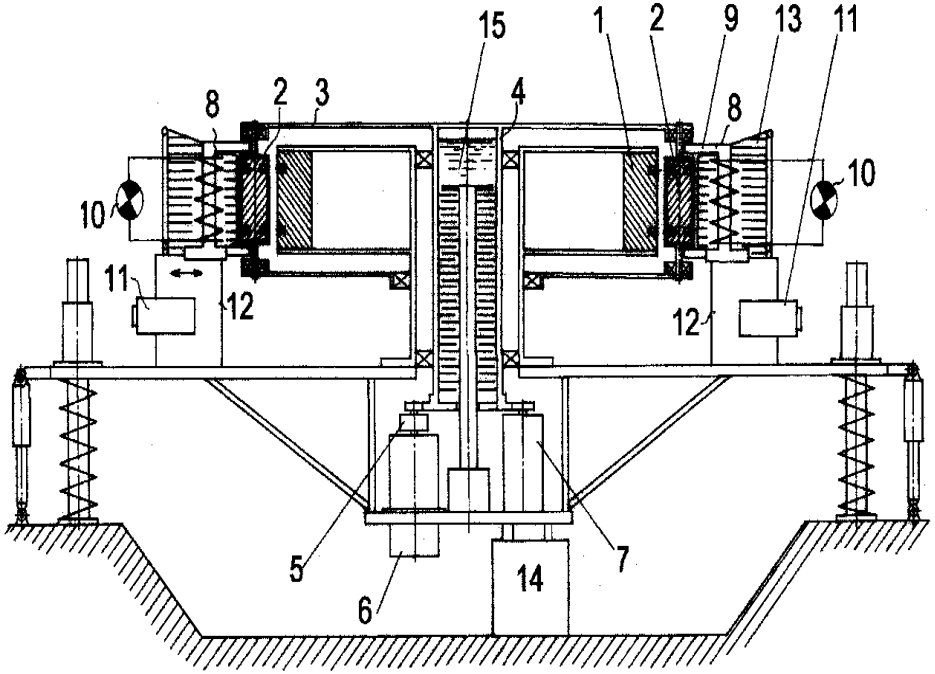




Collaborating with T. Ueno, U of Tokyo

Orbiting Homopolar Magnetic Energy Converter

US Patent 6,822,361 drafted by Valone



- V. Roshchin & S. Godin
- 7 kW power generation
- 100 kW capability
- 35% weight reduction or amplification at 550 rpm.
- Spatial magnetic field increase (50 mT) coaxially
- 7° C (13 ° F) temperature drop up to 15 meters away
- Improved efficiency with 20 kV applied high voltage
- Exponential speed increase

Energy & Propulsion Systems, LLC

Russian MEC Inventors, Godin and Roshchin at the US DOE

I am here

VOLUME 84, NUMBER 2 PHYSICAL REVIEW LETTERS 10 JANUARY 2000

Zero-Point Fluctuations and the Quenching of the Persistent Current in Normal Metal Rings

Pascal Cedraschi, Vadim V. Ponomarenko, and Markus Büttiker

Département de Physique Théorique, Université de Genève, 24, quai Ernest Ansermet, CH-1211 Geneva 4, Switzerland

(Received 5 May 1999)

The ground state of a phase-coherent mesoscopic system is sensitive to its environment. We investigate the persistent current of a ring with a quantum dot which is capacitively coupled to an external circuit with a dissipative impedance. At zero temperature, zero-point quantum fluctuations lead to a strong suppression of the persistent current with decreasing external impedance. We emphasize the role of displacement currents in the dynamical fluctuations of the persistent current and show that with decreasing external impedance the fluctuations exceed the average persistent current.

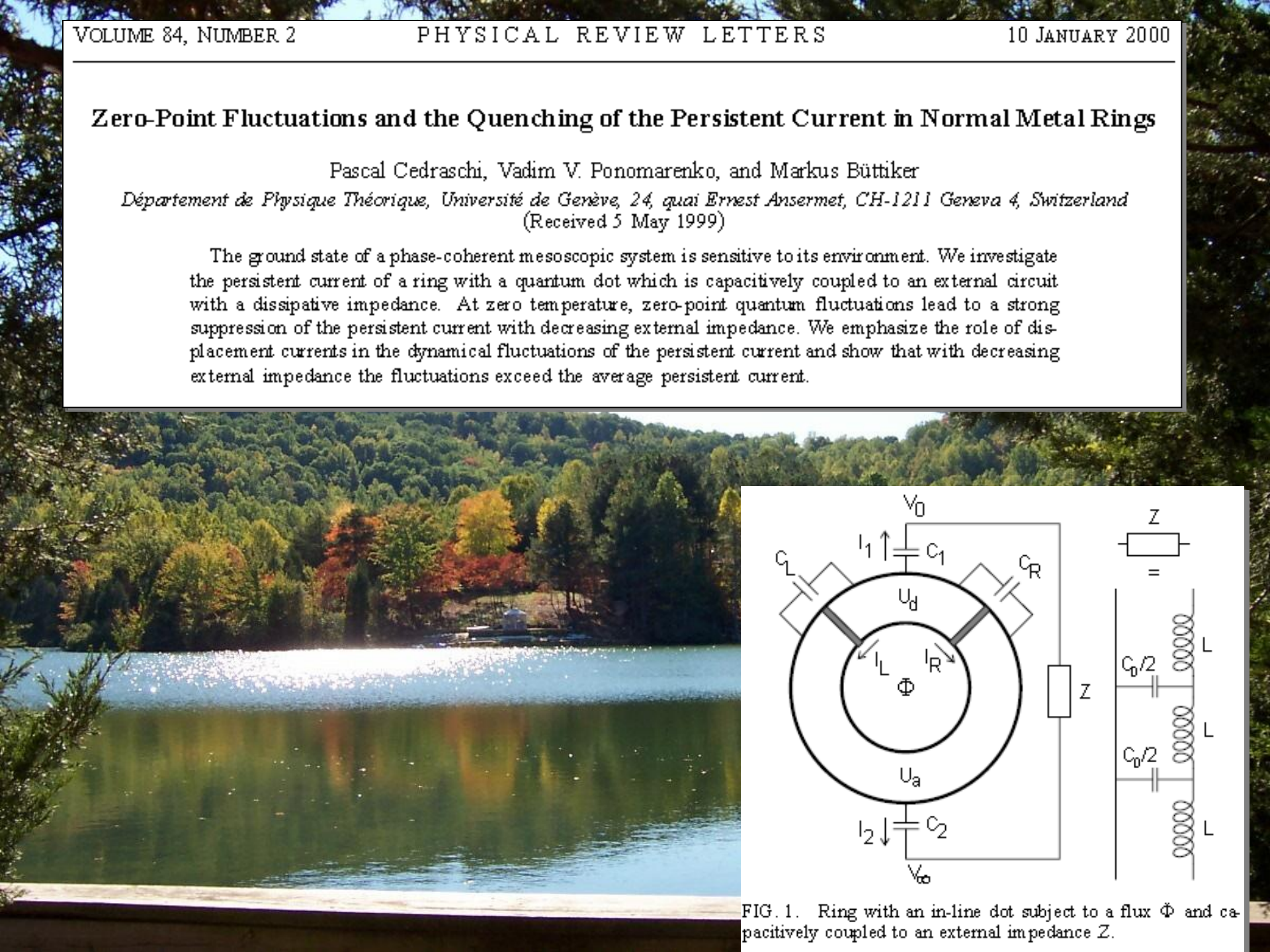
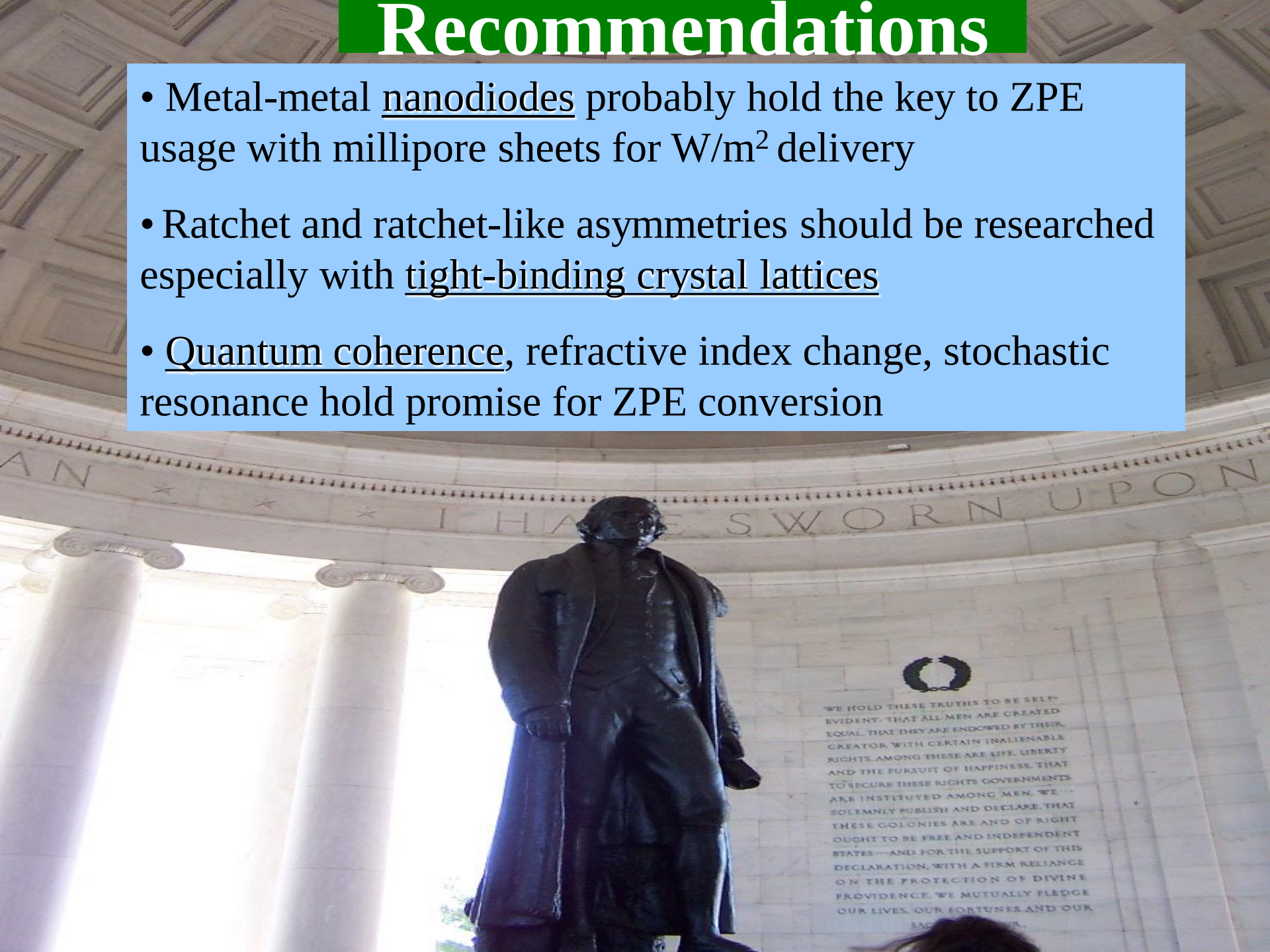


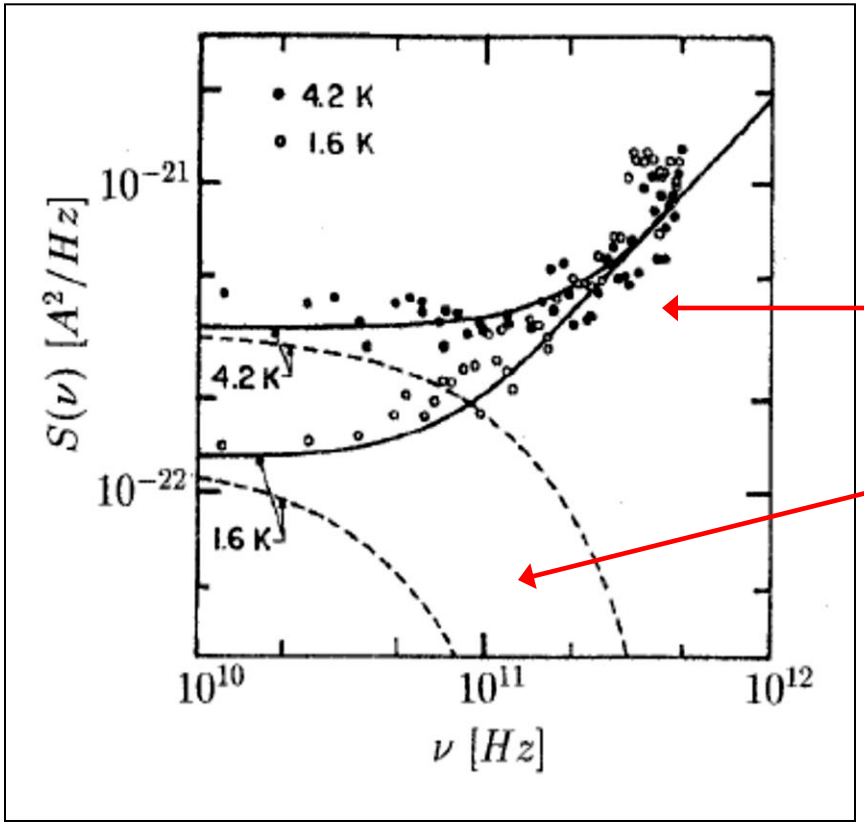
FIG. 1. Ring with an in-line dot subject to a flux Φ and capacitively coupled to an external impedance Z.

Recommendations

- Metal-metal nanodiodes probably hold the key to ZPE usage with millipore sheets for W/m^2 delivery
- Ratchet and ratchet-like asymmetries should be researched especially with tight-binding crystal lattices
- Quantum coherence, refractive index change, stochastic resonance hold promise for ZPE conversion



ZPE Measured in the Lab

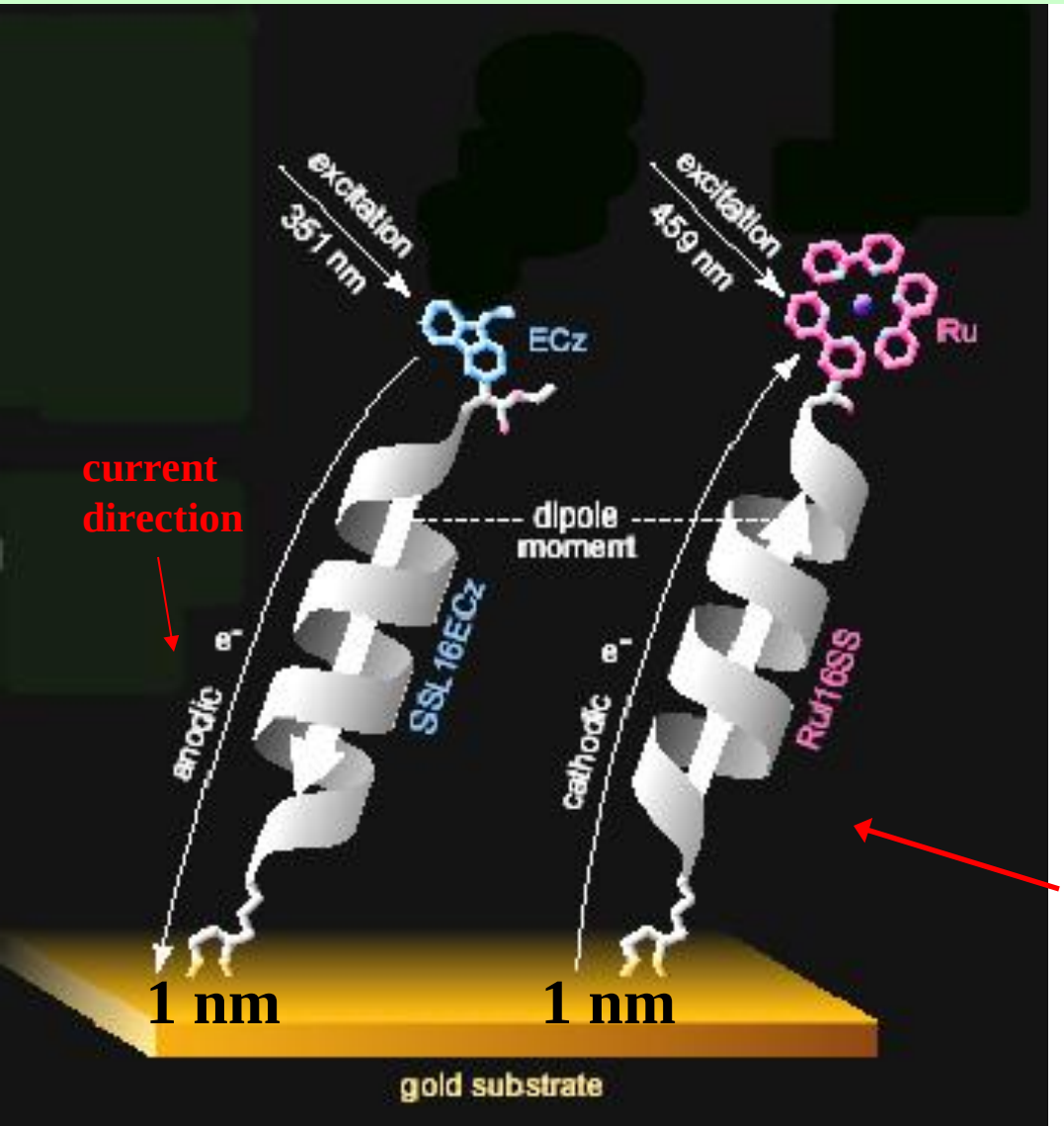


"Laboratory Tests on Dark Energy"
Christian Beck, U of London, Jour. of Phys., Confer. Series 31, 2006, p. 123-130

- Josephson junction meas. at 10 GHz to 500 GHz ($f_J = 2eV/h$)
- Spectral density is Planck's 2nd radiation law for ZPE ($h f_J > kT$)
- Dashed line is Planck's first law for oscillators w/o ZPE ($eV<kT$)
- Dark energy = vacuum fluctuations directly affects electrons and other charges
- Beck analyzed Koch results
- Koch, UC Berkeley, Phys. Rev. B, 26, 1, 1982

  - Read excerpt from article -

Rectifying Thermal and Non-Thermal Electric Noise



- Brown patent, metal-metal diodes #3,890,161
- Single electron transistors (SET) high noise at zero bias
- High resistance good for more thermal noise
- Not related to Peltier effect that needs current flow
- Self-assembled diodes
- Peptide molecular photodiodes 1 nm across

Yasutomi et al. 2004 *Science* 304 1944

VOLUME 91, NUMBER 10 PHYSICAL REVIEW LETTERS week ending 5 SEPTEMBER 2003

Quantum Charge Fluctuations and the Polarizability of the Single-Electron Box

K. W. Lehnert,[1,*] B. A. Turek,[1] K. Bladh,[2] L. F. Spietz,[1] D. Gunnarsson,[2] P. Delsing,[2] and R. J. Schoelkopf[1,†]

[1]*Department of Applied Physics and Physics, Yale University, New Haven, Connecticut 06511 USA*

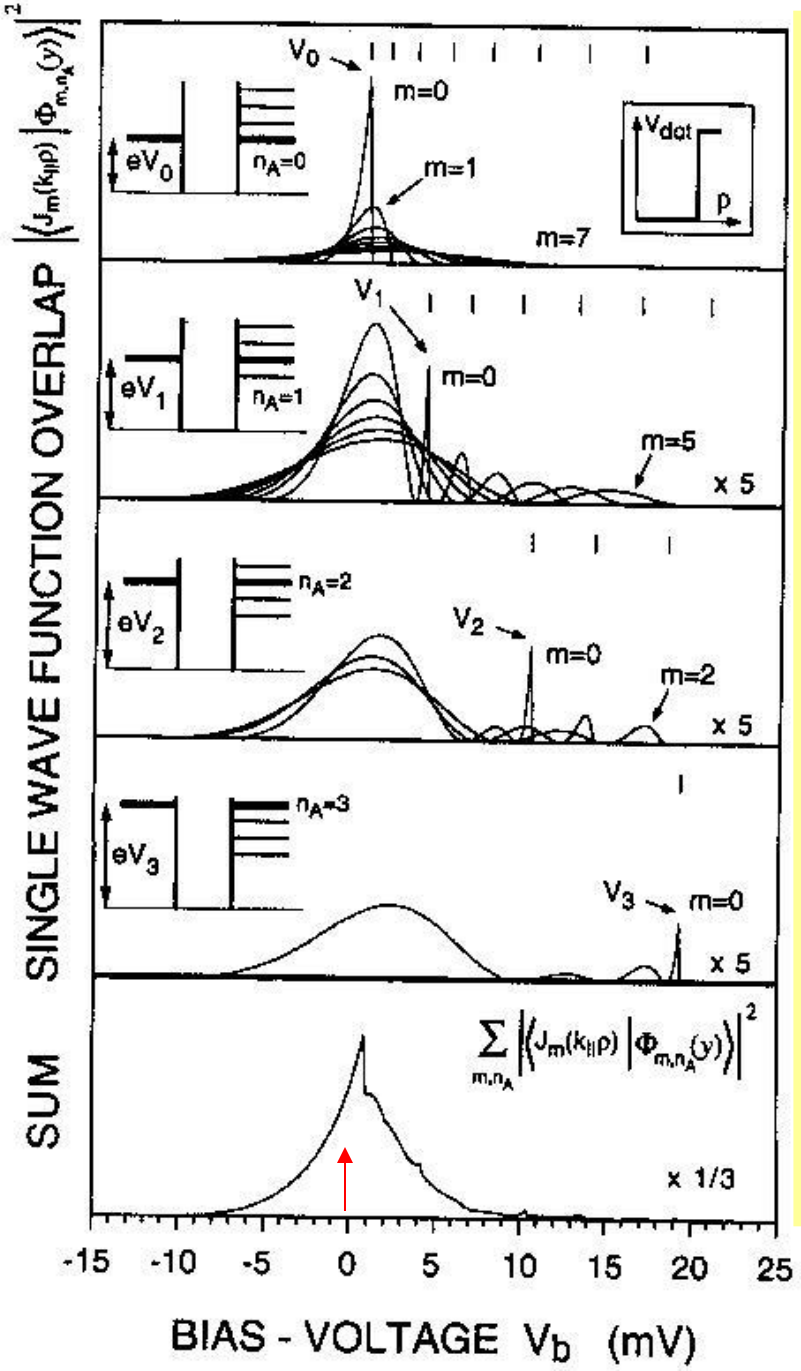
[2]*Microtechnology Center at Chalmers MC2, Department of Microelectronics and Nanoscience, Chalmers University of Technology and Göteborg University, SE-412 96, Göteborg, Sweden*

(Received 20 February 2003; published 5 September 2003)

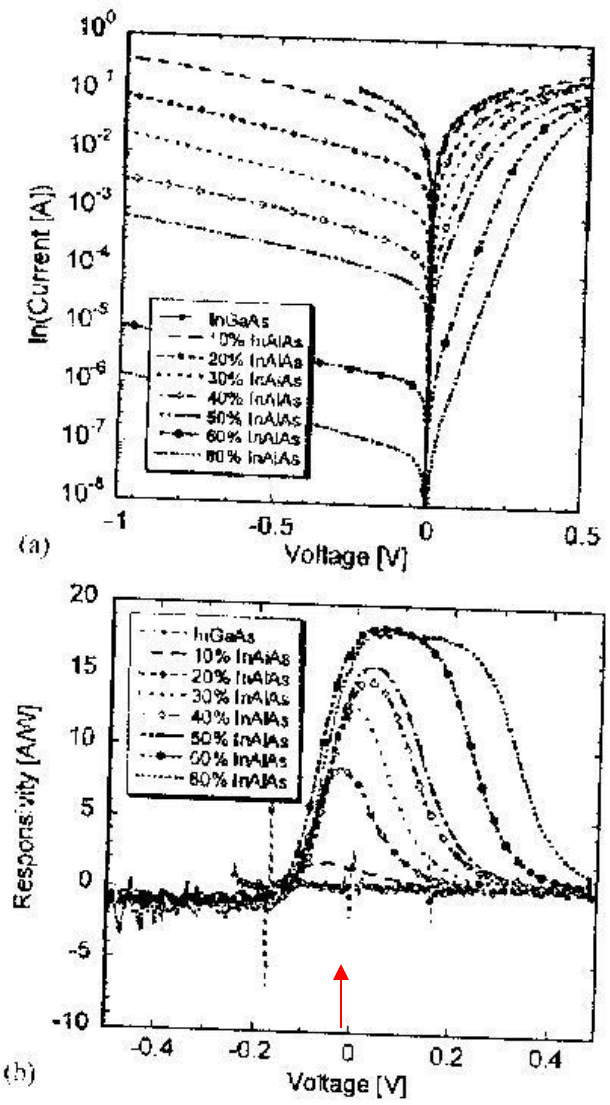
We measure the average charge on the island of a single-electron box, with an accuracy of two thousandths of an electron. Thermal fluctuations alone cannot account for the dependence of the average charge on temperature, on external potential, or on the quasiparticle density of states in the metal from which the box is formed. In contrast, we find excellent agreement between these measurements and a theory that treats the quantum fluctuations of charge perturbatively.

Defense Interest in Quantum Charge Fluctuations

This work was supported by the National Security Agency (NSA), Advanced Research and Development Activity (ARDA) under Army Research Office (ARO) Contract No. DAAD-19-02-1-0045, the David and Lucile Packard Foundation, the Wallenberg Foundation, and the W. M. Keck Foundation. The authors thank



Pillar shaped tunnel diodes - Smoliner, 1996



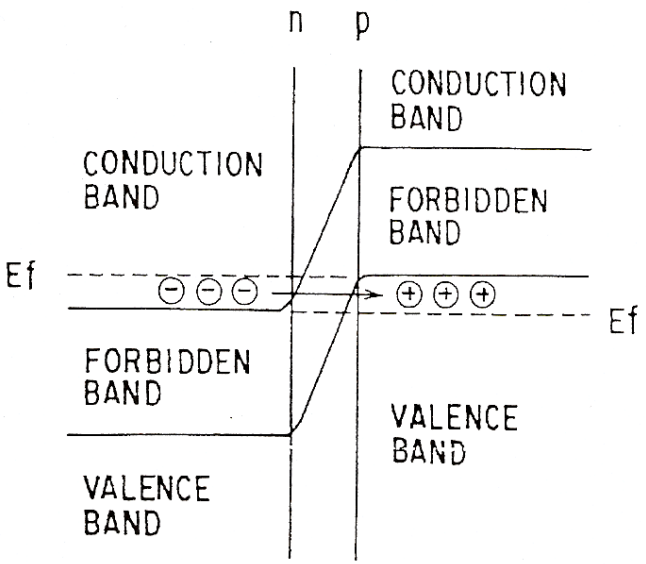
Noise eq. power = pW/Hz^{½}
semimetal-semiconductor

Diode developed at UC Santa Barbara

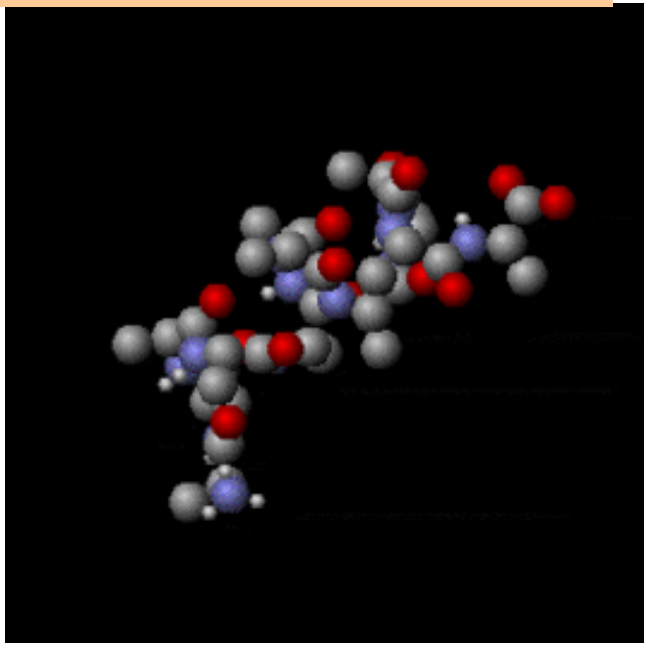
Modified Schottky RF-DC diode – Young, 2005

Tunneling Diode Currents

- HRL Labs, 2006, DARPA contract* developed BTD for field radiometer with a noise equivalent power (NEP) of 1.1 pW/$\sqrt{\text{Hz}}$
- Thermal noise $V_N = 4kTRF_{BW}$ is the biggest contribution
- Equivalent input noise ~ 1 nV/$\text{Hz}^{1/2}$ (Luukanen, NIST Boulder)



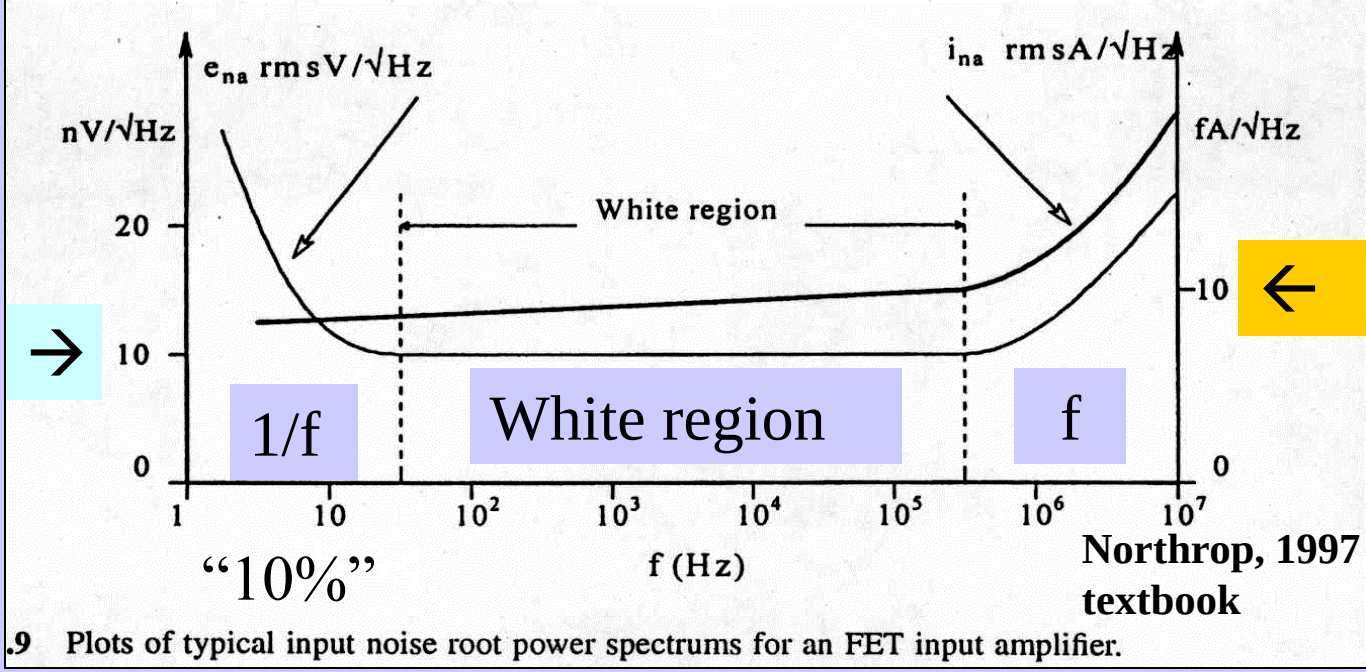
Thermal energy → can be rectified



Backward diode – Morizuka #5,930,122

***Lynch, Proc. of SPIE, 2006, p. 621101**

Noise Root Power Spectra



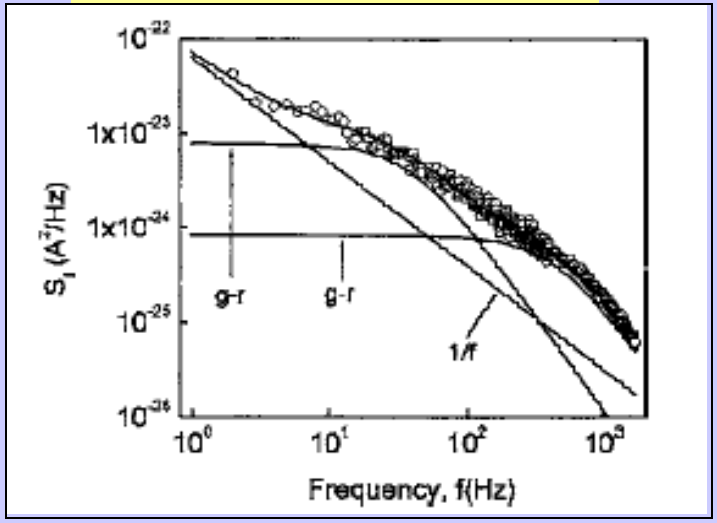
Northrop, 1997 textbook

.9 Plots of typical input noise root power spectrums for an FET input amplifier.

1/f noise graph - quantum dots

$$S_J(f) = (2hf / R)\coth(hf / 2kT)$$

S_I= 1 pA /√Hz

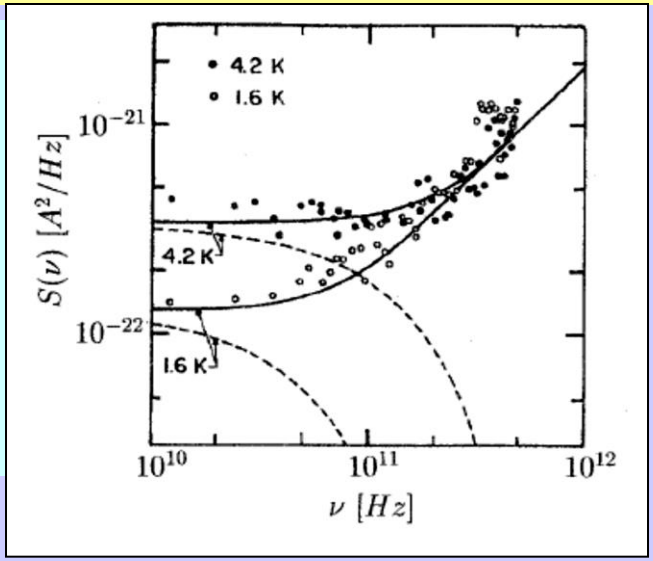


Tsormpatzoglou, 2005

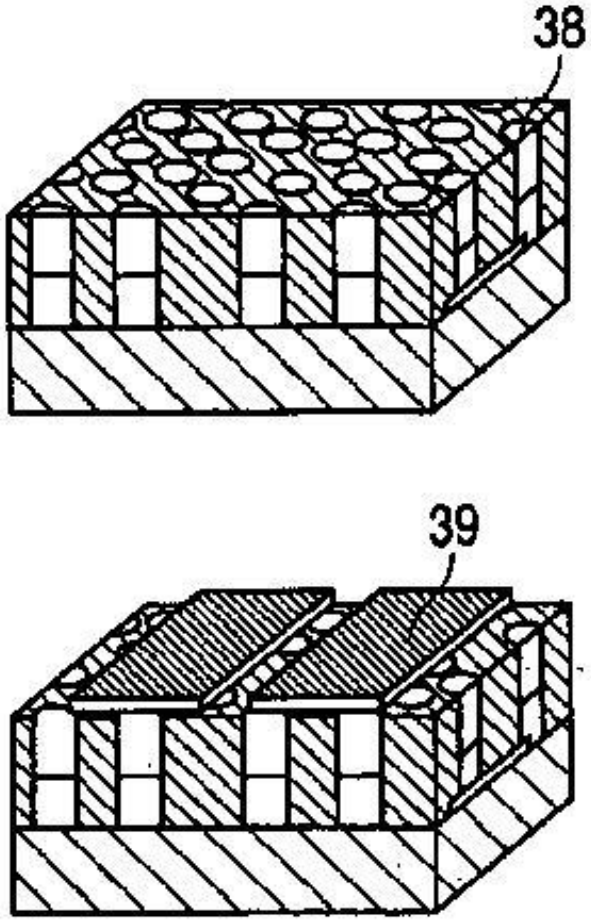
Josephson jct, S_J= 10 pA /√Hz

Koch, 1982

eV>>kT, current spectral density in R, S_I= hf/R



Proposed Diode Energy Array Converter (DEAC) Design



1) Kuriyama, Patent #7,183,127 cites Brown patent "Diode Array" #3,890,161

Kuriyama: **1 nm diode pillars** with 3 nm spacing yields 10^{12} diodes / cm^2

2) Compares favorably to **Hastas, 2003*** with GaAs Schottky diodes grown by atomic layer molecular beam epitaxy (ALMBE) yielding 10^{11} diodes / cm^2

Hastas**, ***J App Phys, **93, 7, 2003, p. 3990**

D

Textbook Noise Estimate

Intro. to Instrumentation and Meas., CRC Press, Northrop, 1997

Voltage fluctuation noise: nanovolt (nV) per root hertz*

Current fluctuation noise: femtoampere (fA) per root hertz

(background thermal noise and light scatter may add to this estimate)

Using Koch's measured frequency **THz upper limit** for current noise:

$$(10\ \mathrm{nV/Hz^{1/2}})(10\ \mathrm{fA/Hz^{1/2}})(10^{12}\ \mathrm{Hz}) = 0.1\ \mathrm{nW} = 100\ \mathrm{pW}$$

Assume a 10% efficiency yields **10 pW per diode** for a conservative estimate

*Also see Luukanen, NIST Quantum Electrical Metrology Division, Proc. of SPIE, V. 5410, 2004 (eq. noise **nV/Hz** $^{1/2}$)

ZPE Spectral Density

Picojoules per second (pJ/s) = picowatts (pW)

Zero Point Energy Spectral Density Equation*

$$\int_{\omega_1}^{\omega_2} \rho(\omega)\,d\omega = \frac{\hbar}{8\pi^2 c^3}\left(\omega_2^4 - \omega_1^4\right) \quad \text{eV/m}^3$$

Compare to 10^{17} Hz using 1 nm = λ resonant wavelength of diode junction and c/λ = f, put into Einstein's E=hf

keV or femtojoule (10^{-15} J)

390 eV/nm^3 = 10^{-15} J/nm^3 = 10^{12}J/m^3

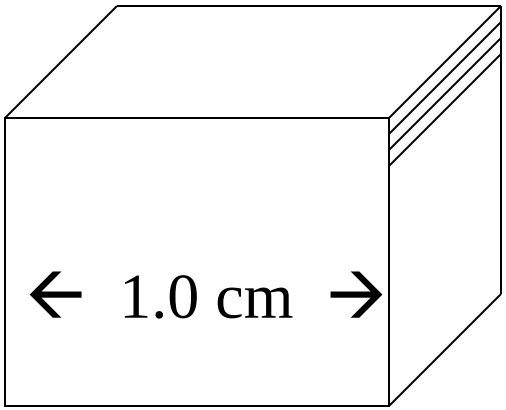
Same order of magnitude

Now use gamma ray (10^{23} Hz) as upper frequency limit. ZPE density = 390 MeV/fm^3 and an electron is a few femtometers in size, so Zero point energy density is 60 pJ per electron

*Milonni, ***The Quantum Vacuum***, Academic Press, 1994, p. 49

DEAC Power Cell with THz Limit

For a **10 cm^3 (10 cc) box** and 10% efficiency = 10 pW/diode



Nano-sized diodes = 10^{11} per cm^2

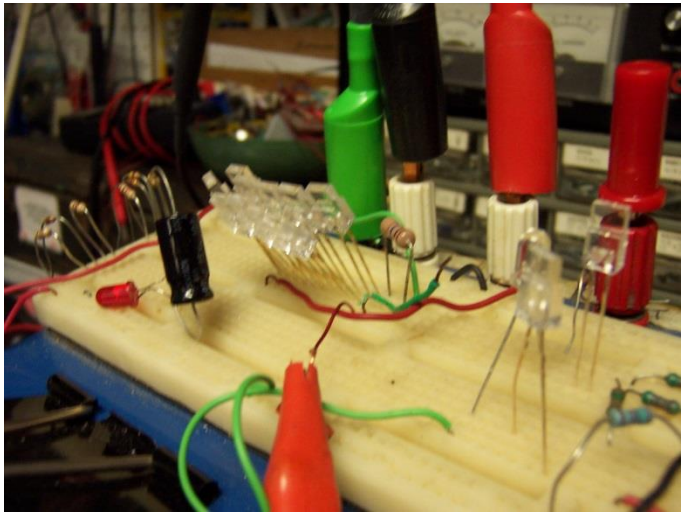
assuming 2 mm per layer with 1 mm substrate, yields 50 diode layers =
5 trillion diodes × 10 pW = **50W**

→ Therefore, a 1 cc cube = **5 W**

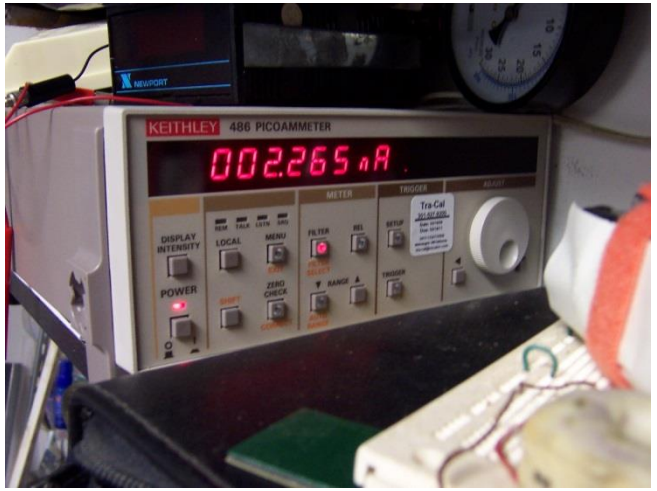
This conservative estimate, assuming only a 10% efficiency for total energy conversion, still reaches the kW/m^3 range of production, 24/7 from ambient thermal and non-thermal energy combined. This calculation also ignores the 1/f and the f range of noise that exceeds 10 nV and 10 fA per root hertz.

Corrected/Updated 2013

IRI Diode Energy Converter Research



10 Megohm resistor in series with 10 diodes



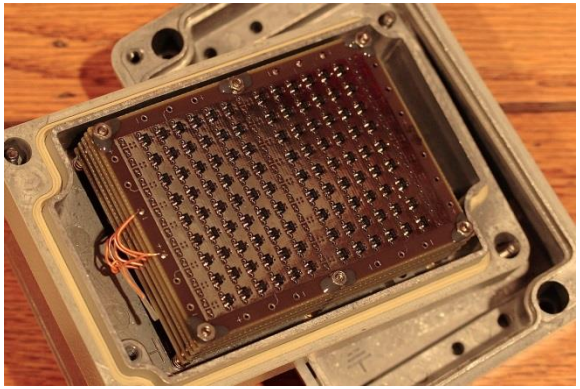
Keithley 486 Picoammeter reads 2.27 nanoamps constant current with or w/o resistor in series

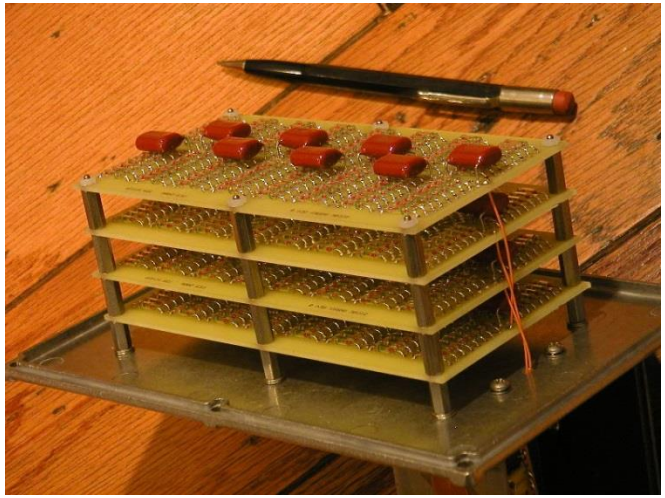
Voltage Readings with 10 Meg

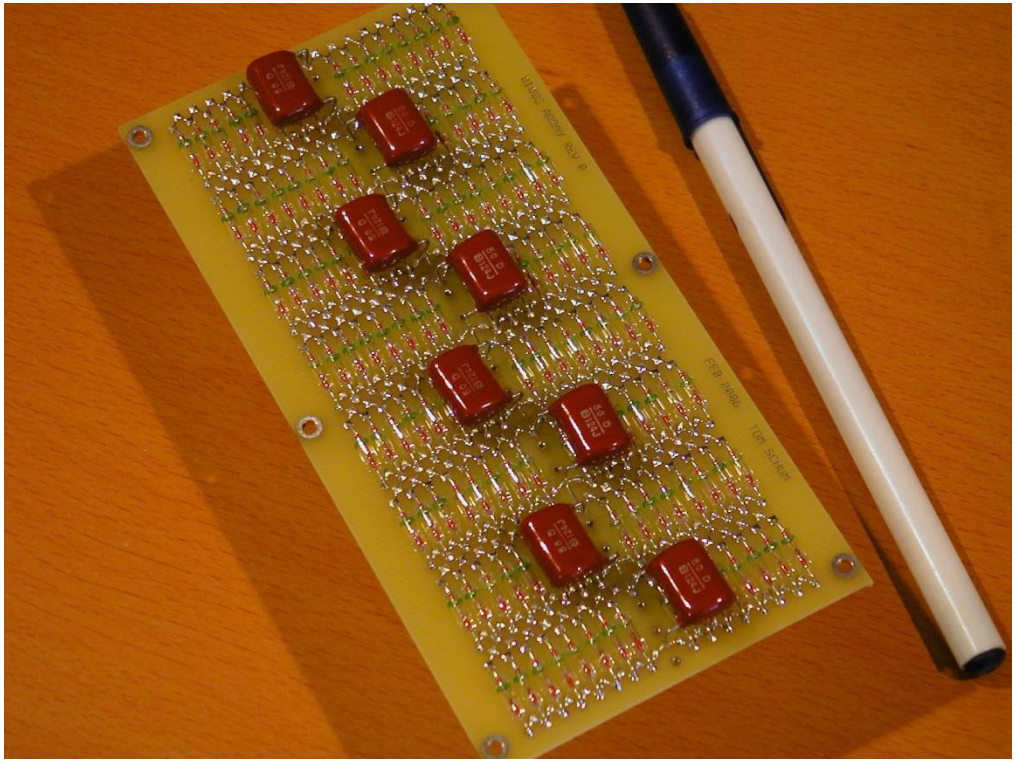
23 mV
across
10 MΩ
= 2.3 nA

Two views of IRI Electromagnetics Research Lab

Diode Array Example







Courtesy of Tom Schum

Summary of ZPE Conversion

	Microsphere	Nanosphere	Picosphere	Femtosphere
Photon energy	infrared 1 eV	optical 1keV	X-rays 1 MeV	Gamma rays 1 GeV
$E = mc^2$	Si: 10^{44} eV	Ag: 10^{17} eV	Pt: 10^{11} eV	p: 940 MeV
ZPE energy	390 meV/μm^3	390 eV/nm^3	390 keV/pm^3	390 MeV/fm^3
Physical cross sectional area	3 x 10^{-12} m^2	3 x 10^{-18} m^2	3 x 10^{-24} m^2	3 x 10^{-30} m^2
Scattering cross section	10^{-8} m^2	10^{-15} m^2	10^{-21} m^2	10^{-30} m^2

Highest energy Density: picojoules

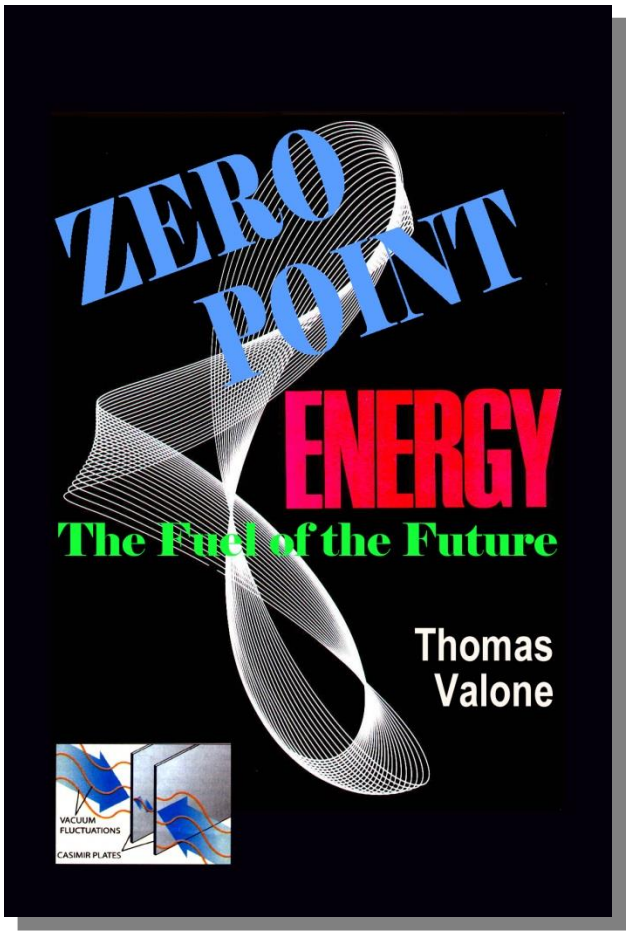
***Classical electron radius e^2/mc^2 = 2.8 fm**

Electromagnetic	Mechanical	Fluid Dynamic	Thermodynamic
Dual sphere - Mead	Casimir engine - Pinto	Inertia Effects - Froning	Quantum coherence - Allahverdyan, Scully
Focusing ZPE - Ford	Cavity QED - Haroche	Hydrodynamic model – Bohm	Brownian motors - Astumian
	Spatial squeezing- Hu	Casimir cavity - Maclay	Transient fluctuation theorem - Crooks
	Casimir cavity optimized design - Maclay		Thermal fluctuation rectifiers – Brown, Ibarra-Bracamontes, Engel
	Vibrating cavity photon emission - Hizhnyakov		Quantum Brownian nonthermal rectifiers - Goychuk

Valone, ***Practical Conversion of ZPE***, 2003

Directions for Further Research

- Single layer series testing to be pursued for next paper
- Two independent verifications of zero bias diode array already have surfaced
- Refrigeration effect is expected
- Hastas (GaAs Schottky diodes) measured 100 pA of forward current at zero bias
- Hundreds of kW/m^3 is possible even without EMF energy harvesting and 1/f and f contributions
- Noise amplification is well known, enhancement of shot noise is an example that resulted in charge accumulation



Websites:

www.quantumfields.com

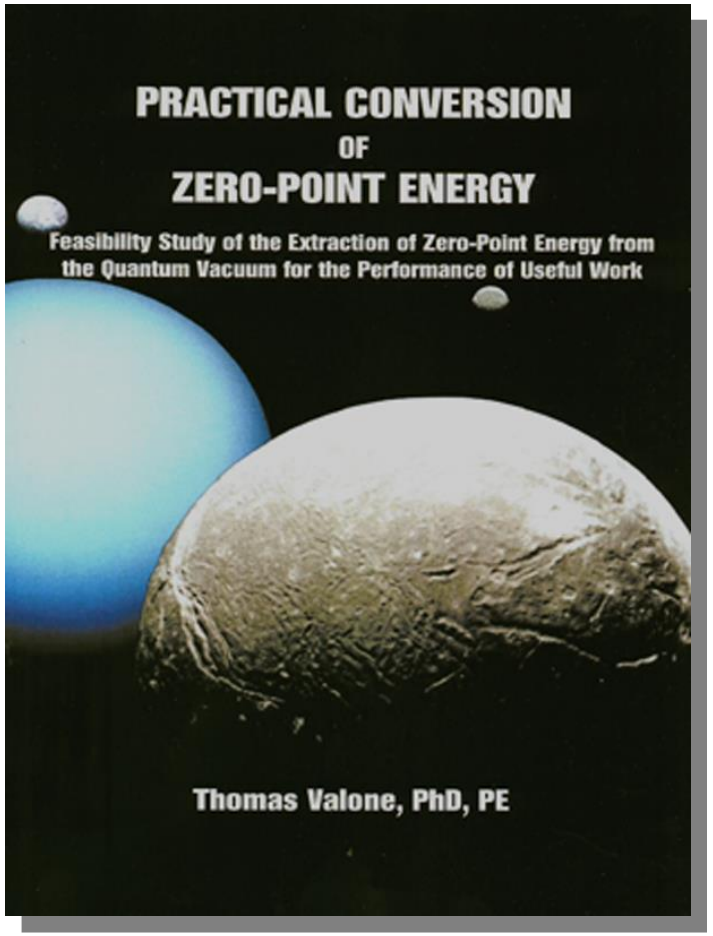
www.zpenergy.com

www.IntegrityResearchInstitute.org

www.earthtech.org

Latest book (250-page) loaded with pictures explains zero point energy utilization in easy-to-understand terms. Available on Amazon.com

For further technical information



Also see “Proposed Zero Bias Diode” paper - IRI website.