



Theory of Condensed Matter

Theoretical Research in Condensed Matter
and Related Fields

at

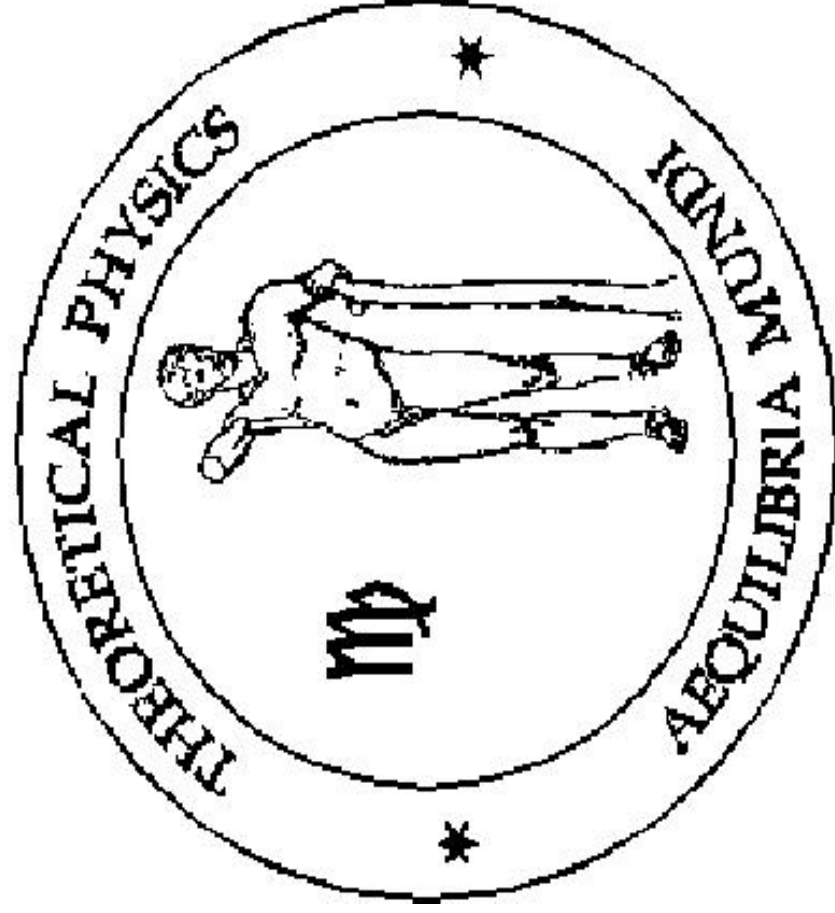
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Institute of Atomic Physics, MG-6, POBox
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<http://www.theory.nipne.ro/CMP>

**THEORY of CONDENSED
MATTER**



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apoma@theory.nipne.ro

dr. Marian Apostol

Professor of Theoretical Physics



Quantum theory of plasmons in layered structures (1975)

One-dimensional bosonization (1980)

Four-fermion condensate (1985)

High- T_c superconductivity (1990)

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250 scientific papers in

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Binding**

at *apoma*, MB

Founder and Editor of
**Journal of Theoretical Physics and
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High-School Textbooks
Elementary Mathematics
Introductory Physics

Quanta of Viscosity

M. Apostol

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Abstract

It is shown that the viscosity is quantized in h/m quanta, where h is Planck's constant and m denotes the particle mass.

The chaotic motion of classical statistical ensembles consists of fluctuating times τ during which particles move over a fluctuating distance a , such that these movements are independent of time and of each other; consequently, one may write down the conservation of particle density

$$\begin{aligned} n(x, t + \tau) - n(x, t) &= \frac{1}{2} [n(x + a, t) - n(x, t) + \\ &+ n(x - a, t) - n(x, t)] = \frac{1}{2} [n(x + a, t) + n(x - a, t) - 2n(x, t)] \end{aligned} \quad (1)$$

for motion in both directions; whence

$$\partial n / \partial t = (a^2 / 2\tau) \partial^2 n / \partial x^2 \quad (2)$$

which is the diffusion equation with the diffusion coefficient $D = a^2 / 2\tau$ on the average. Similarly, particles moving with velocity v in time τ are given by $\eta v \tau$ and by

$$\int_0^a d\xi [n(x + \xi/2) - n(x - \xi/2)] \quad (3)$$

whence the diffusion equation $\eta v = D(\partial n / \partial x)$ (Fick's law, or $\partial n / \partial t = D \partial^2 n / \partial x^2$ above) with the diffusion coefficient $D = a^2 / 2\tau$ and a^2 the mean square displacement. Even more, half of $n(x - a/2)$ particles move through x over an average distance a in time τ (the other half move through $x + a$), and, similarly, half of $n(x + a/2)$ move through a in opposite direction; therefore $(1/2)[n(x + a/2) - n(x - a/2)] = (a/2) \partial n / \partial x$ particles (per unit volume) move over a distance a ; it follows that $(a^2 / 2\tau) \partial n / \partial x$ particles move per unit time, which equal ηv ; one obtains again the diffusion equation with the diffusion coefficient $D = a^2 / 2\tau$.

Equation (1) is Einstein's kinetic equation.[1] It describes the approach to equilibrium over long times and large distances, by slow processes in comparison with the rapid, short fluctuations. This is the relaxation motion, taking place by diffusive motion. The main content of Einstein's kinetic

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On the End of the World, Expi(r)atory Theories and Poor Theoretical Physics

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Recent authors herald, on so-called scientific grounds, the end of the world (as it would deserve, probably) in 2052 ± 10 . [1] This was one more reason to hurry up and give here my comments. These authors write up in Statistical Mechanics, where they handle large data sets and plot them against and versus various variables. This time they took the world population over the last 2000 years, Gross Domestic Product (GDP), Research and Development (R&D) and technology and plot them *vs* time. The plots show a sudden and abrupt increase, much beyond any exponential, of a characteristic power type, at a finite critical time, estimated as about 2052 ± 10 , as said above. Hence, the authors conclude that the world nears soon an end.

First, large sets of data, say N , are affected by statistical errors that are \sqrt{N} , which diverge precisely at the critical point, rendering futile any χ^2 -test of the fit. This is a well-known point in the so-called theory of the critical point, telling that "if the critical transition exists then the singularity goes like that divergence", but, oppositely, "from no empirical divergence can be inferred a critical point", because we can not derive a divergence from an "empirical" divergence. This is a very nice point, where the accurate knowledge can only be derived from theory, and not from empirical world.

Secondly, leaving aside that R&D and technology are hard to define, they and the GDP span a few hundreds of years, precisely near the "divergence", while the population is taken from year 0. The coincidence of the critical times for all these three data sets could therefore be merely a wishful thinking, because short data sets can be fitted with anything over long variables sets.

Nevertheless, the authors believe that after reading their paper people would stabilize population and the demographic growth, possibly by terrorism and segregation, return to an ecological life, transfer the resources from developed to developing countries, populate other planets, or adopt a knowledge-based society, where "knowledge, intellectual, artistic and humanistic values replace the quest for "material wealth". Indeed, knowledge is non-rival, *i.e.* using it in some place does not prevent it being used elsewhere, while a clothing item can not be used simultaneously by someone else. What is sure is that people will not be doing theoretical physics anymore, after reading this paper.

Which is a pity, because the Ginsburg-Landau functional for population with complex coefficients (to exhibit oscillations) can be constructed, Wilson's theory of renormalization group[2] may be applied, and critical exponents might be derived for a phase transition of the world. Which would be a nice exercise.

apoma BOOKS

MECHANICS

M. Apostol

apoma 1997
Institute of Atomic Physics
Magurele-Bucharest

STATISTICAL PHYSICS

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Journal of Theoretical Physics 1995–1999

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L. C. Cune and M. Apostol

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TRANSPORT THEORY

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ACADEMY *of* **PHYSICS**

Magurele–Bucharest

We,

Marian Apostol

Independent researchers of Physics,

In pursuit of truth,

**Out of our desire to impart it among ourselves and with our fellow men,
Both as individuals and as social beings,**

Endeavouring with Theoretical Physics and Natural Philosophy,

Convinced of their capability of elevating our souls,

Believing in God, in Science and in ourselves,

Founded

The
Academy of Physics

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As an Open, Free, Independent and Universal Association,

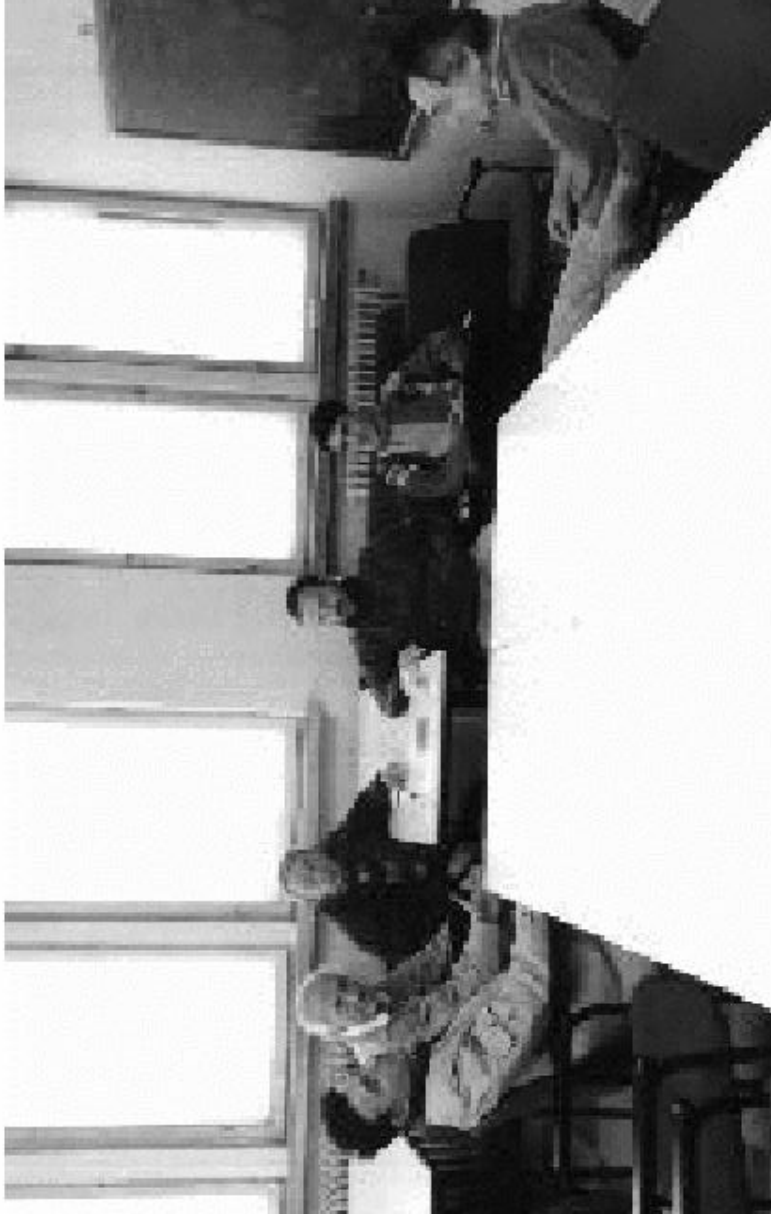
To cultivate
the

Seeking of Truth
and

Aequilibria Mundi

March 26, 2000

Apostol's Laboratory of Theoretical Physics



An empty table and a few heads



dr. M. Apostol, professor of Theoretical Physics, Institute of Atomic Physics
Magurele-Bucharest MC-6, POBox MC-35, Romania, ph-40-1-40-73 007313, -40-1-45- 40 82
(h), fax: -40-1-423 1701, e-mail: apoma@theory.nipne.ro, <http://www.theory.nipne.ro/~apoma>



Theoretical research in Condensed Matter Physics

This research group was set up at the Institute of Atomic Physics, Magurele-Bucharest, Romania, in 1980s, with the aim of investigating the theoretical aspects of the condensed matter physics. In the intervening time the group acquired a pretty fair expertise in several areas of research in this field, to be listed below. The group has also developed certain skills in other branches of theoretical physics, such as nuclear physics, atomic physics, materials science, physical chemistry, etc. Since 1998 we affiliated to the University of Bucharest too.

The group teamed, at various times, an average of 4–5 researchers, and published, on the average, cca 10 scientific papers per year, in internationally refereed journals. It maintains an electronic archive (<http://archive.theory.nipne.ro>), which offers, among others, two electronic journals (*J. Theor. Phys.* and *Antiphys. Rev.*). More information is to be found at <http://www.theory.nipne.ro/~apoma>.

The main areas of group's expertise in theoretical condensed matter physics are:

1. Low-dimensional quantum gases and liquids
2. Electronic correlations
3. Phase transitions
4. Charge- and spin-density waves
5. High-temperature superconductors
6. Fullerenes
7. Atomic clusters, mesoscopic systems
8. Magnetic field-related phenomena
9. Non-linear phenomena
10. Transport phenomena
11. Quantum mechanics of molecules
12. Defects, disorder and modulated structures
13. Quantum correlations, non-equilibrium phenomena and quasi-classical behaviour
14. Waves in guiding structures and special geometries
15. Statistical physics

At present the group includes (mainly): prof.dr. M. Apostol, prof. dr. N. Angelescu, dr. M. Bundaru, dr. F. Buzatu, G. Costache, C. Cune, dr. F. Despa, dr. N. Marinescu, C. Schiava. They can be contacted at the address above.



Professor Marian Apostol

Marian Apostol is professor of Theoretical Physics at the Institute of Atomic Physics, Magurele-Bucharest, Romania. He obtained his PhD from the same institute in 1984 and worked there as scientific researcher, where he is now the Head of the Condensed Matter Theory group. His research interests include condensed matter; atomic, nuclear, solid-state, materials, chemical and mathematical physics. He has published over 200 papers in these areas, 8 postgraduate monographs, and founded and is currently editing and publishing the **Journal of Theoretical Physics** (<http://archive.theory.nipne.ro>).

Condensed Matter Theory Group at Magurele-Bucharest

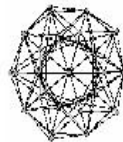


Apostol's Laboratory of Theoretical Physics

The group is interested and active in: **Low-dimensional quantum gases and liquids, Electronic correlations, Phase transitions, Charge- and spin-density waves, High-temperature superconductors, Fullerenes, Atomic clusters, Mesoscopic systems, Magnetic field-related phenomena, Non-linear phenomena, Transport phenomena, Quantum mechanics of molecules, Defects, disorder and modulated structures, Quantum correlations, non-equilibrium phenomena and quasi-**

classical behaviour, Waves in guiding structures and special geometries, Statistical physics and Mathematical Physics, Nanostructures, Spin transport, Surfaces, Magnetism

It includes 2 professors, 4 researchers, 2 PhD students, and has several open post-doc and PhD positions. More information can be found at <http://www.theory.nipne.ro/CMP>



A metallic cluster of 45 atoms in ground-state

Atomic Clusters and Nanostructures

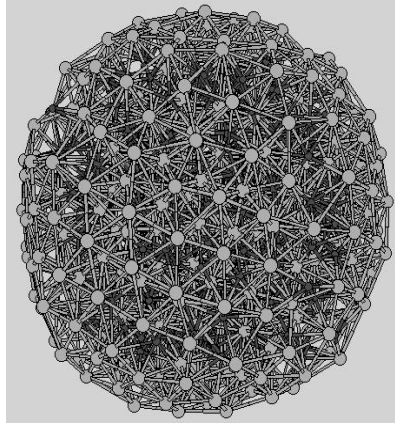
Matter aggregation at atomic level has been pursued recently, in order to get quantitative physical and chemical information about clusters and nanostructures from first principles. This was partially attained by the quasi-classical solution to Hartree-Fock equations. We may know at this moment equilibrium geometric forms, ionic positions, inter-ionic distances, ground-states and isomers, magic numbers, vibration spectra, etc for a large variety of homo-atomic metallic clusters, both isolated and deposited on surfaces, with a reasonable accuracy.

Recent Publications

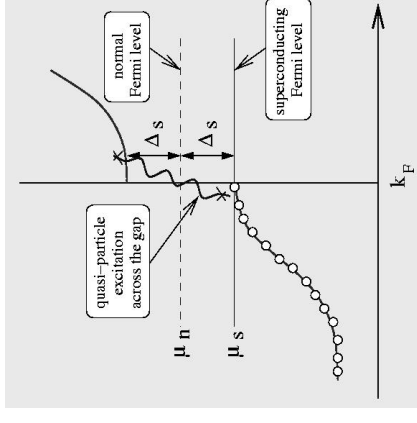
1. *Ground-state energy and geometric magic numbers for homo-atomic metallic clusters*, L. C. Cune, M. Apostol, Phys. Lett. **A273** 117 (2000).
2. *Iron-hydrocarbon cluster $Fe_{45}(C_2H_2)_6$* , L. C. Cune, M. Apostol, Chem. Phys. Lett. **344** 287 (2001).
3. L. C. Cune, M. Apostol, **Metallic Binding**, apoma, MB (2001).

For additional information please contact
Marian Apostol at email:
apoma@theory.nipne.ro

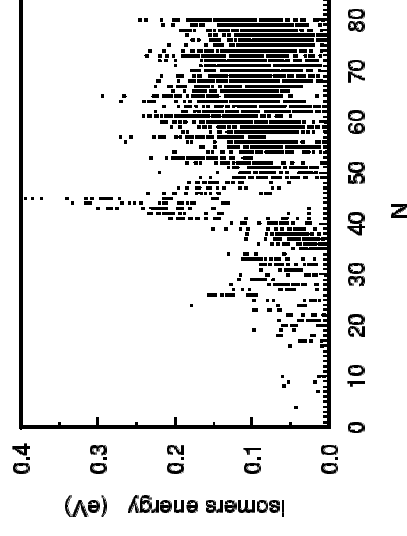
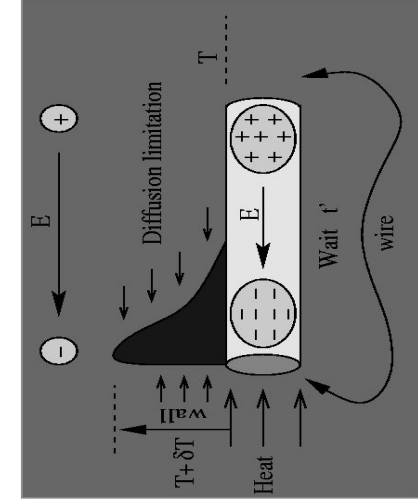
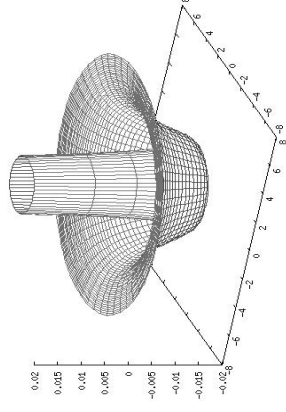
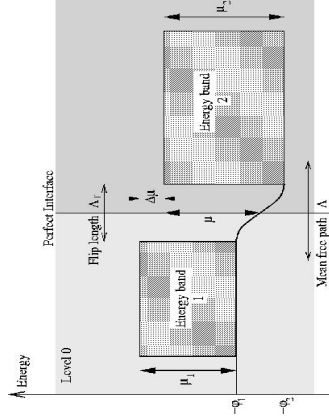
Research Projects



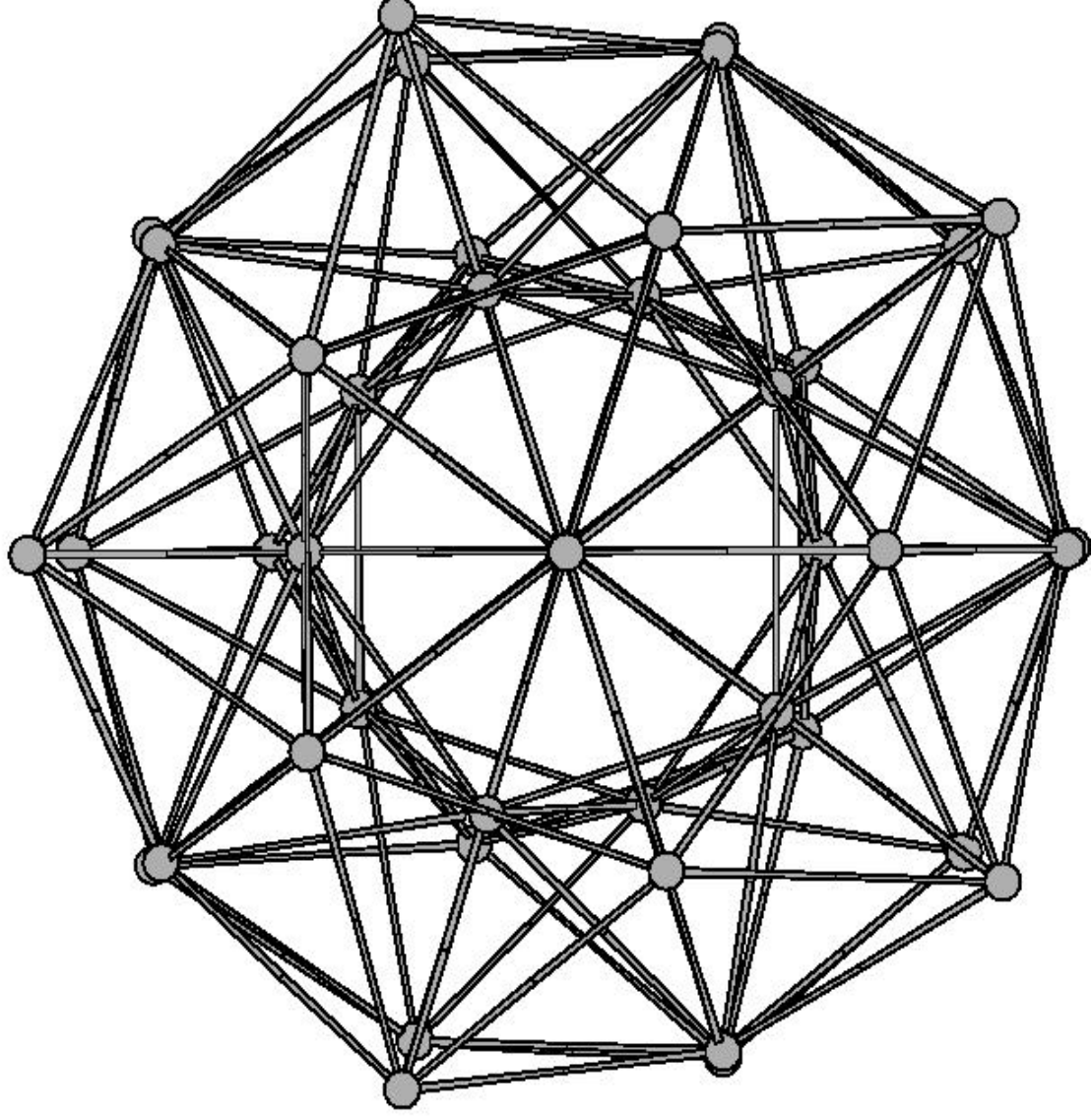
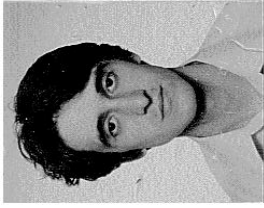
1. Theory of Condensed Matter
2. Matter Aggregation
3. Factory of Chemical Bonds
4. Electric Flow through a Ferromagnet-Superconductor Junction
5. Alternate Thermoelectricity
6. Laboratory of Scientific Multimedia

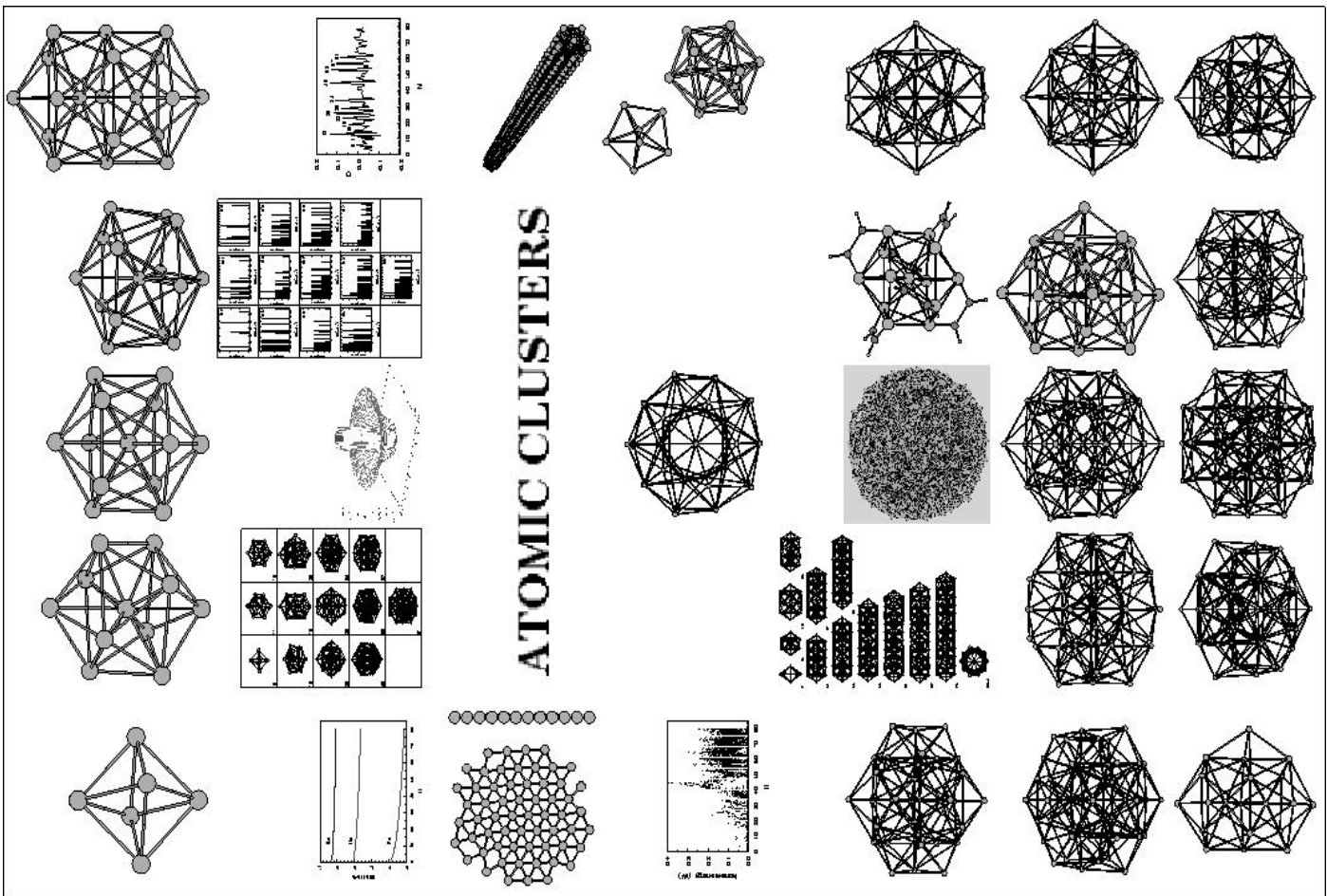


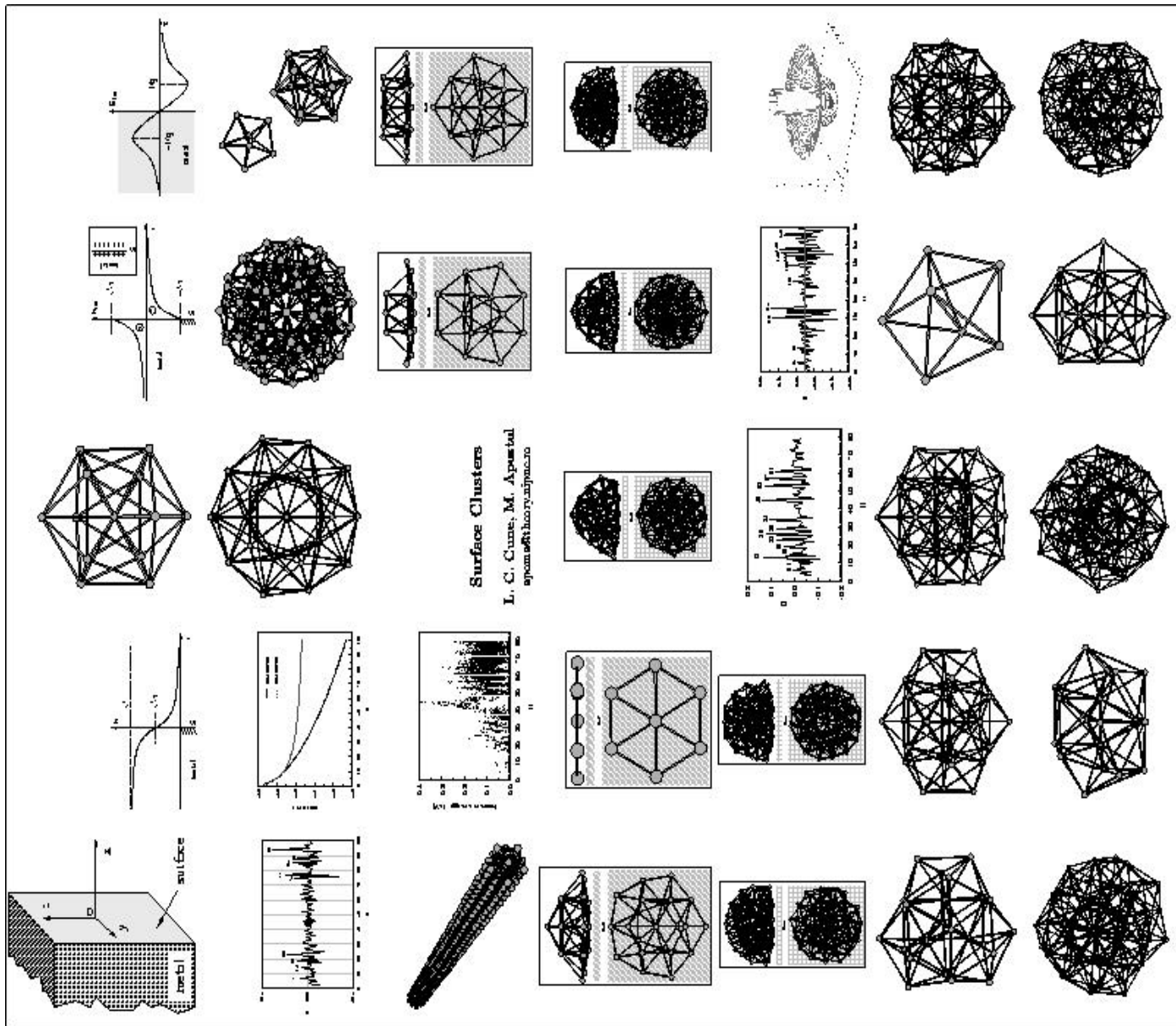
7. Virtual Laboratory of Physics
8. Living Matter
9. Elementary Mathematics
10. Introductory Physics



Matter Aggregation, Cohesion of Solids, Chemical Bonds, Metallic Binding







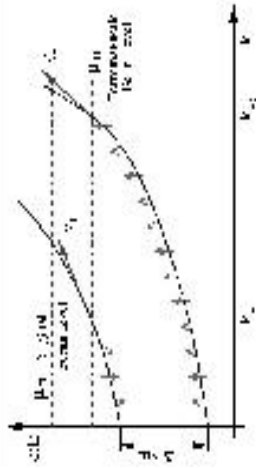


Fig. 1. Spectrum of Ferrimagnetic Quasi-Particles

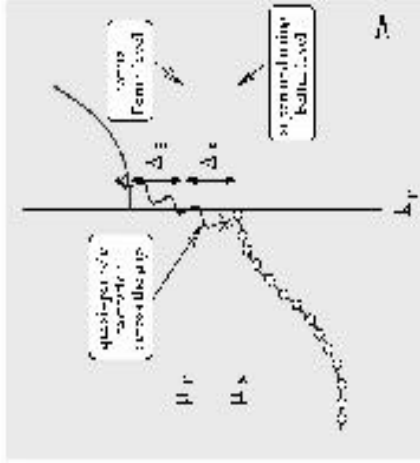


Fig. 2. Superconducting Quasi-Particle Spectrum

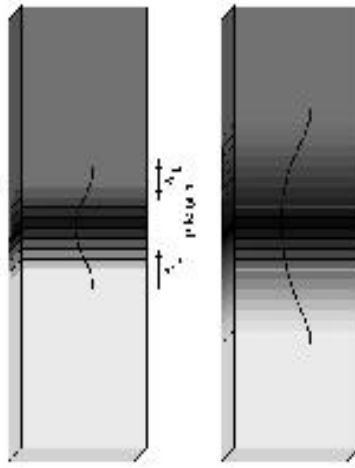


Fig. 4. Two Solids in Contact

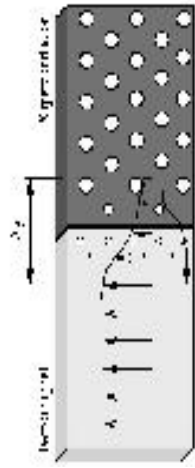


Fig. 5. Spin-Fin and Gap Opening at the Interface

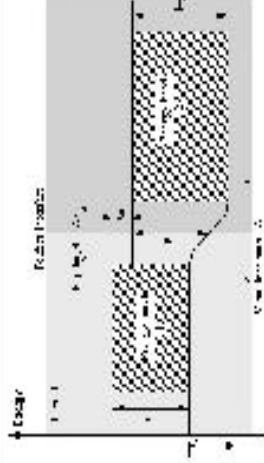


Fig. 3. Two Solids with a Perfect Contact

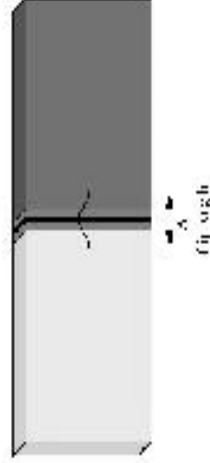


Fig. 7. A Perfect Contact

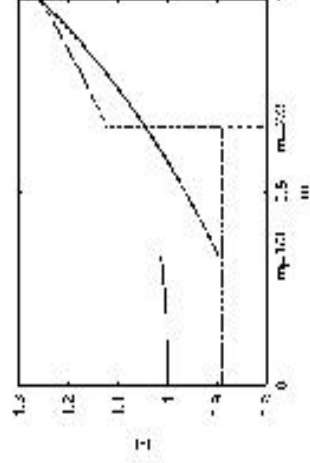


Fig. 8. FIS Resistance vs Magnetization

Electric flow through a ferromagnet-superconductor junction

M. Apostol, L. C. Cone

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Institute of Atomic Physics,
Magurele-Bucharest, Romania

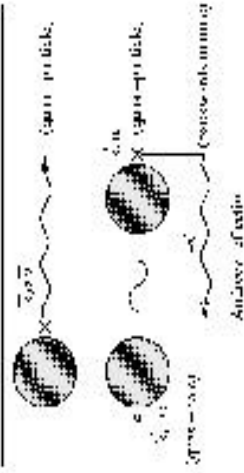
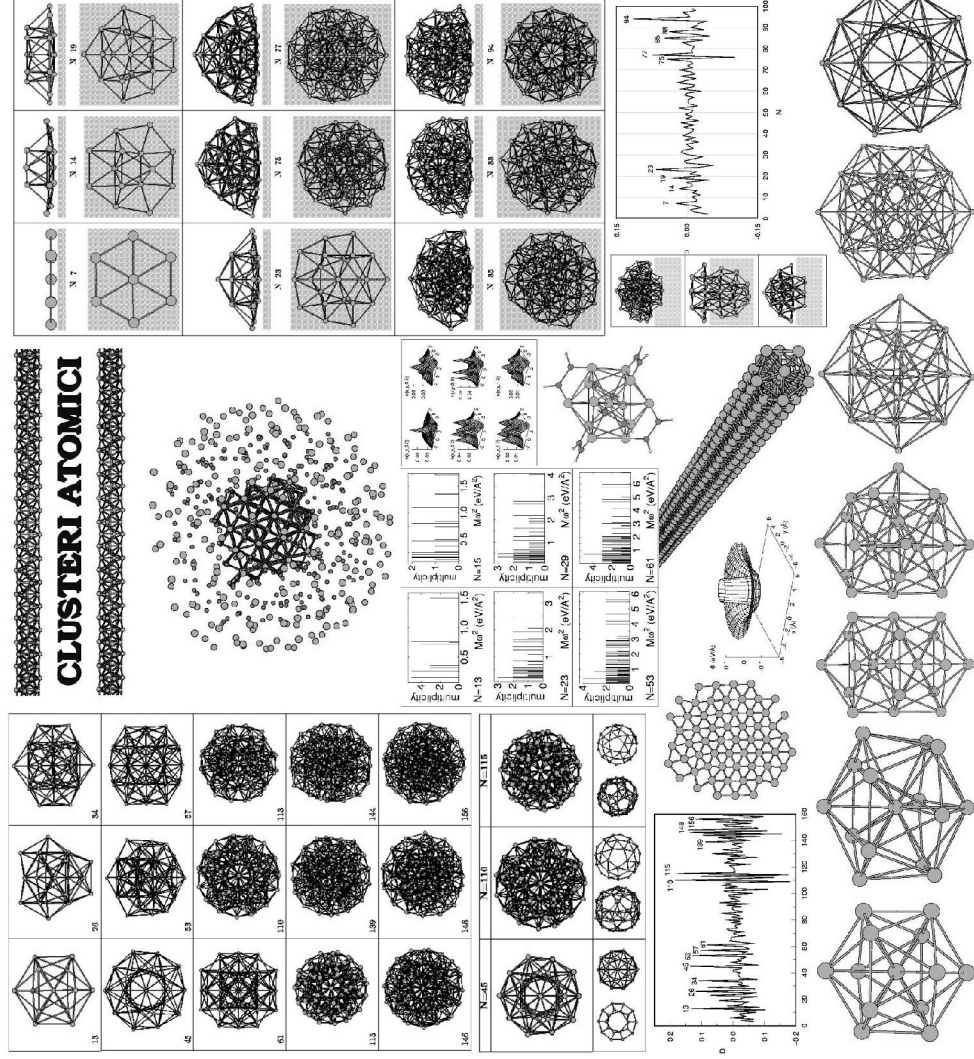


Fig. 6. Andreev Reflection



SESIUNEA STIINTIFICA ANUALA A PROGRAMULUI CERES (28-29 noiembrie 2002)



TEMA: CERETARI TEORETICE FUNDAMENTALE ASUPRA UNOR PROBLEME ACTUALE DE MATERIE CONDENSATA

FINANTAT IN CADRUL PROGRAMULUI CERES NR. 65/2001

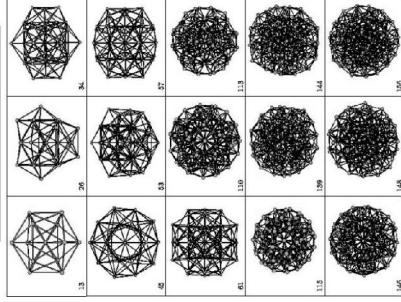
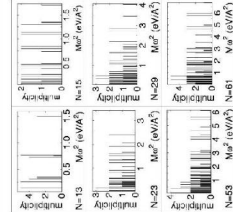
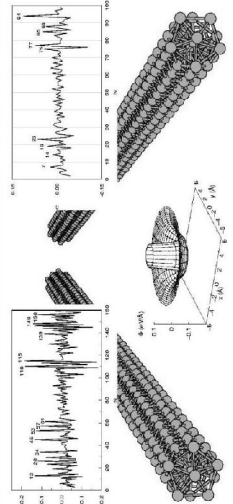
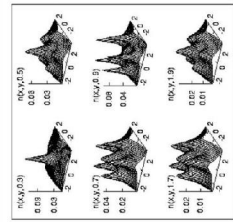
Director de proiect: Prof. M. Apostol

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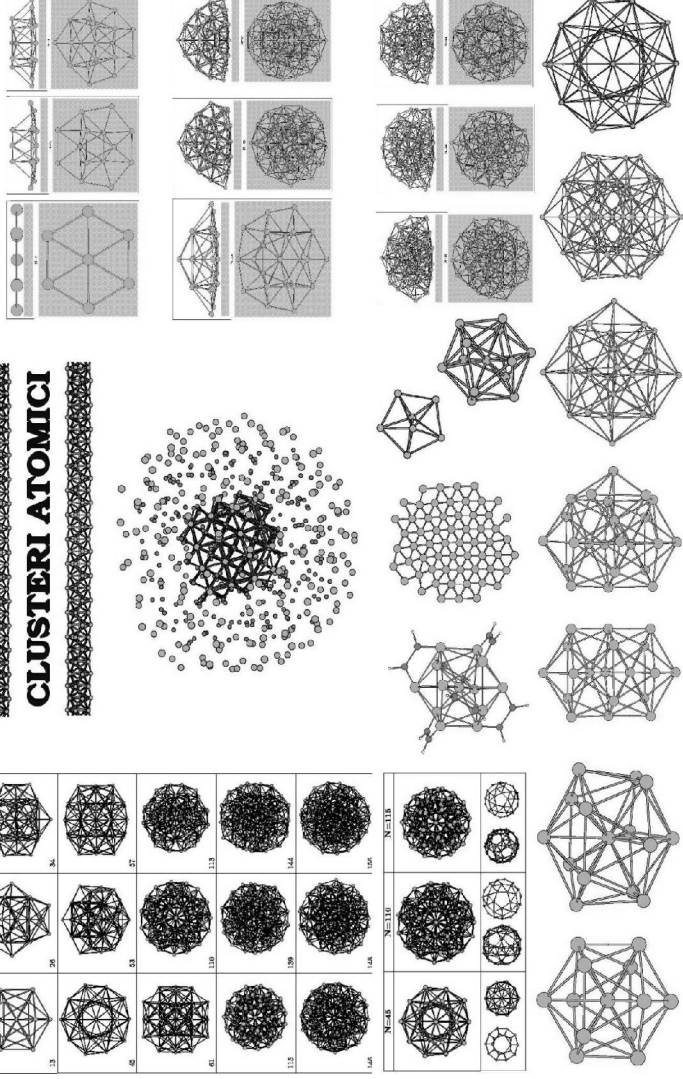


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SESIUNEA STIINTIFICA ANUALA A PROGRAMULUI CERES (28-29 noiembrie 2002)



CLUSTERI ATOMICI



● **TEMA: CERCETARI TEORETICE FUNDAMENTALE ASUPRA UNOR PROBLEME ACTUALE DE MATERIE CONDENSATA**

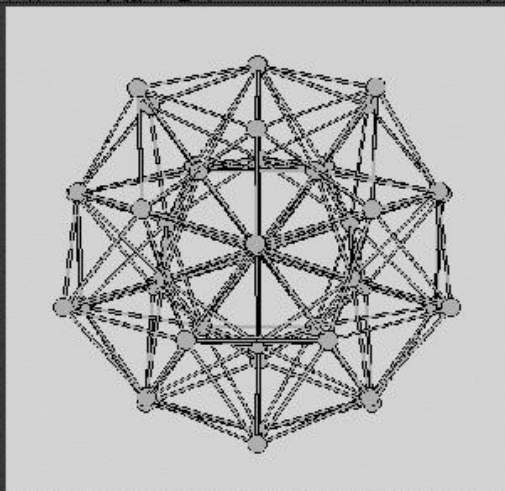
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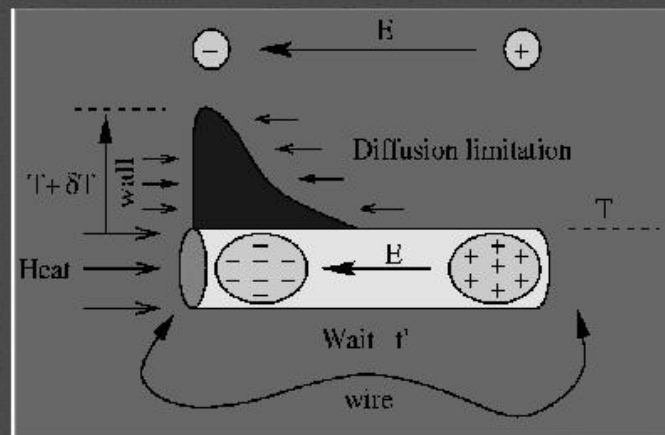
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Atomic Clusters



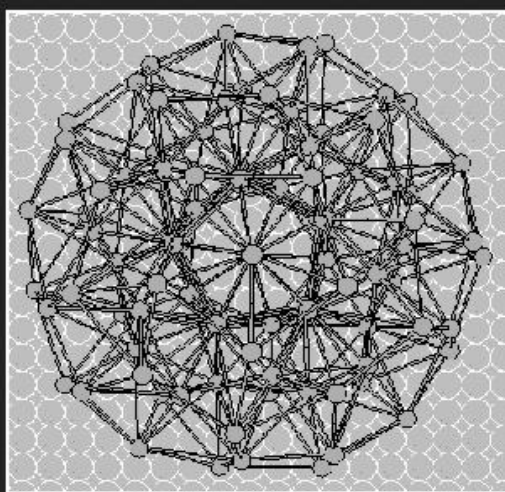
Thermoelectrics



www
Cluster Album
Phys. Lett. A273 117 (2000)

Slideshow

Metallic Clusters Deposited on Surfaces



Field Induced Superconducting Transistor

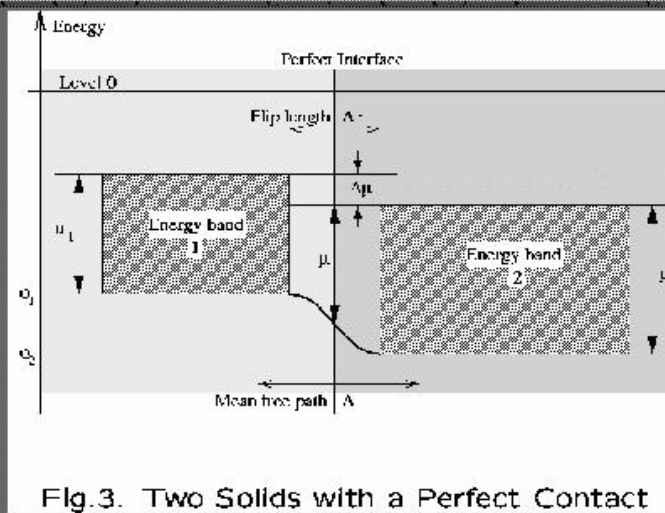


Fig.3. Two Solids with a Perfect Contact

L.C. Cune, M. Apostol



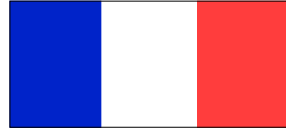
Our Collaborations



Bulgaria



China



France



Germany



Great Britain



Italy



Poland



Russia



Switzerland



USA

EUROPE



Marian Apostol
Professor of Theoretical Physics
Institute of Atomic Physics, Magurele-Bucharest,
Romania



Magurele-Bucharest MG-6, POBox MG-35, Romania, tel: -40-21-404 23 00/3213, fax:-40-21-457 44 40, apoma@theory.nipne.ro, <http://www.theory.nipne.ro/~apoma>

**Laboratory of Condensed Matter
Theory of Condensed Matter Laboratory
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ThermoLab**

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NANOSPIN European Network of Excellence in Magnetoelectronics, Spintronics and Nanomagnetism, CSIC, Madrid, Spain, Nanotechnologies Programme

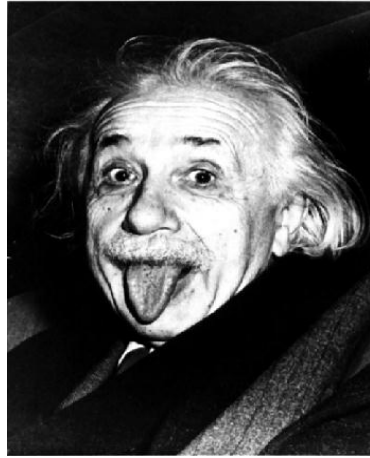
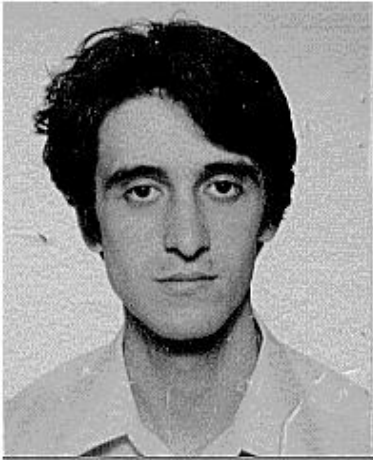
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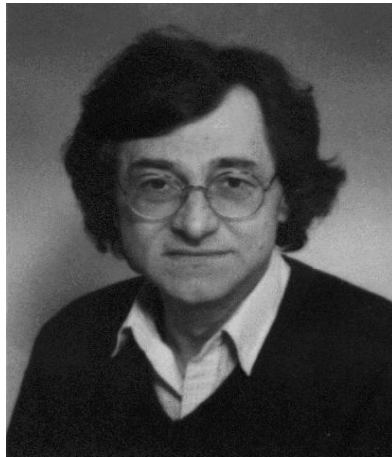
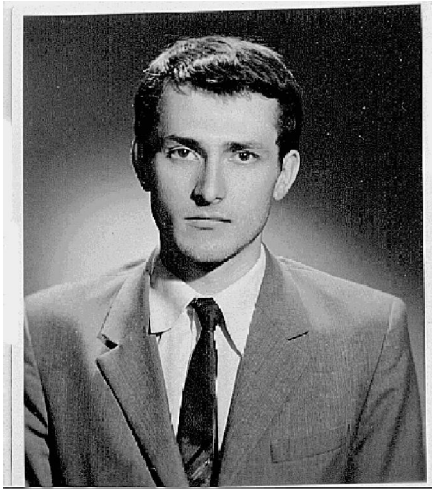
MOLETRONICS European Integrated Research Project, PHANTOMS, CMP Cientifica, Madrid, Spain, Nanotechnologies Programme

NAMTEC European Network of Excellence on Thermoelectrics, Cardiff, Wales, Ireland, Nanotechnologies Programme

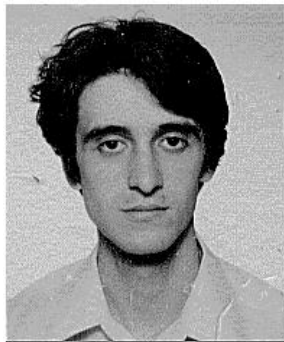


This is ME with some of my friends





Here is many of ME with few of my students



This is my Church

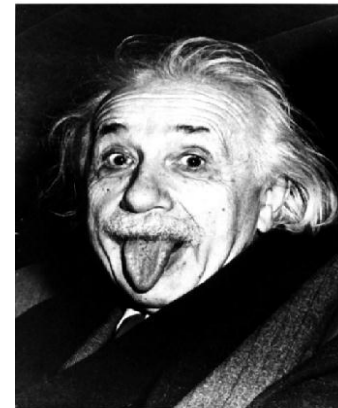


This is my country





This is my physics





**Talking on Nano-Objects
at Puszczykowo, Poland, NATO-2002**



Talking more for NATO on NanoTechnologies

Condensed Matter Physics

I've seen the Truth

and it makes no sense

4:16:37