From One Potsdam to Another

- A Personal Career Journey Through the Physical Sciences -

Paul M. Grant, '60

Senior Life Fellow, American Physical Society

AGING "TECH" ALUM

Science Fellow, Electric Power Research Institute

www.w2agz.com

Honors Advisory Council
13 January 2013
Clarkson University
Potsdam, New York

Paul Michael Grant ’60 “Life-Line”

- Poughkeepsie/Wappingers Falls Native
  - Born 9 May 1935, St. Francis Hospital (Only Child)
    - Mother: Mary Ann Whalen (Mullin, Joyce, Berry,...)
      - Daughter of Irish Immigrants
      - Education: One year of High School + Secretarial School
      - Career: At age 17, employed by Central Hudson Gas and Electric Co. as stenographer: retired as administrative assistant to CHG&E CEO
    - Father: Paul Archibald Grant (McCabe, Meddaugh,...)
      - Descended from Irish-Scottish Immigrants (1747+)
      - Education: One year of High School, ojt machinist, later US Navy Electronics Technician School
      - Career: Helped pioneer “Ham Radio” in the Hudson Valley, Machinist, Tool Maker, Electronics Technician IBM
  - Basic Education
    - Gov. Clinton School, K-8, 1940-1948, graduated highest NYS Regents score
    - Oakwood Friends School, 1948-1950, expelled for egregious misbehavior, 1950
    - Attended Wappingers Central School, 1950-1953, failed trigonometry and physics, honors in America History, barely graduated June, 1953
    - Application to Clarkson rejected
    - Hired by IBM, August 1953, as “mail boy,” later trained as technician, system programmer
- Subsequent Career
  - Stayed tuned for The Story...to follow...

…in their shoes…

- Paul Archibald Grant
  - W2AGZ
  - US Navy, WWII
  - IBM, 1948-1974
  - Ski Patrol, 1948-1970
- Mary Ann Whalen Grant
  - CYO BB Champ, 1921
  - NYS Bowling Champ, 1939
  - Women's Baseball, '33-'47
  - CHG&E, 1927-1965

PMG Career Timeline

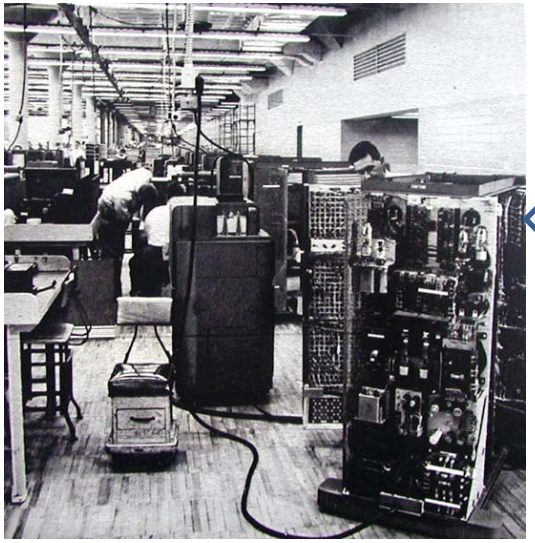
- **IBM (1953-1993)**
  - Project SAGE (IBM, MIT, USAF) (1953-56)
  - IBM Education Plan (Clarkson, Harvard) (1956-65)
  - Research Division Staff/Management: San Jose/Almaden (1965-90)
  - Sabbatical @ UNAM (1990-93)
- **EPRI Science Fellow (1993-2004)**
  - Power Applications of Superconductivity
  - Wide Bandgap Semiconductor Materials (SiC, GaN, Polymers...)
  - Power Electronic Devices (To Enable "Smart Grid")
  - Novel Fusion Technologies (e.g., p-11B)
  - "Bad Science Cop," debunking proposals claiming the "Energy Salvation of Mankind"
- **W2AGZ Technologies (2004-?)**
  - Visionary Energy Societies (SuperCity, SuperSuburb, SuperGrid)
  - "Due Diligence" VC/AI Consulting
  - Visiting Scholar, Stanford University, 2005-2008
  - Business Associate, JPL/NASA/CalTech, 2009-Present
  - Uncovering the Nature of HTSC !
  - Developing a DFT Roadmap to Enable"Superconductivity at Room Temperature and Above"

IBM

1953 - 1993

IBM – 100 Years

1952



604 (1948)

Grant-Whalen
IBM Family
-Poughkeepsie-

701 (1952)

1953

Project Sage – IBM/MIT

The Clarkson Years

1956 - 1960

"Prelude"

- Majored in "STEM" subjects in high school, anticipating an engineering career
- Initially accepted to RPI, Clarkson, after 1st term senior year, 1952
- However, in 2nd term discovered three "Laws of XY Physics"
  - *Fast Cars*
  - Cold Beer
  - **HOT WOMEN**
- QED, flunked Trig and Physics...acceptance to RPI, Clarkson withdrawn, May 1953
- Hence, had to get a job at IBM Poughkeepsie...sigh...well, maybe it was for the best

"Post-lude"

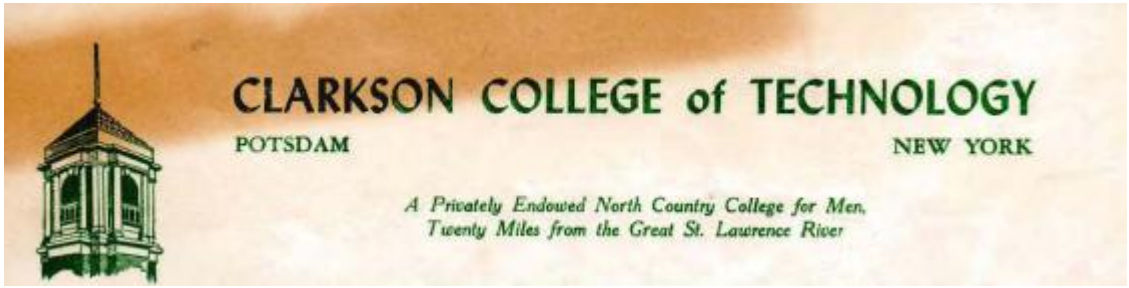
- Urged by IBM management in 1956, especially by Richard J. Whalen, '43, to consider re-applying to Clarkson
- Rejected again due to poor high school grades, but "conditionally accepted" pending passing a "make up" trig exam (got 100% !)
- Entered "Tech" fall of 1956 as "affirmative action" (due to advanced age of 21) freshman for the class of 1960

Diary*

- Freshman (1956-7)
  - “Look at the guy next to you...you won’t see him in four years”
  - Rooming downtown over Sears store
  - Moved to the Hill just before winter (3 days, -52 °F)
  - Mentoring my roomie, three years my junior
  - Grinding away: 8 A’s, 1 B, 1 C
- Sophomore (1957-8)
  - Men’s Dorm Counselor...resolving disputes among room
  - Handling dropouts, fail-outs, and their parents
  - Floor nurse during major flu epidemic
  - 10 A’s
- Junior (1958-9)
  - Married Joan Ruth Grant of Lexington, Mass.
  - Physics, EE Lab Assistant
  - 11 A’s, 1 B
- Senior (1959-60)
  - Physics, EE Lab Assistant
  - Senior Thesis
  - Several Essay Awards
  - 12 (maybe 13) A’s, Several Essay Prizes, 3.95 GPA, First in Class of 1960, BEE (minor in Physics)
  - Levinius Clarkson Prize

*Worked summers at IBM Kingston, promoted to Senior Engineer on graduation

Graduation



CLARKSON COLLEGE of TECHNOLOGY

POTSDAM NEW YORK

A Privately Endowed North Country College for Men.
Twenty Miles from the Great St. Lawrence River

Potsdam, June 5 --- Paul M. Grant, Poughkeepsie, and Philip O. Sliva, Yonkers, were presented with the Levinius and Frederica Clarkson Awards as the two members of the Clarkson College of Technology graduating class showing the best combination of scholarship and promise of outstanding professional achievement.

The Levinius Clarkson prize was established on March 19, 1906, the decennial Charter Day, by Misses Elizabeth and Frederica Clarkson.

Grant, the son of Mr. and Mrs. Paul A. Grant, 10 Van Siclen Dr., Poughkeepsie, led the Clarkson graduating class scholastically and received his degree of bachelor of electrical engineering with high distinction.

Potsdam I Accomplishments

CLARKSON COLLEGE OF TECHNOLOGY
DEPARTMENT OF ELECTRICAL ENGINEERING

A STUDY OF THE ELECTRONIC PROCESSES IN
EXTRINSIC GERMANIUM AS EXHIBITED BY THE
HALL AND MAGNETORESISTANCE EFFECTS

A SENIOR THESIS
by
PAUL M. GRANT

Submitted in partial fulfillment of the requirements
for the degree of
Bachelor of Electrical Engineering
January 20, 1960

Approved by Thesis Advisor Date

Albert B. Martin 26 Jan 60

George W. Reed 26 Jan '60
Department Chairman

Geoffrey Paul Grant
15 April 1959
Canton-Potsdam Hospital

The Harvard Years

1960 - 1965

IBM *Kingston News*

A Federal Systems Division Publication

P. M. Grant to Study Physics at Harvard

"The engineer working in modern electronics will be lost without a knowledge of basic theoretical atomic physics, especially in the field of solid-state device development," explains IBM M.S. Scholarship participant Paul M. Grant.

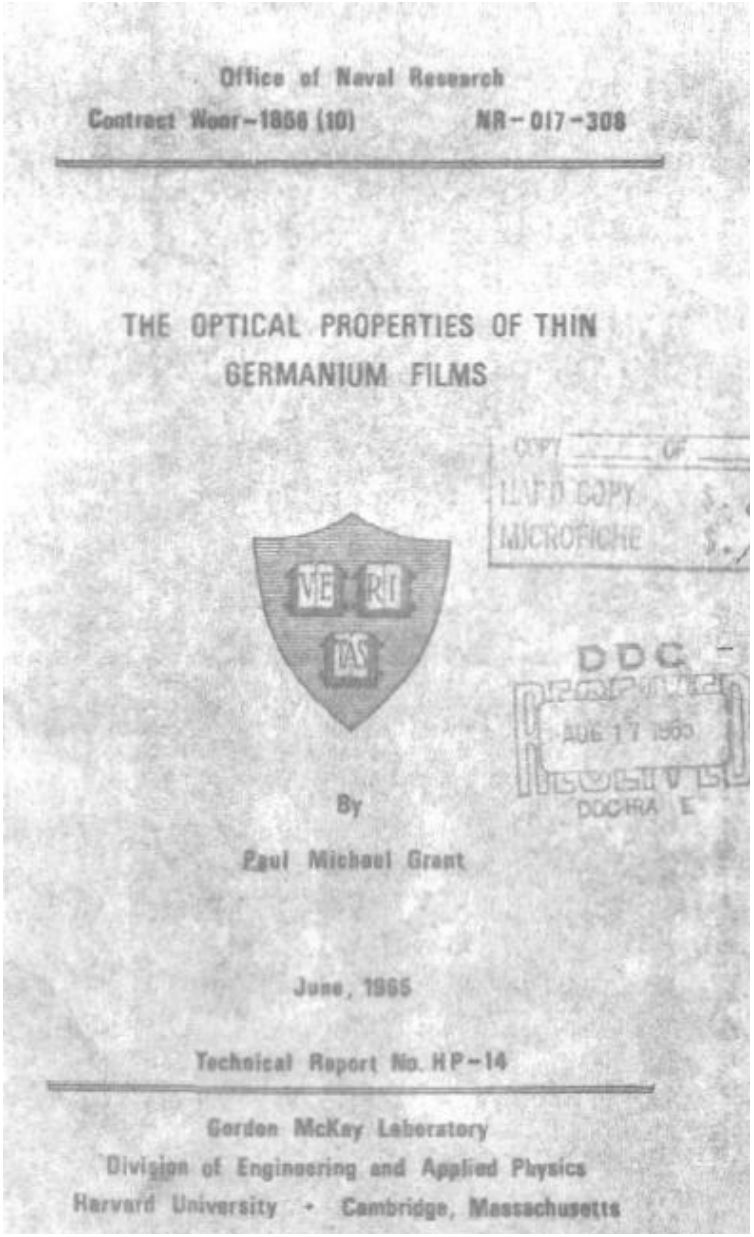
Paul M. Grant

Courses

(1960) Applied Mathematics 201 Applied Function Theory.pdf
(1960) Applied Physics 215 Fluctuation Phenomena.pdf
(1960) Applied Physics 295 Quantum Theory of Solids.pdf
(1960) Physics 251a Quantum Mechanics.pdf
(1961) Applied Mathematics 202 Partial Differential Equations.pdf
(1961) Applied Mathematics 203 Advanced Methods.pdf
(1961) Applied Physics 231 Electron Physics.pdf
(1961) Applied Physics 297 Semiconductors.pdf
(1961) Physics 251b Quantum Mechanics.pdf
(1961) Physics 253 Advanced Quantum Mechanics.pdf
(1961) Physics 262 Themodynamics and Statistical Mechanics.pdf
(1962 S) Astronomy 230 Celestial Mechanics (Aud).pdf
(1962) Applied Physics 296 Magnetism in Solids.pdf
(1962) Physics 264 Group Theory and Quantum Mechanics.pdf
(1963 S) Applied Physics xxx Quantum Electronics (Aud).pdf

July – September, 1965
Post-Doc, Imperial College

PhD Thesis



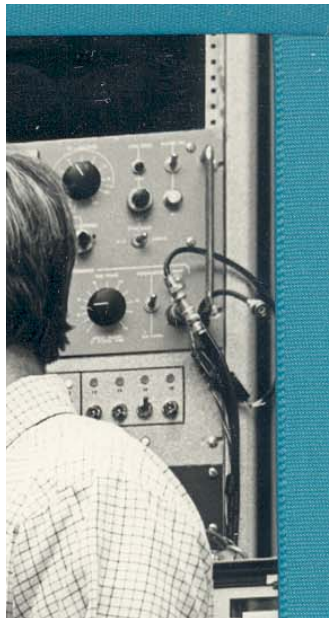
At IBM San Jose/Almaden Research

1965 – 1990, 1992-1993

Diary

- Spectroscopy & Laboratory Automation (1965-71)
  - Spectroscopy of RE Chalcogenides
  - IBM 1800 Lab Automation Package
- Staff Assignment, Manufacturing Research (1971-72)
- Organic and Polymeric Conductors and Superconductors (1973-82)
  - Optical, Thermal and Transport Measurements
  - Electronic Structure Theory and Computations
- Laboratory Director's Staff, Physical Sciences and I/O Technologies (1982-84)
  - Member LED Display Development Task Force
  - Member Advanced Printing Technology Task Force (Ink Jet)
- Manager, Magnetism and Superconductivity Phenomena Research (1984-93)
  - Set up initial investigations leading to development of GMR hard drive read heads
  - Organized and led Almaden Research Center efforts on high temperature superconducting materials
  - Co-inventor on international patent on high temperature superconductors (HTSC)
  - Served as corporate public spokesman on HTSC..."15 nanoseconds of fame."
- IBM Visiting Professor, IIM-UNAM, Mexico City (1990-92)

P. M. Grant

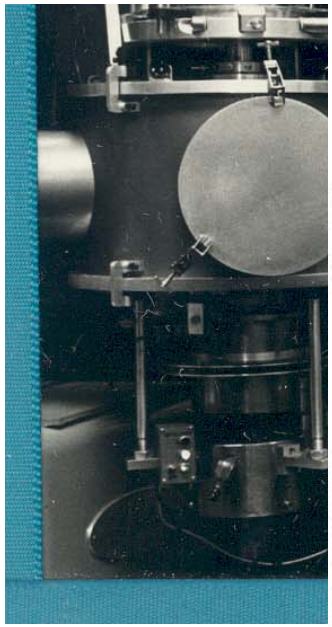


Automation of a Wide-range, General-purpose Spectrophotometric System

January, 1969 IBM JRD

Abstract: The application of an IBM 1800 computer to the control and data acquisition functions of a wide-range spectrophotometric system is described. The optical part of the system is designed primarily for solid-state spectroscopy in the reflectance mode, the energy range of interest being roughly 1 to 12 eV (10^4 to 10^5 cm^{-1}). The operations of the computer include regulation of the wavelength setting, determination of the system gain, analog-to-digital conversion of the output signal, and positioning of the sample and detector. Two experimental configurations are employed, depending on whether or not the sample and detector are to remain stationary or to be repositioned during a run. The former holds for electroreflectance, fluorescence, and photoconductivity studies, while the latter pertains to ordinary reflectance and transmittance measurements. The principal advantage to be derived from on-line computer control of such experiments, besides more rapid accumulation and reduction of data, is the improvement in signal-to-noise ratio by averaging many repetitive scans over the same energy

P. M. Grant



Interleaving Slow- and Rapid-data-rate Experiments with a Time-sharing Laboratory Automation System

July, 1971 IBM JRD

Abstract: A technique is described for accommodating rapid-transfer-rate experiments within an IBM 1800 Time Share Executive (TSX) laboratory automation monitor designed primarily for slow-scanning, low-drift apparatuses, each having the computer control its independent variable. The slow-scan experiments may be delayed for substantial periods to allow break-in by, and dedication of the computer to, those tasks requiring acquisition of short bursts of high-speed data. The system is structured so that each user can implicitly and dynamically specify the current maximum time interval for which his experiment may be interrupted.

The break-in on a slow-scan experiment is done on a demand-response basis through the use of interrupt coreloads and masking of all other interrupts that are likely to interfere with a particular high-speed scan that has been initiated. When data acquisition is completed, control is returned to the time-sharing system by unmasking the interrupts and an appropriate data analysis task is queued for later execution.

VOLUME 31, NUMBER 21 PHYSICAL REVIEW LETTERS 19 NOVEMBER 1973

Temperature Dependence of the Near-Infrared Optical Properties of Tetrathiofulvalinium Tetracyanoquinodimethane (TTF-TCNQ)

P. M. Grant, R. L. Greene, G. C. Wrighton,* and G. Castro
IBM Research Laboratory, San Jose, California 95114
(Received 13 August 1973)

We report the near-normal-incidence reflectivity spectrum of single-crystal TTF-TCNQ in the range 0.2–2.0 μm. A Drude-like edge, persistir tor transition at 60°K, is observed near 1.3 μm for light pola ing axis. The temperature dependence of the optical paramet cussed in conjunction with Hopfield's relation for the electron

First PRL from IBM San Jose Research Laboratory

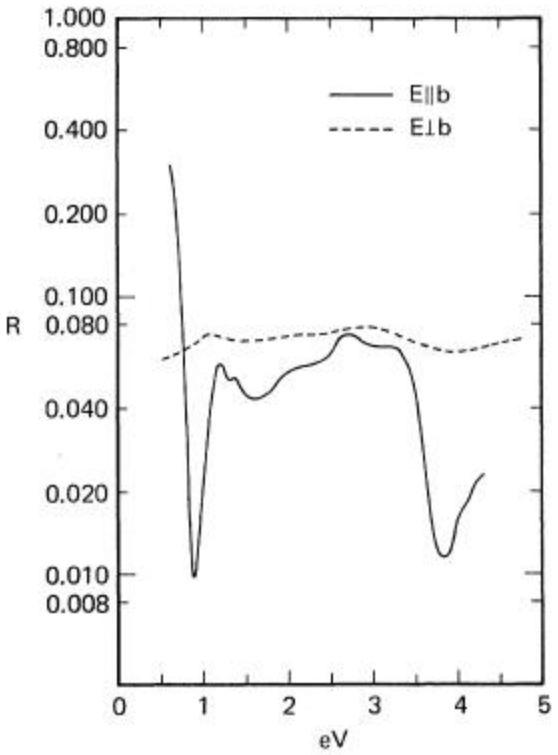


FIG. 1. Normal-incidence room-temperature reflectivity from the near infrared to the near uv for light polarized both parallel ($E \| b$) and perpendicular ($E \perp b$) to the conducting axis of TTF-TCNQ. Relative values of reflectance are accurate to within 0.001.

VOLUME 35, NUMBER 25 PHYSICAL REVIEW LETTERS 22 DECEMBER 1975

Optical Properties of Polymeric Sulfur Nitride, $(SN)_x$ †

P. M. Grant, R. L. Greene, and G. B. Street
IBM Research Laboratory, San Jose, California 95193
(Received 30 June 1975)

We report polarized reflectivity measurements on crystalline $(SN)_x$ in the range of 0.25–6.0 eV. Our analysis of the data gives $\hbar\omega_p = 4.6$ eV and $m^* = 2m_e$, values considerably different from those previously reported by other workers. The data also suggest that $(SN)_x$ has sufficient electronic dimensionality to suppress a Peierls distortion.

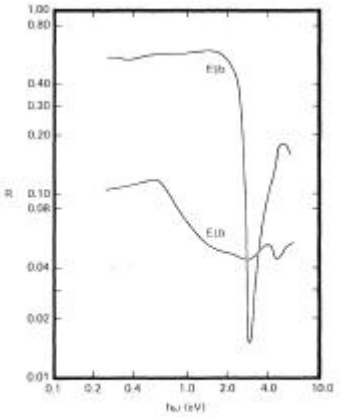
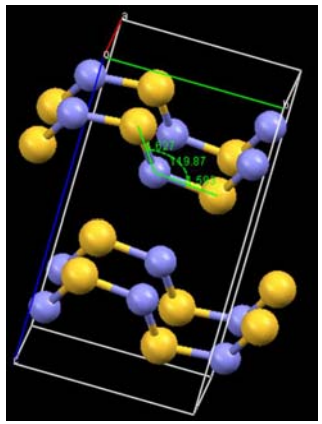


FIG. 1. Parallel ($E \parallel b$) and perpendicular ($E \perp b$) polarized reflectivity of crystalline $(SN)_x$ at room temperature.



Polysulfur Nitride, (SN)x
Tc = 0.3 °K (1975)

VOLUME 35, NUMBER 26 PHYSICAL REVIEW LETTERS 29 DECEMBER 1975

Orthogonalized-Plane-Wave Band Structure of Polymeric Sulfur Nitride, $(SN)_x$

W. E. Rudge and P. M. Grant
IBM Research Laboratory, San Jose, California 95193
(Received 22 September 1975)

We present the first orthogonalized-plane-wave band structures and corresponding densities of states for two reported crystal structures of polymeric surfur nitride, $(SN)_x$, and compare our results with experiment. We examine the band structures in light of the low-temperature stability of the metallic and superconducting states in $(SN)_x$ and conclude that this stability derives from closed Fermi surfaces introduced by electronic interchain coupling.

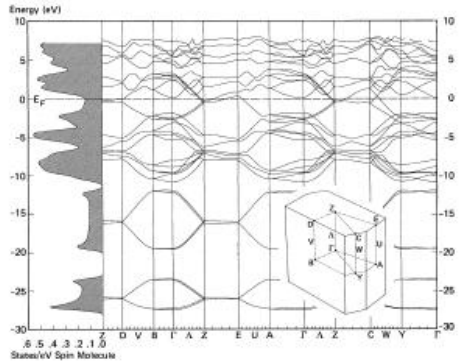


FIG. 2. OPW energy bands for $(SN)_x$, Penn structure. The density of states was obtained as for Fig. 1.

VOLUME 35, NUMBER 26 PHYSICAL REVIEW LETTERS 29 DECEMBER 1975

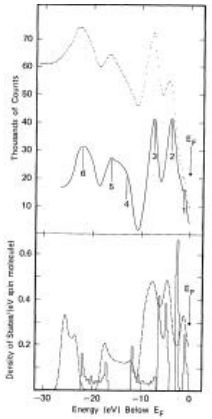
X-Ray-Photoelectron-Spectroscopy Determination of the Valence Band Structure of Polymeric Sulfur Nitride, $(SN)_x$

P. Mengel,* P. M. Grant, W. E. Rudge, and B. H. Schechtman
IBM Research Laboratory, San Jose, California 95193

and

D. W. Rice
IBM General Products Division, San Jose, California 95193
(Received 22 September 1975)

We report x-ray photoemission (XPS) measurements on polymeric sulfur nitride, $(SN)_x$. Both valence-band states and core-level binding energies have been studied. The charge transfer δ in the $S^{+\delta}N^{-\delta}$ bond is estimated to be 0.30–0.42 electrons. The XPS spectra are compared with densities of states derived from a single-chain tight-binding calculation and also with three-dimensional orthogonal-plane-wave (OPW) calculations based on the two reported $(SN)_x$ crystal structures. Good quantitative agreement is found with the OPW density of states.



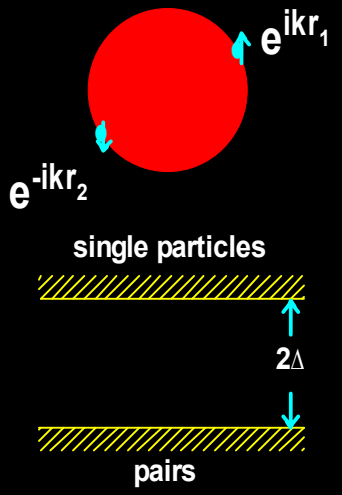
3 PRLs in One Month!
A record for an industrial research lab?

Physics of Superconductivity

"Bound Electron Pairs in a Degenerate Fermi Gas,"

L. N. Cooper, Phys. Rev. 104, 1189 (1956)

Cooper Problem



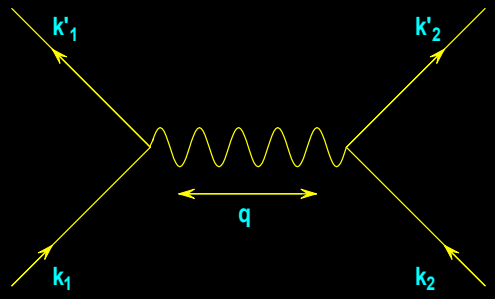
$H(k) + H(-k) + V(k)$

$V(k) = -V_0 \int_0^{k_f} dk\, e^{ik(r_1 - r_2)}$

$\psi(r_1-r_2) = \phi(r_1-r_2)\chi(s_1,s_2)$

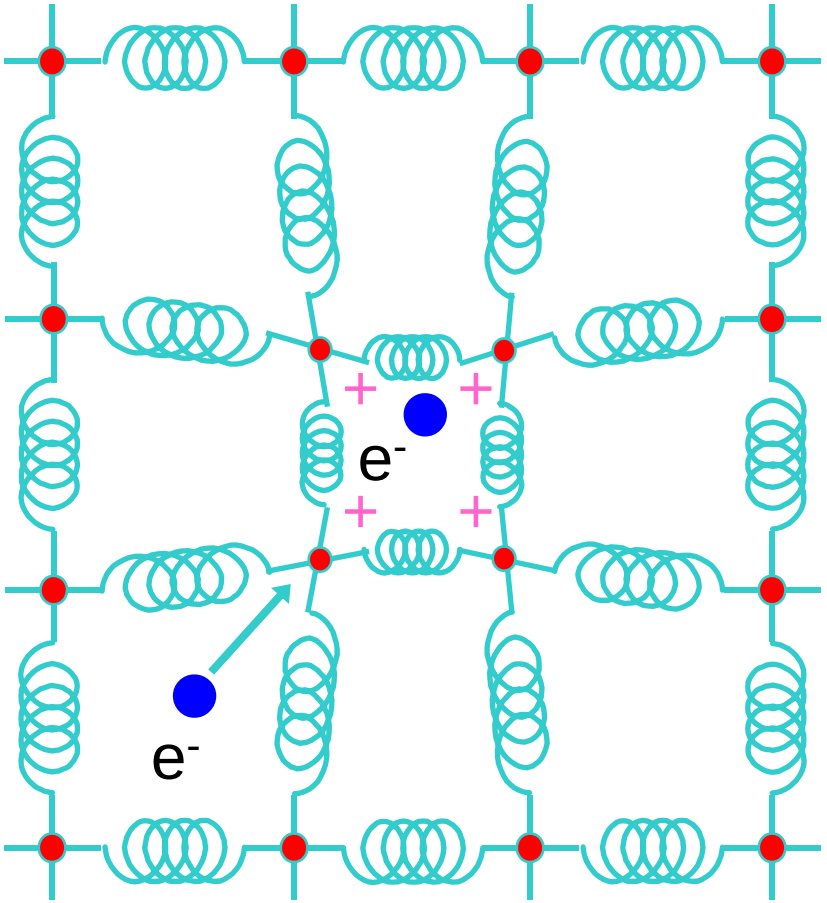
$2\Delta \sim e^{-2/N(E_f)V_0}$

Fermion-Boson Feynman Diagram



Physics of Superconductivity

"Theory of Superconductivity,"
J. Bardeen, L. N. Cooper and J. R. Schrieffer, Phys. Rev. 108, 1175 (1957)



Electrons Pair Off!

BCS Equation

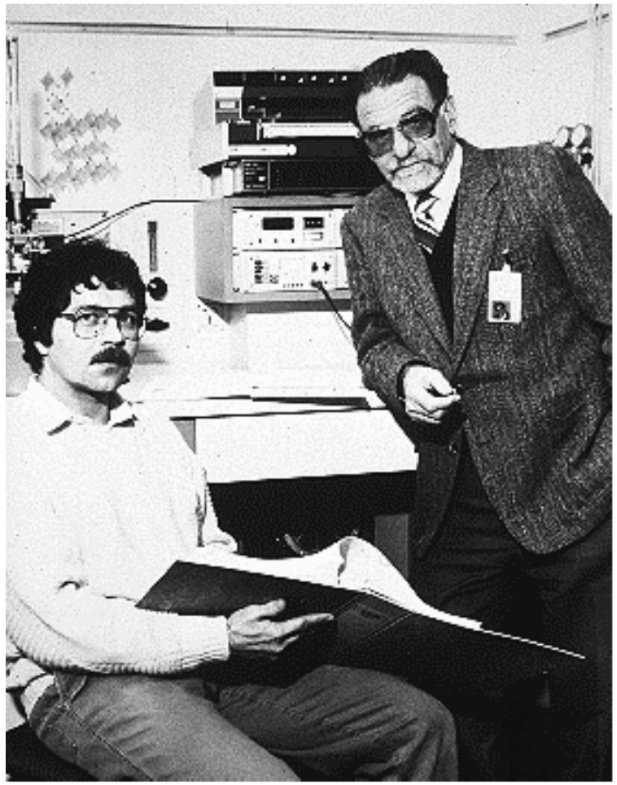
$$T_C = 1.14\,\theta_D \exp(-1/\lambda)$$

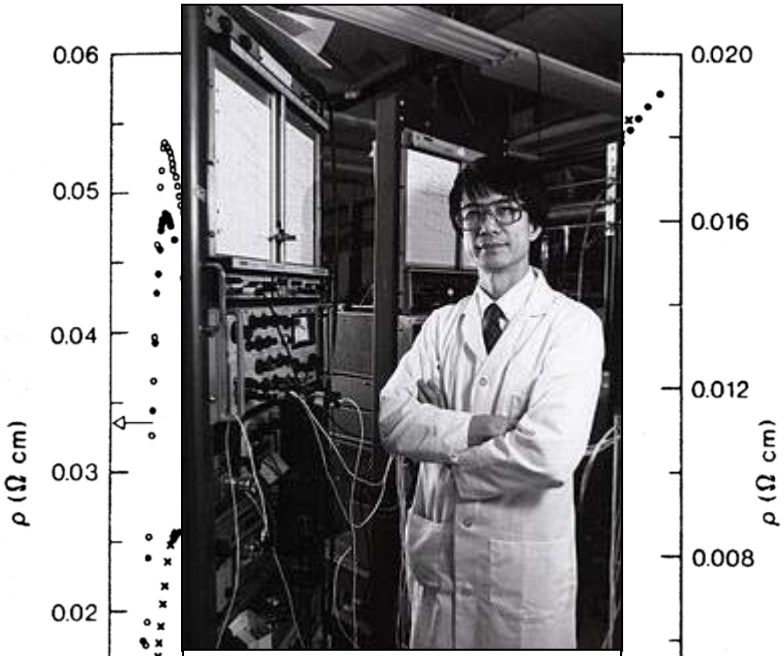
$$\theta_D = 275\ \text{K},$$

$$\lambda = 0.28,$$

$$\therefore T_C = \underline{9.5\ \text{K}}\ \text{(Niobium)}$$

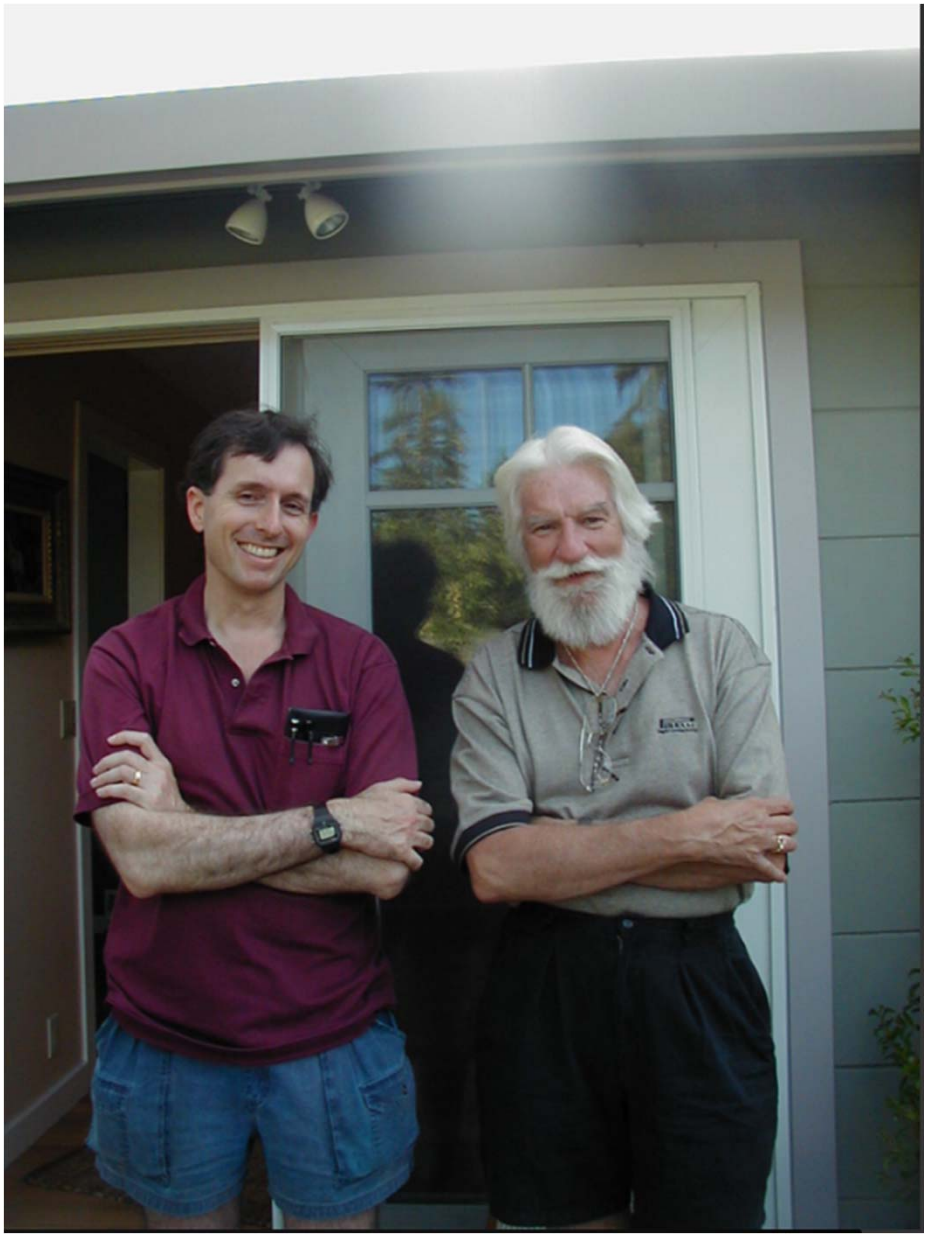
January, 1986
IBM Zuerich Research Laboratory



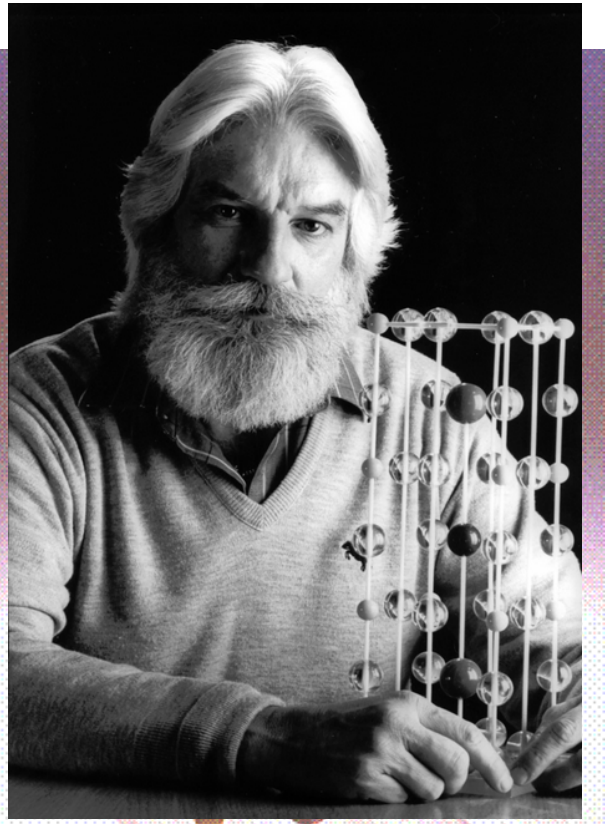


January, 1987
C. W. Chu,
U. Houston, sees
zero resistance at 91
°K in a mixed
copper oxide
perovskite!

The Almaden 1-2-3 Story: 1986-89



2 March 1987
"1-2-3"



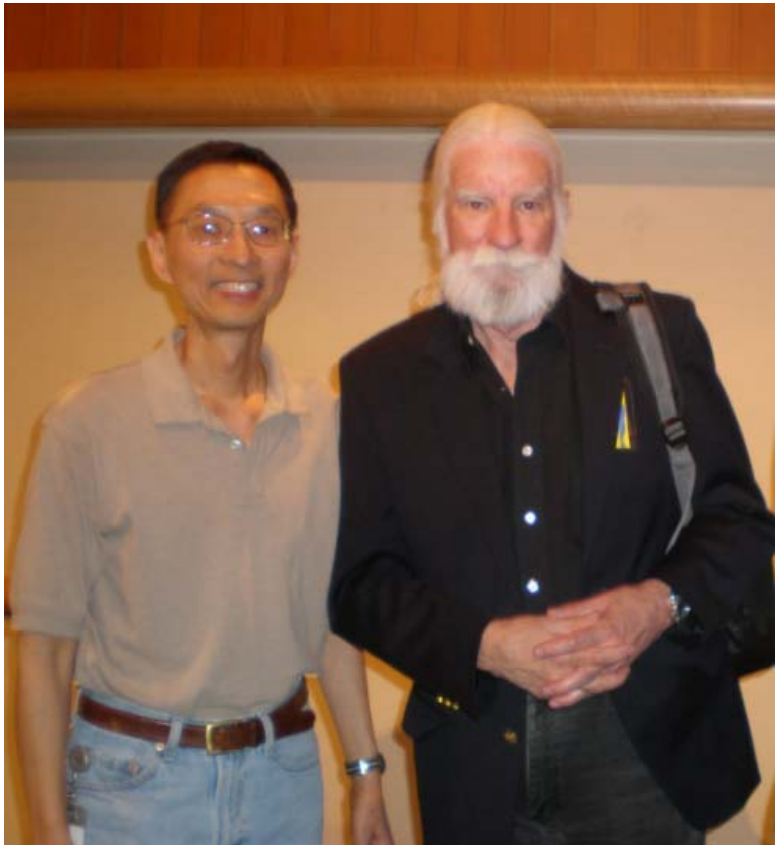
Read all about it at...
www.w2agz.com

“The Great Communicator”

Alan Schriesheim, Director of Argonne National Laboratory, demonstrates superconductivity to the President, Chief of Staff Howard Baker, Secretary of Defense Caspar Weinberger, Secretary of State George Shultz and Secretary Herrington.

Band of Brothers (and a Sister!)

http://www.w2agz.com/The%20Picture%20Story.htm



New Scientist 30 July 1987

Do-it-yourself superconductors

It is extremely easy to make high-temperature superconductors. Schools in the United States and Britain have already produced their own samples. Here is the recipe

Paul Grant

HTSC verified at Gilroy High School, May 1987, 5 months after discovery, and 5 months before bestowment of the...

"Shake 'n' bake" recipe for 1-2-3 ($YBa_2Cu_3O_{7-x}$)

Mix 1·13 grams yttrium oxide, 3·95 grams barium carbonate, 2·39 grams copper oxide
Compact
Grind in mortar and pestle
Bake in air at 950 °C (1650 °F)
Regrind in mortar and pestle
Press into pellets
Rebake pellets in flowing oxygen at 950 °C (1650 °F)
Allow to cool very slowly
Recipe by Heidi Grant

Left: Heidi Grant demonstrates superconductivity at the US National Science Foundation

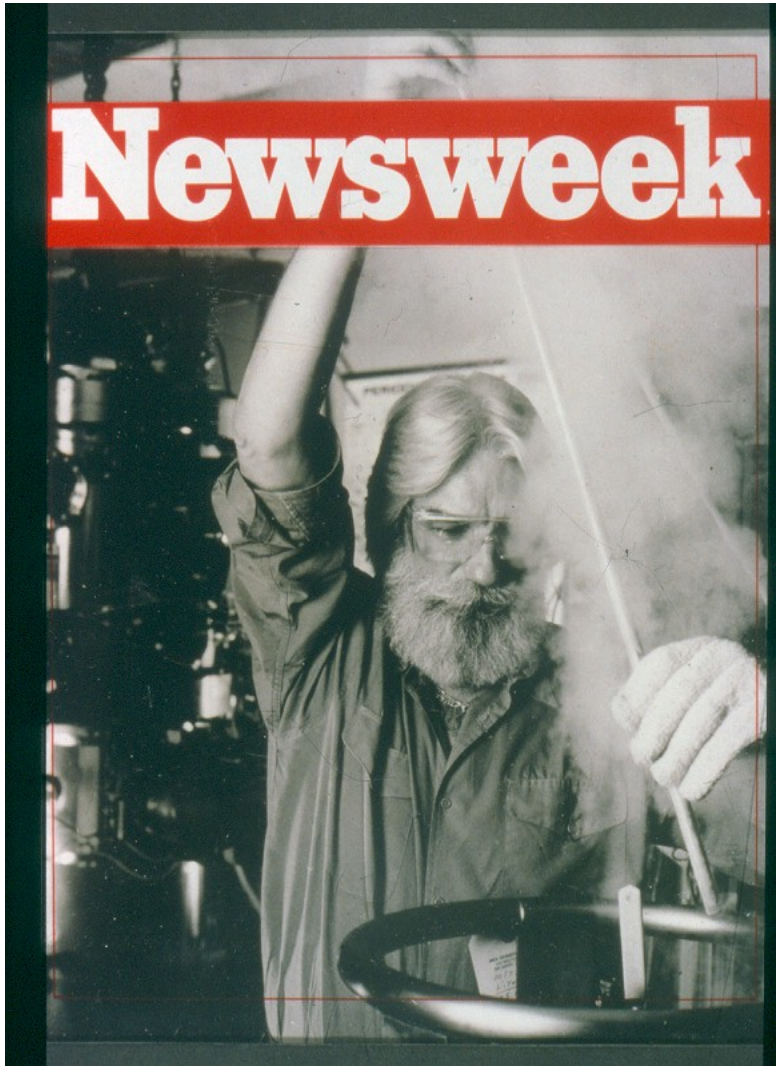
s (at their request)

- 35,000 copies distributed to high schools worldwide by ICTP-Trieste

Nova 1988

PMG Questioned on Demise of IBM's Josephson Computer Effort

15 Nanoseconds of Fame



At IIM-UNAM / Mexico City

1990-1992

It takes two to Tango

IBM Visiting Professor

Instituto de Investigaciones en Materiales
(Materials Research Institute)

Universidad Nacional Autónoma de México (National Autonomous University of Mexico)

PHYSICAL

1 APRIL 1990

physical properties

Escudero

Diego Patrick Grant Lopez-Morales
1 March 1991
Hospital de Mexico
Ciudad de Mexico

EPRI

1993 - 2004

EPRI

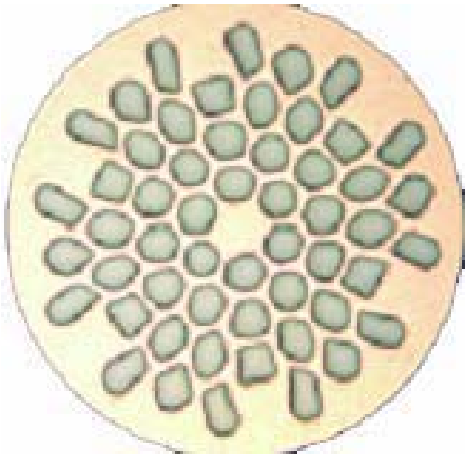
1993-2004

Diary

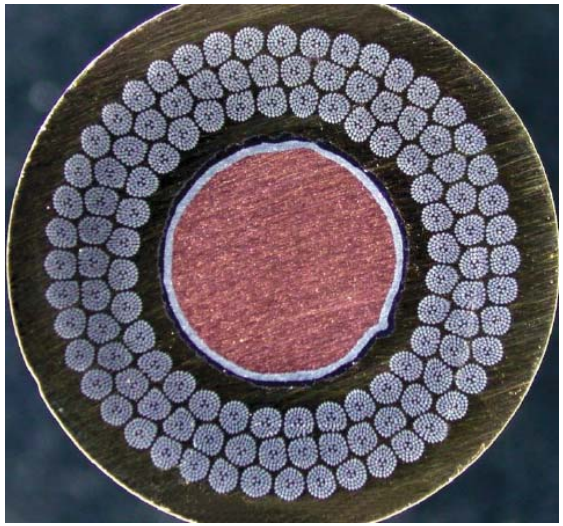
- Science Fellow, Strategic Science & Technology (1993-1997)
  - $3M Annual Program Funding:
    - Power Applications of Superconductivity
    - Wide Band Semiconductor Materials and Devices
    - Polymer Conductors Materials and Devices
  - Projects included:
    - HTSC wire development and investment at Stanford, LBNL, LANL, AMSC and DOE
    - Prototype cable demonstrations at Detroit Edison and National Grid
- Science Fellow, Strategic Research & Development (1997-2004)
  - The SuperGrid, a symbiosis of hydrogen, superconductivity and nuclear fission for the co-delivery of electrical and chemical power.
  - Book reviews, commentary and newsletter editorials in both EPRI and various scientific journals (Nature, Nature Physics, Nature Materials, Physics World, Physics Today...and others.
- Advisor to, and Reviewer of, the DOE Program for Power Applications of Superconductivity (1993-2004)

Wires & Films

LTSC

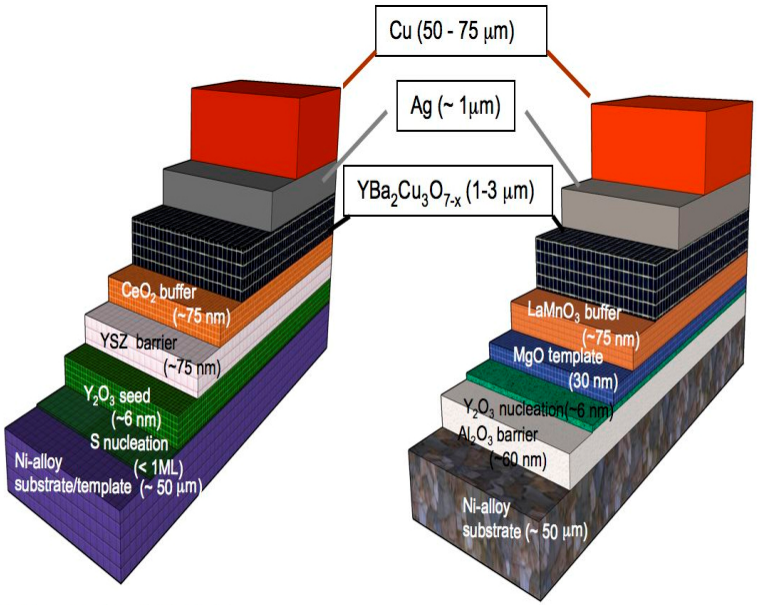


NbTi/Cu
Oxford



Nb_3Sn
Supercon

HTSC



Rolling-Assisted Biaxially Textured Substrates (RABiTS)

American Superconductor

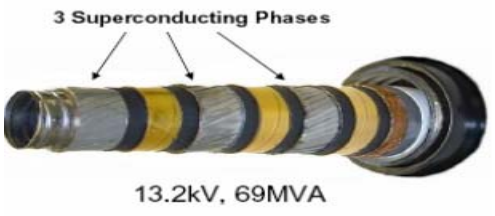
Ion-Beam-Assisted Deposition (IBAD)

SuperPower

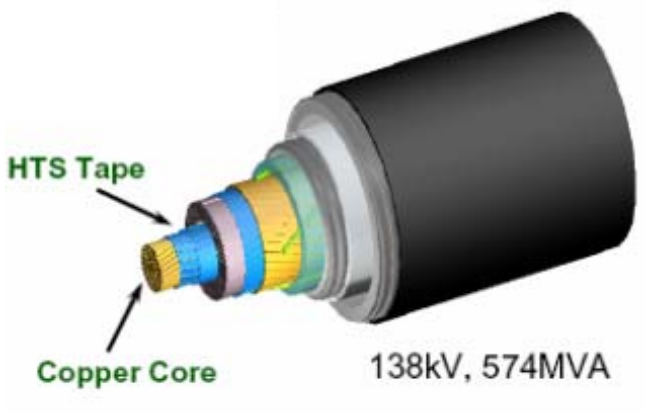
Medical Imaging

Various HTSC Cable Designs

Sumitomo



Ultera-ORNL



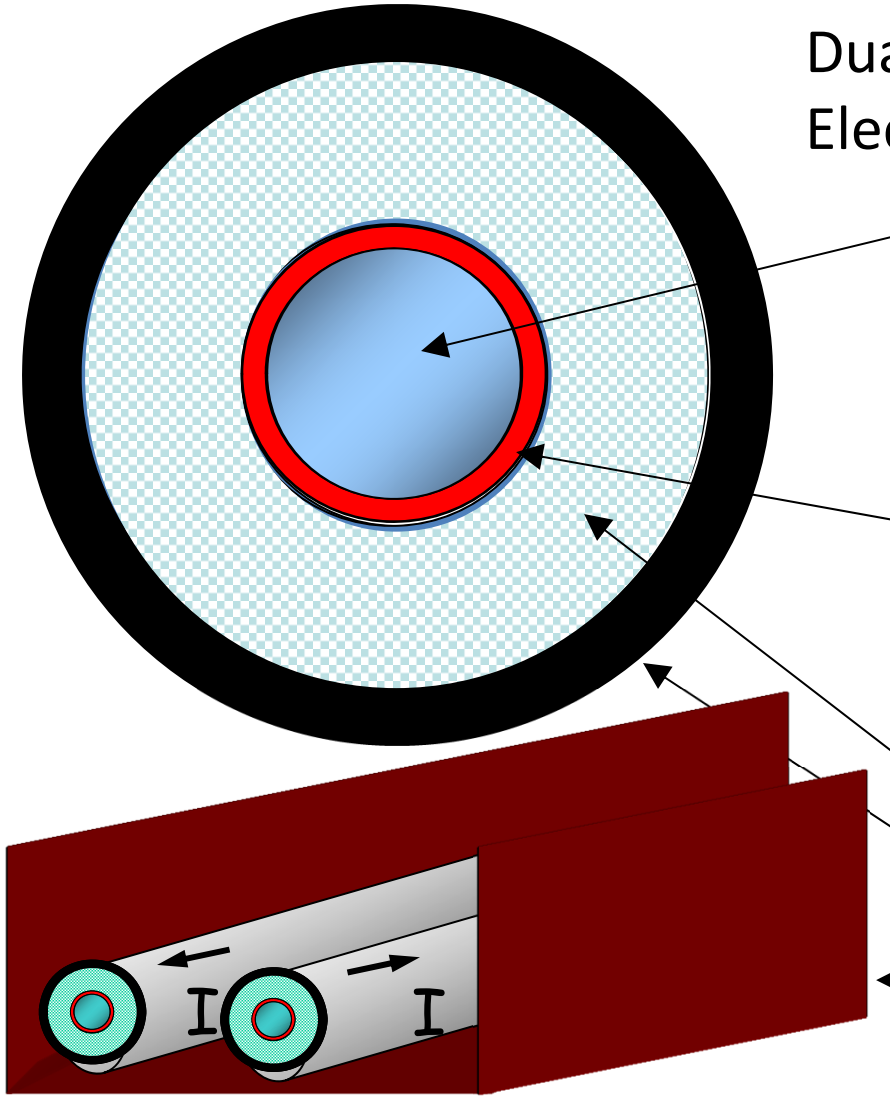
Nexans-AMSC

Pirelli-Pryzmian

My Virtual Grandfather (@ 94)

Implementation Technology

The Hydricity SuperCable



Dual Delivery of Hydrogen and Electric Power

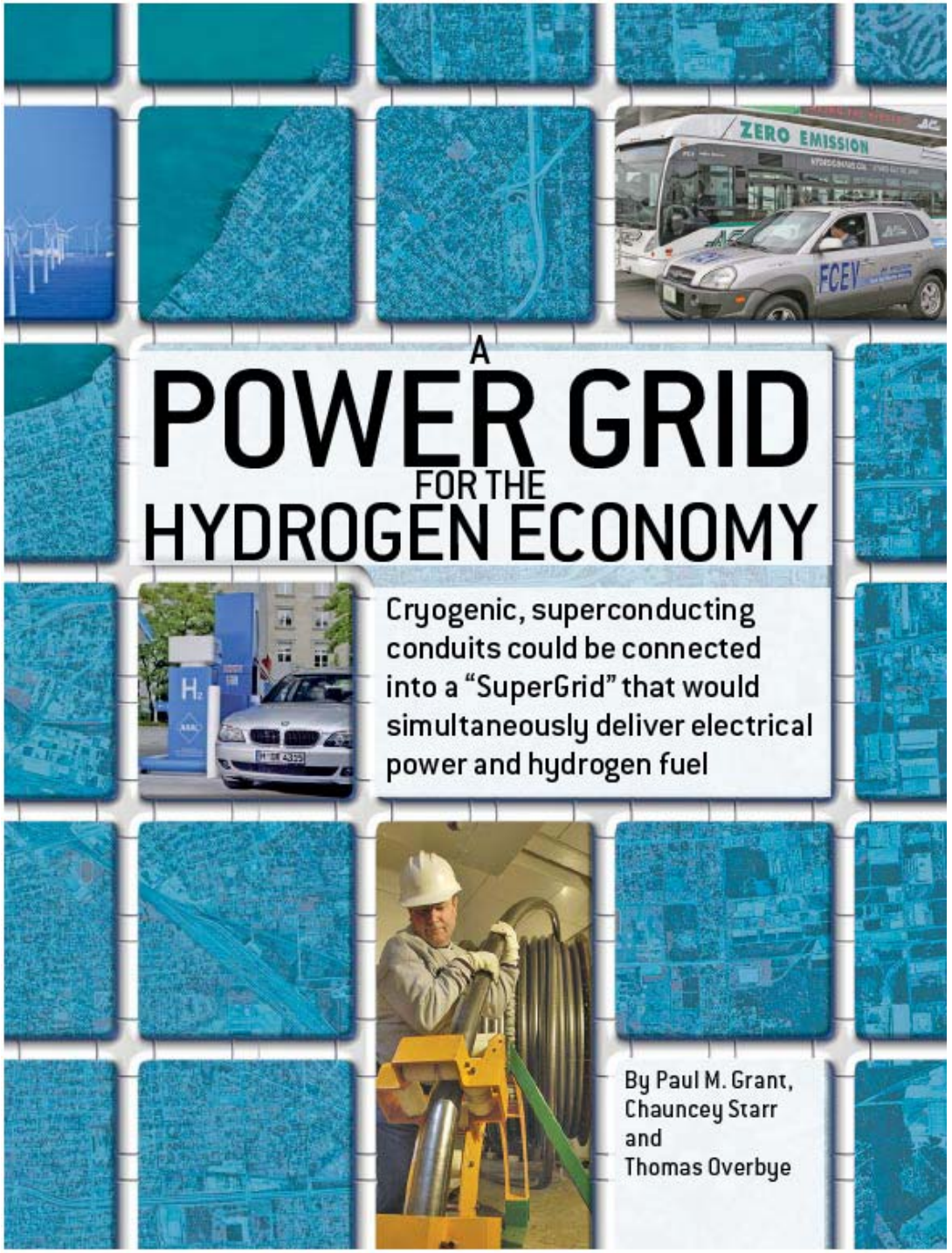
Flowing liquid hydrogen or cold H_2 gas under pressure delivers power and also serves as the refrigerant to …

Enable the transmission of large amounts of electric power losslessly using superconductors

Thermal Insulation

Electrical Insulation

Enclosed in underground tunnel or trench



On the afternoon of August 14, 2003, electricity failed to arrive in New York City, plunging the 10 million inhabitants of the Big Apple—along with 40 million other people throughout the northeastern U.S. and Ontario—into a tense night of darkness. After one power plant in

Published in

SCIENTIFIC AMERICAN

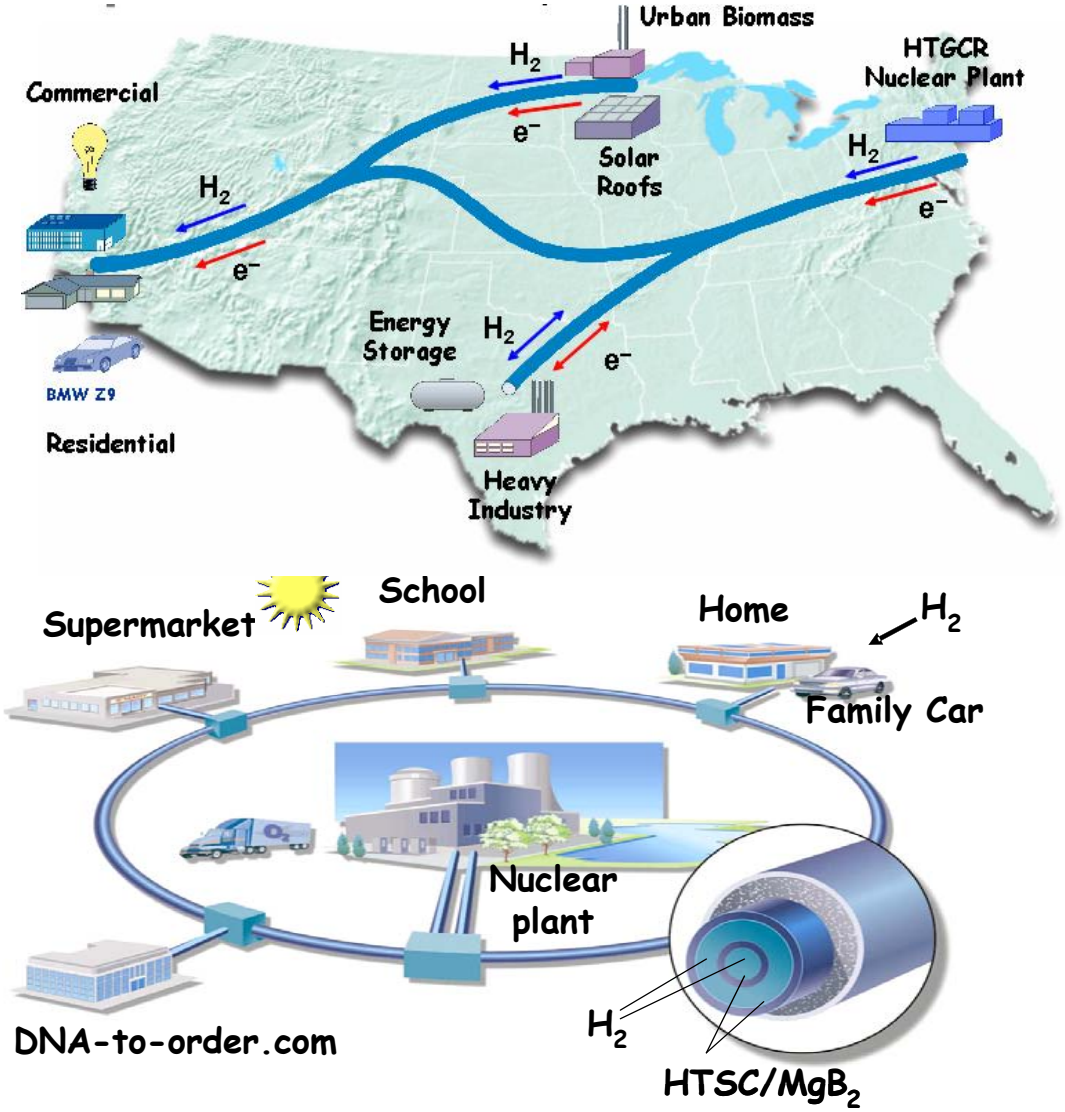
July, 2006

"System Crash"

Omni Productions, Vancouver, BC

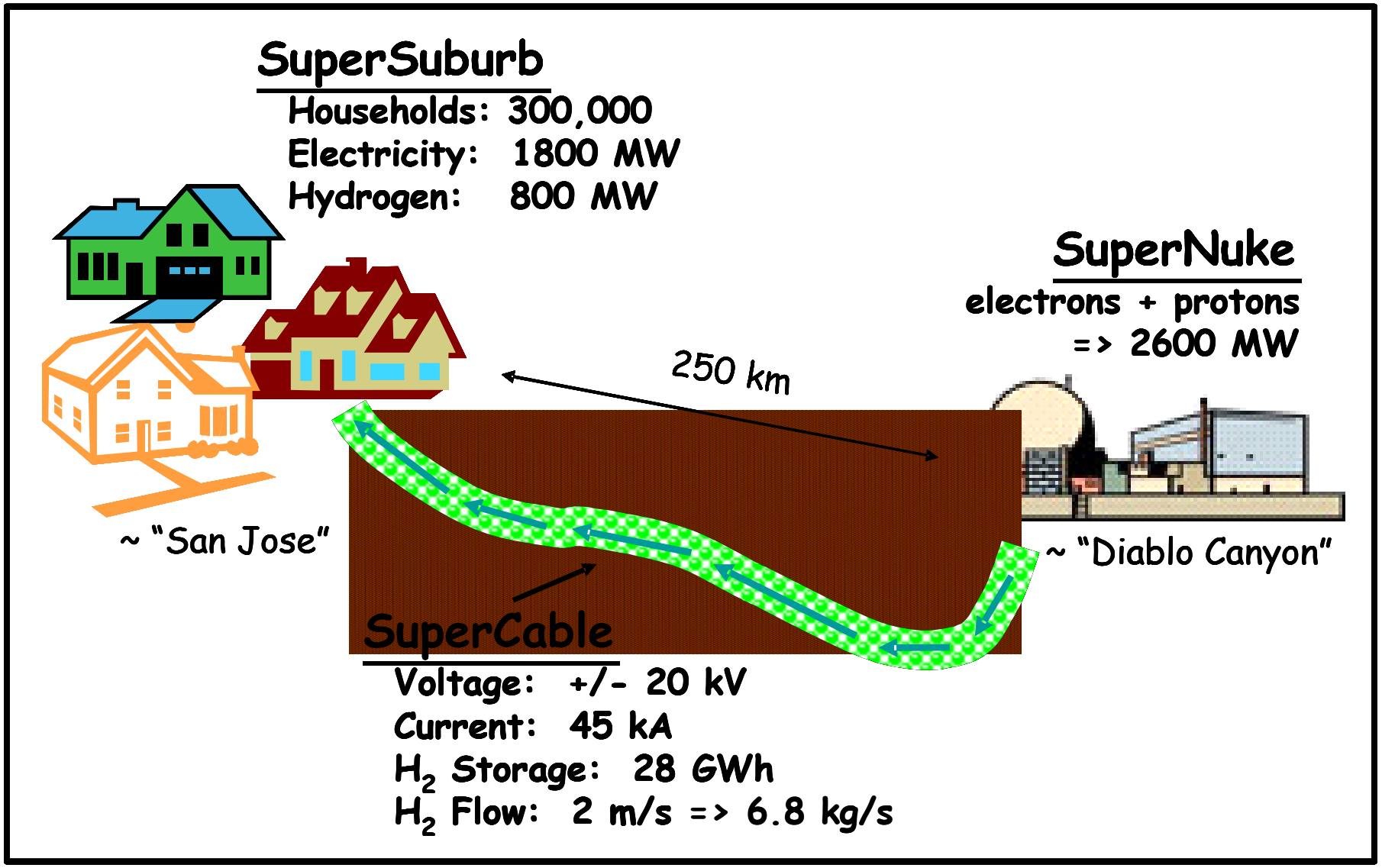
CBC Broadcast October, 2008

SuperCities & SuperGrids



- Nuclear Power can generate both electricity and hydrogen – "Hydricity"
- Hydricity can be distributed in underground pipelines like natural gas
- The infrastructure can take the form of a **SuperGrid**
- ...or a **SuperCity**

SuperSuburb



W2AGZ

2004 - ?

W2AGZ

2004-?

Diary

- Visiting Scholar in Applied Physics, Stanford University (2005-08)
  - Growth and properties of tetragonal, rocksalt CuO films
  - DFT studies of cubic and tetragonal rocksalt CuO as a proxy structure for understanding the origin of high temperature superconductivity (ongoing)
- Due diligent consulting services for various venture capital startups and government agencies (2004-present)
- Business Associate, JPL/NASA/CalTech (2009-present)
- Pursuit of right-of-way co-location of natural gas/petroleum with HTSC cables for the co-transport of chemical and electrical energy (2008-present)
- Advisor to IASS on visionary uses of superconductivity (2011-present)
- Authored numerous popular articles, including one in Scientific American on the SuperGrid, and on various environmental and sustainability issues (2004-present)

Epitaxy and oxidation of thin films of CuO_x

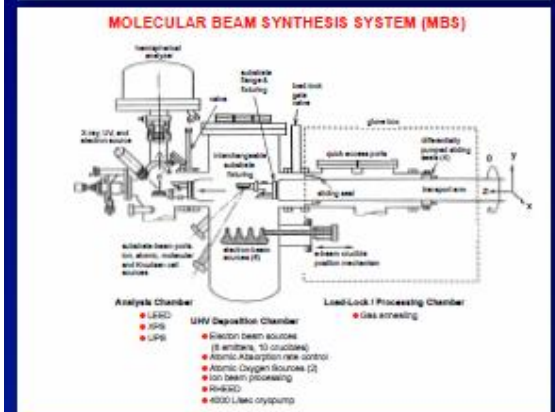
W. Siemons[α,β], G. Koster[α], H. Yamamoto[γ], R.H. Hammond[α], P. M. Grant[δ], T.H. Geballe[α], M.R. Beasley[α]

Introduction

- Vapor phase deposited copper oxide has shown a rich variety of epitaxial relationships as a function of the flux ratios of three species on the substrate surface (i.e., Cu, O* and Ar^+) (Kita et al. APL 60 (1992) 2684, Catana et al. PRB 46 (1992) 15477). This will be used to explore the possibility of the highest crystal symmetry possible in $Cu(II)O_X$ system, which is an ongoing effort.

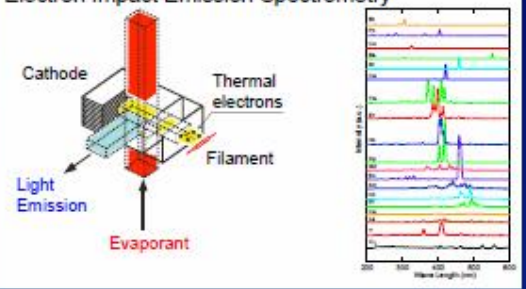
- Here we present a detailed study on the initial growth of thin epitaxial CuO_X films on single crystal substrates by MBE. *In situ* photo electron spectroscopy (X-ray PES and UV-PES) is used to establish the degree of oxidation of Cu while *in situ* electron diffraction (RHEED) monitor the crystal structure of the growing thin film. We particularly pay attention to the valence state of Cu and the crystal symmetry as influenced by a combination of activated oxygen and a flux of low energy Ar^+ ions.

System



EIES

Electron Impact Emission Spectrometry



Acknowledgements

EPRI

Netherlands Organization for Scientific Research, VENI

M. Kelly, GLAM, Stanford University, CA

Affiliations

α) Geballe Laboratory for Advanced Materials, Stanford University, Stanford, CA

β) Inorganic Materials Science, Faculty of Science and Technology, University of Twente, The Netherlands

γ) NTT Basic Research Laboratories, Kanagawa, Japan

δ) W2AGZ technologies, San Jose, CA

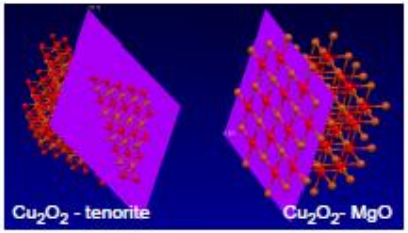
Conclusions

- RHEED: Epitaxy is observed for films thinner than roughly 20Å
- XPS: A large chemical shift is observed for the Cu 2p peaks

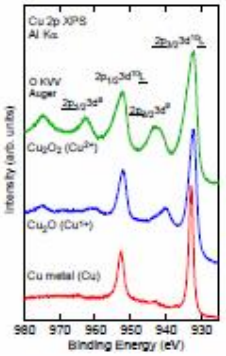
Note: This shift is usually only seen for copper compounds with a high cation coordination number

- MBE: Chemical- and Field Effect doping will be part of future experiments

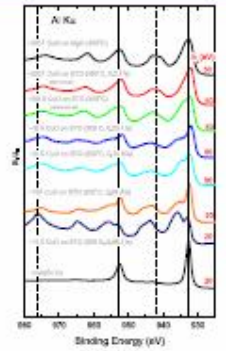
CuO_x structures - Cu-O bond length 10% difference



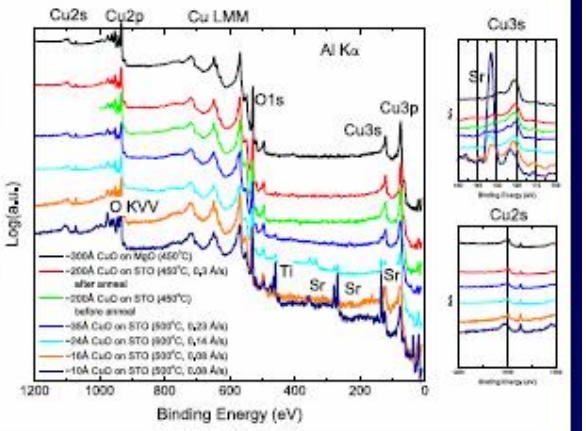
In situ XPS - Cu 2p



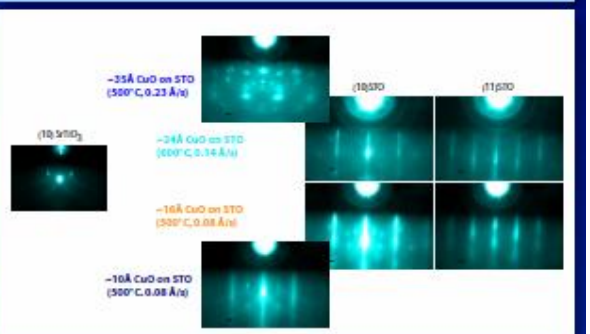
In situ XPS - Cu 2p



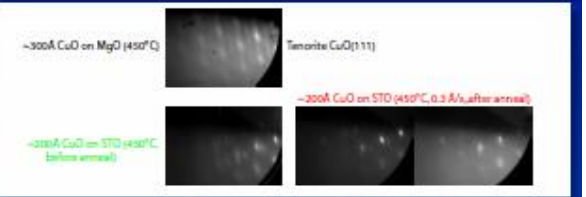
In situ XPS Cu_2O_2



RHEED initial growth



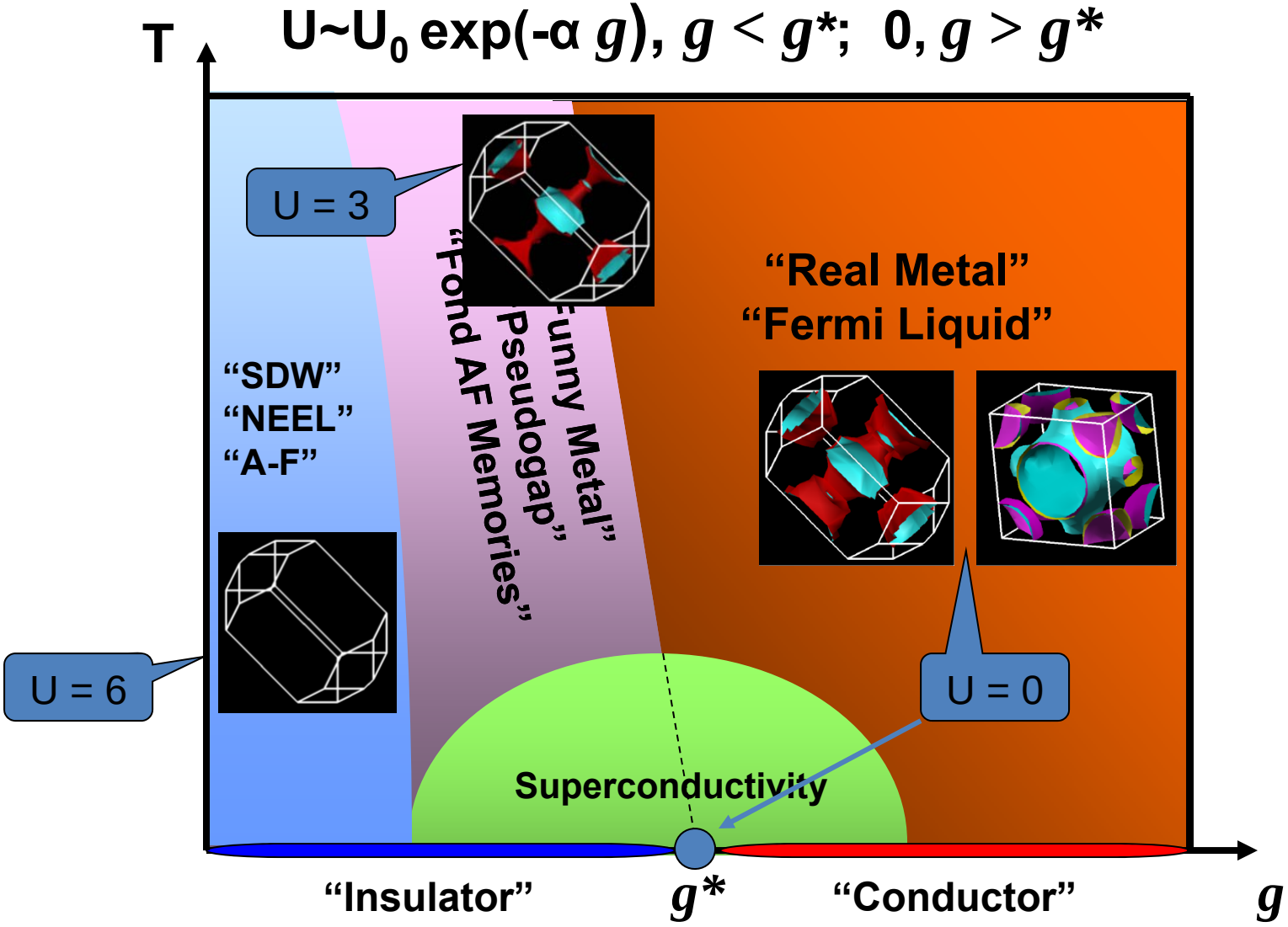
RHEED thick films



The Colossal Quantum Conundrum

Nature, 2011

$U \sim U_0 \exp(-\alpha g)$, $g < g^*$; 0, $g > g^*$

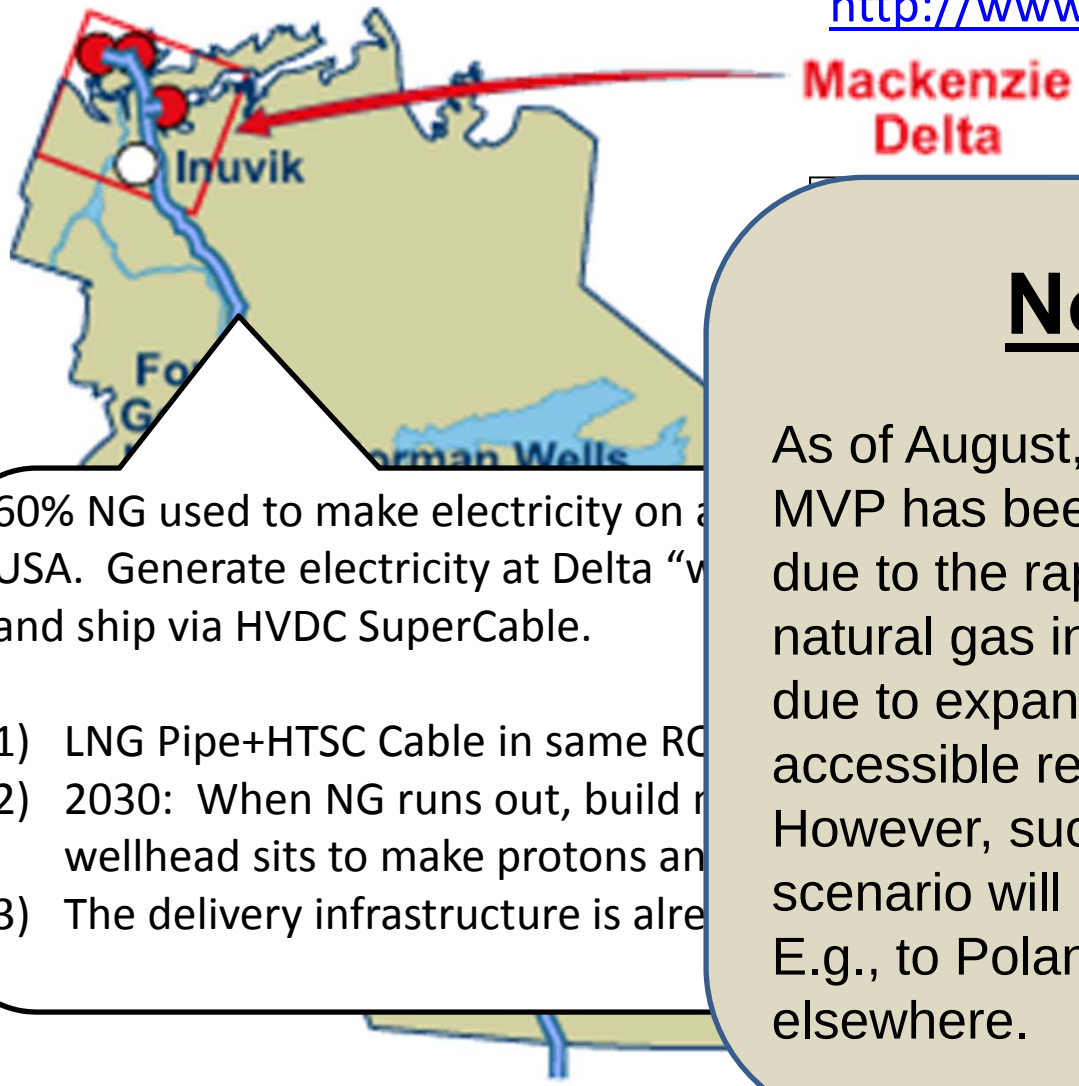


Somewhere in here there has to be "BCS-like" pairing!

A Canadian's View of the World

The Mackenzie Valley Pipeline

http://www.mackenziegasproject.com



60% NG used to make electricity on a
USA. Generate electricity at Delta "w
and ship via HVDC SuperCable.

1) LNG Pipe+HTSC Cable in same RC
2) 2030: When NG runs out, build r
   wellhead sits to make protons an
3) The delivery infrastructure is alre

Nota Bene!

As of August, 2012, funding for the MVP has been reduced by about 30% due to the rapidly decreasing price of natural gas in North America, primarily due to expanding available "fracking accessible reserves" in the US. However, such means the MVP scenario will only expand globally. E.g., to Poland, Mexico, Asia and elsewhere.

The "Another" (Other?) Potsdam!

2011 - ?

Institute for Advanced Sustainability Studies e.V.

Potsdam, Germany

Carlo Rubbia
Scientific Director
Earth, Energy and Environment

- Former Director of CERN
- Shared 1984 Nobel Prize for the discovery of the W and Z bosons
- Envisioned the concept of an “energy amplifier,” based on the fission of thorium and depleted uranium, not suitable for weaponization

Transporting Tens of Gigawatts to the Green Market

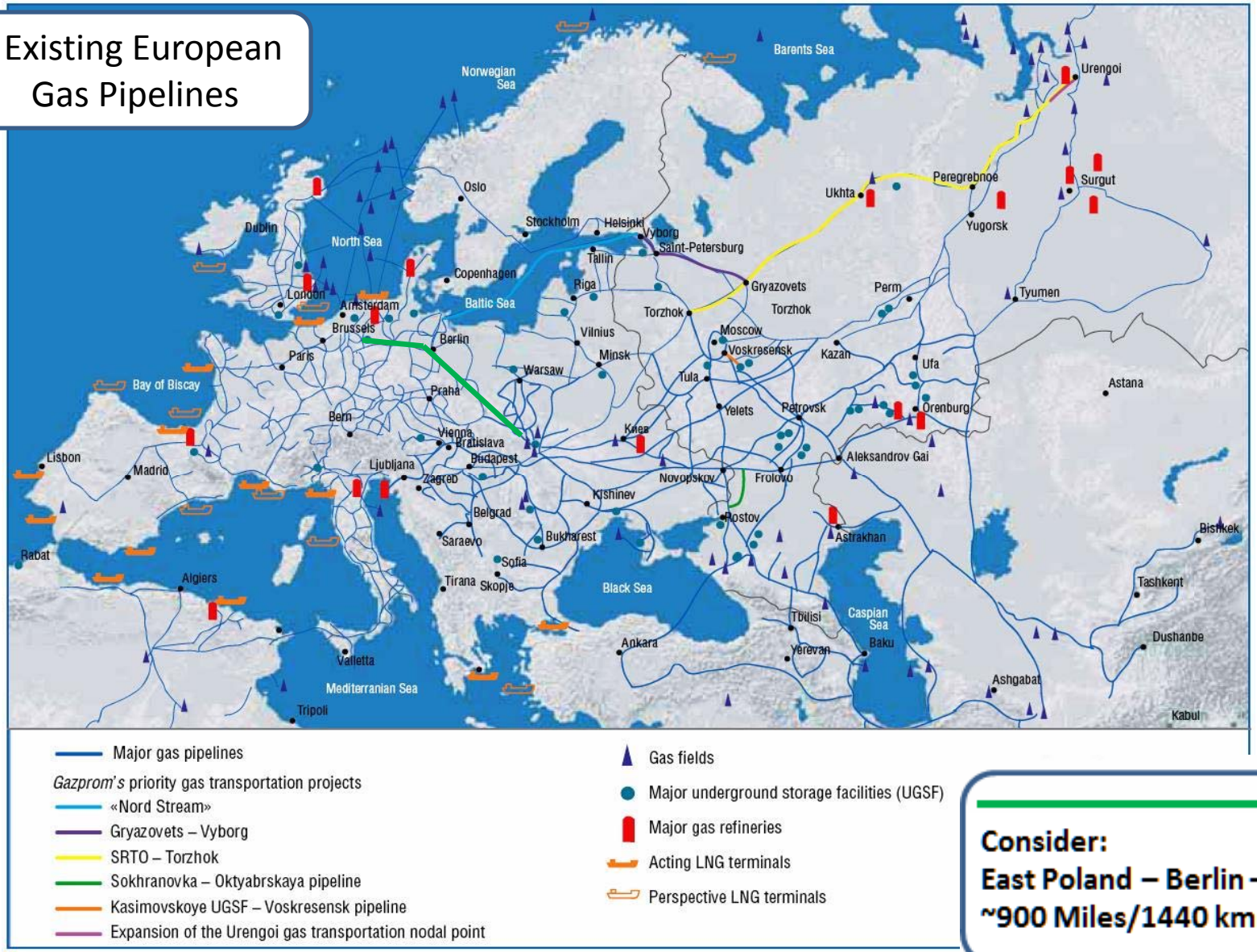
12 – 13 May 2011
Institute for Advanced Sustainability Studies
Potsdam, Germany

Superconducting SolarPipe

2014 Fulbright Proposal (an EU Mackenzie Valley?)

From Where? Poland! ..... To Where? Brussels!

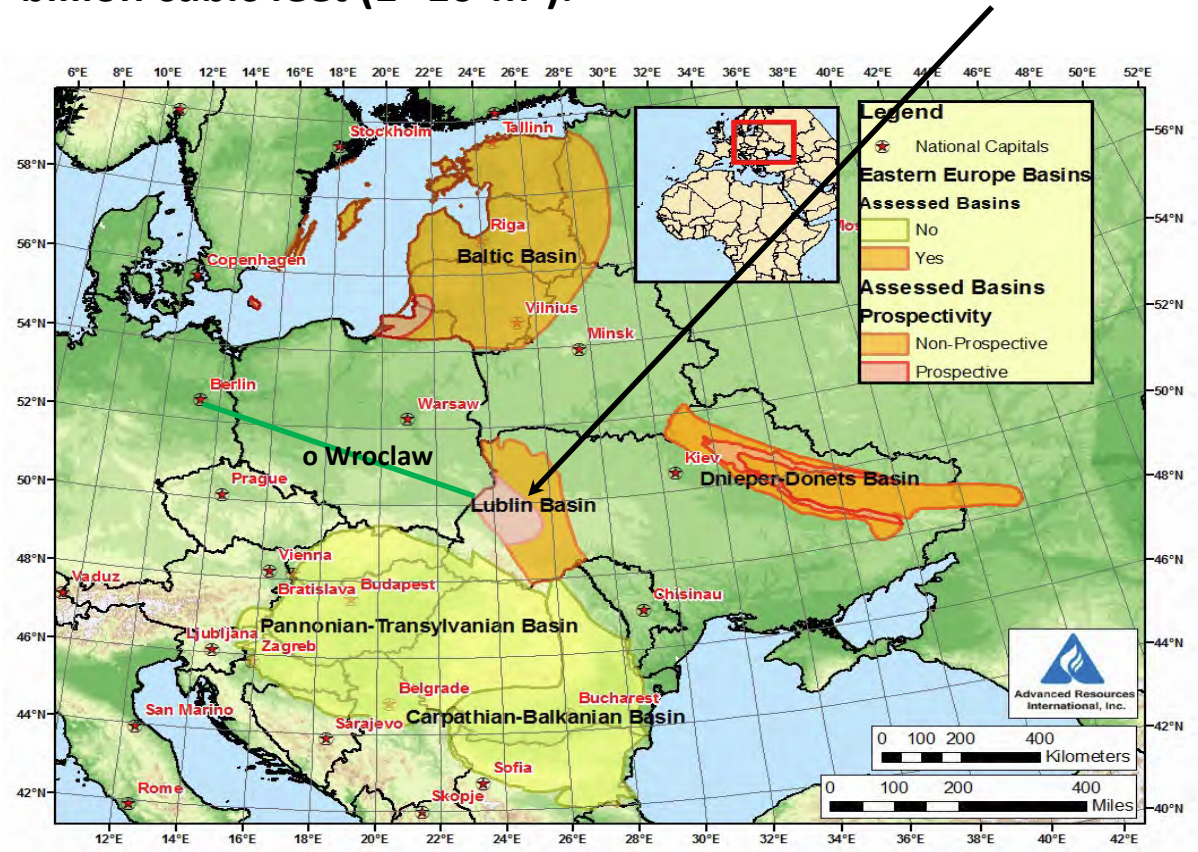
Existing European Gas Pipelines



Consider:
East Poland – Berlin – Brussels
~900 Miles/1440 km

Details

The Wola Obszańska* (Lublin) gas field in Poland was discovered in 1989. It began production in 1992 and produces natural gas. The total proven reserves of the Wola Obszańska gas field are around 37 billion cubic feet ($1\times10^9 m^3$).



*https://en.wikipedia.org/wiki/Wola_Obsza%C5%84ska_gas_field

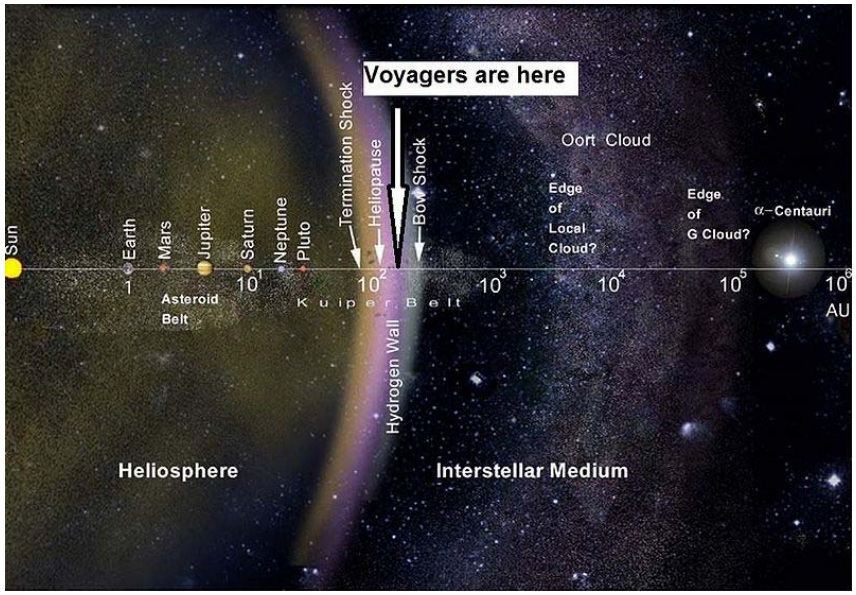
On Site Development

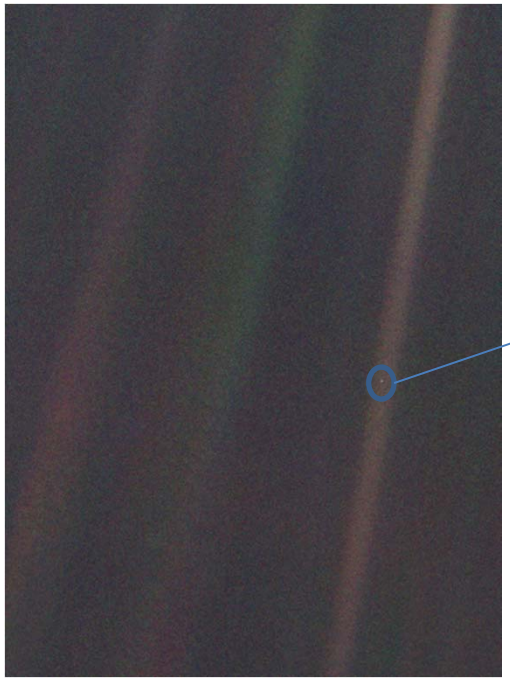
1) Allocate immediate resources to implement advanced IASS technology to recover methanol/ethanol from CCGT H_2O, CO_2 emissions.
2) Allocate future siting areas to implement recycleable, reprocessable thorium-based fission technology along with hydrogen generation.

Pale Blue Dot

From Now On

Where Are We?





September 9, 2012, *Voyager 1* was 121.836 AU (1.82264×10^{10} km; 1.13254×10^{10} mi)

The Earth is the only world known, so far, to harbor life. To me, it underscores our responsibility to deal more kindly with one another and to preserve and cherish the pale blue dot, the only home we've ever known. *Carl Sagan, 1997.*

From this:..faster, smaller, cooler…and cheaper!

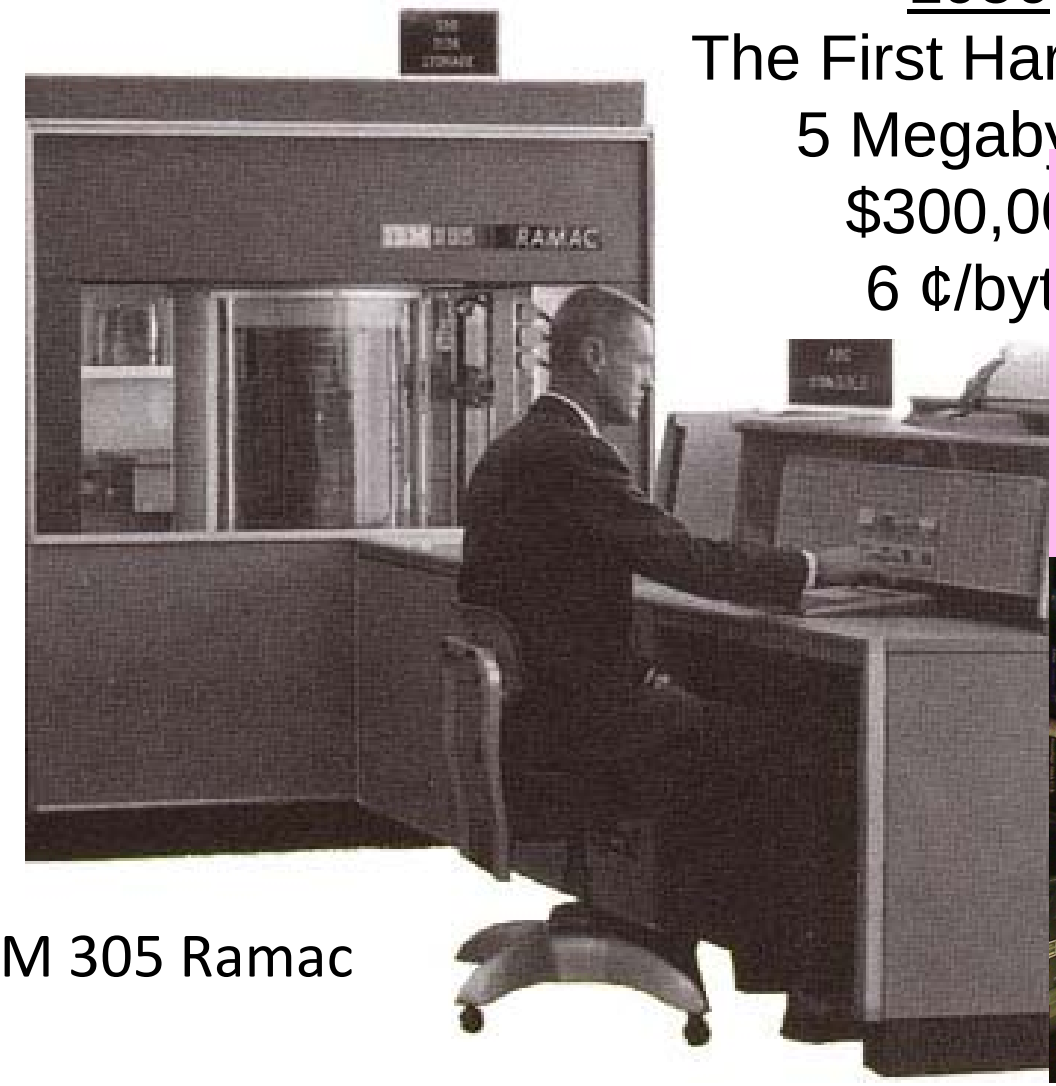
<u>1956</u>

The First Hard Drive

5 Megabytes

$300,0

6 ¢/byt



IBM 305 Ramac

<u>2013 (+57)</u>

HP Personal Media

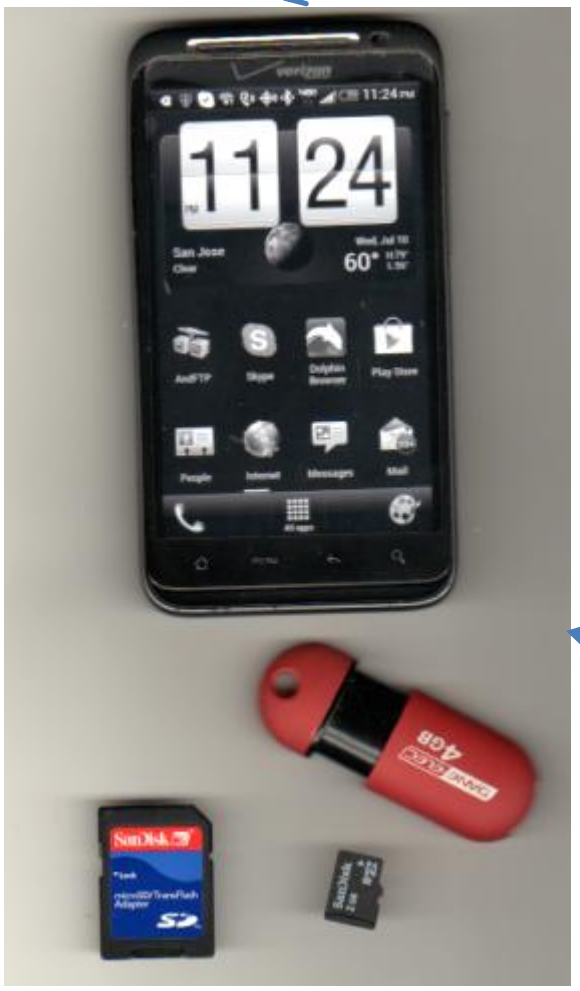
2 Terabytes

$100

5 nano-¢/byte

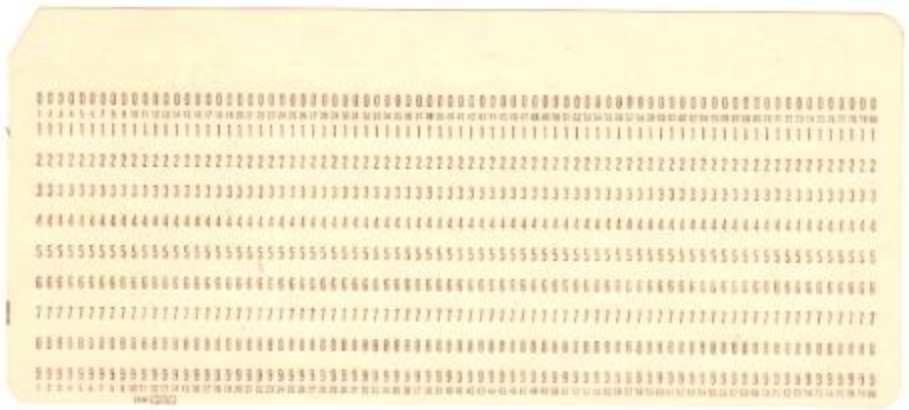
iDiot-i(Pod+Pad+Phone+iTablet) + Android-Whatever

Storage ~ 32 GB (2013)



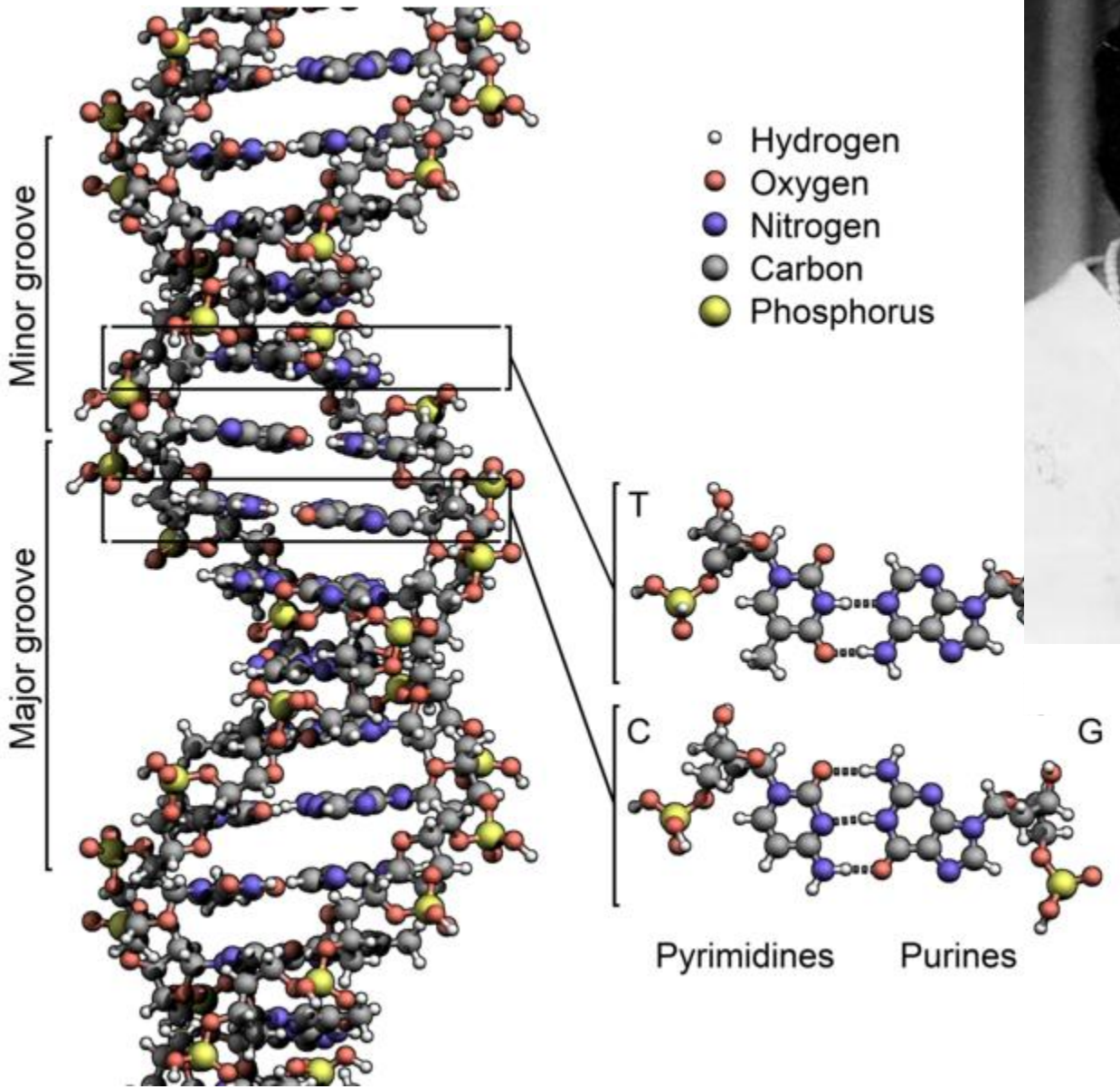
IBM Punched Card, ca. 1935 – 1980

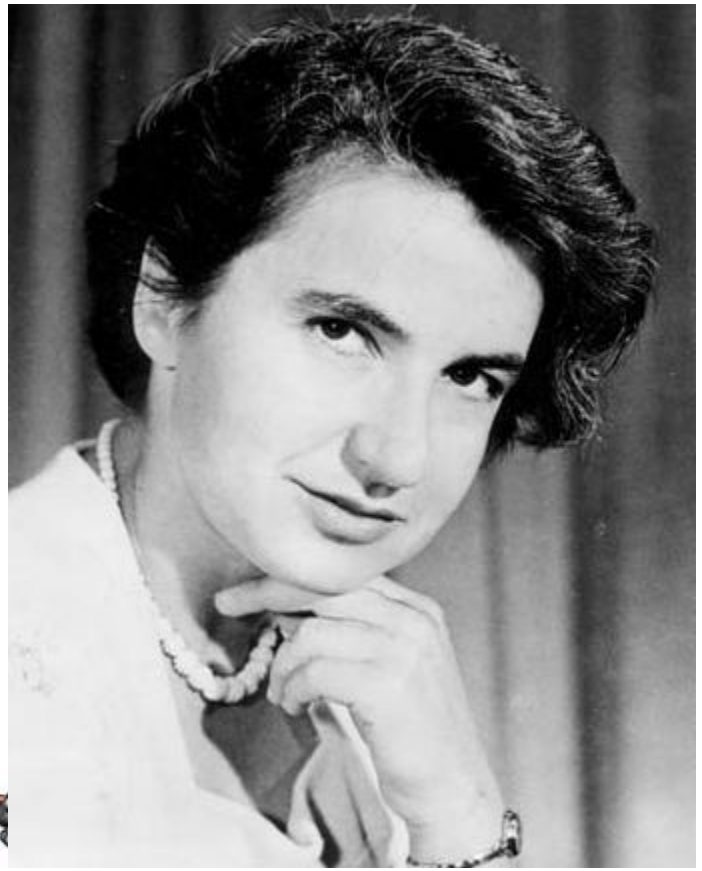
Storage = 120 Bytes = 960 Bits



> 33 Miles of stacked punched cards...as calculated by Ms. Devin Joan Grant, Age 11, 2011

The Structure of Life

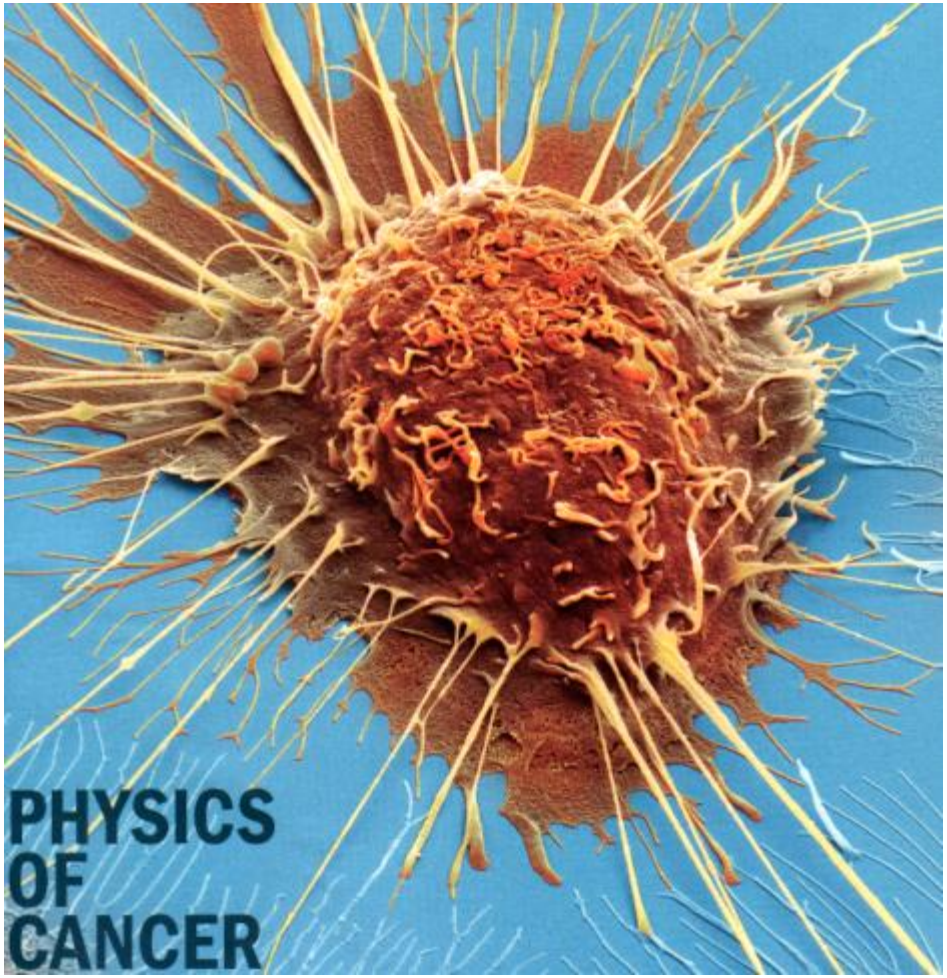


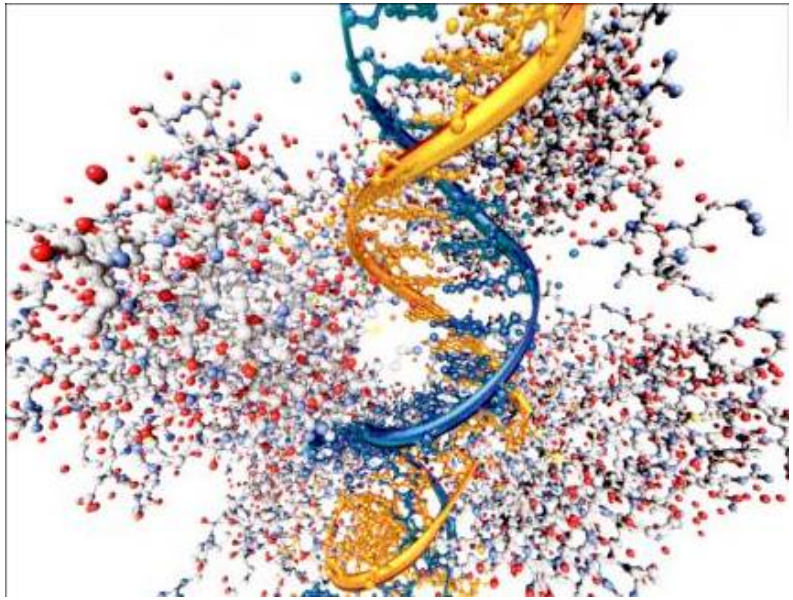


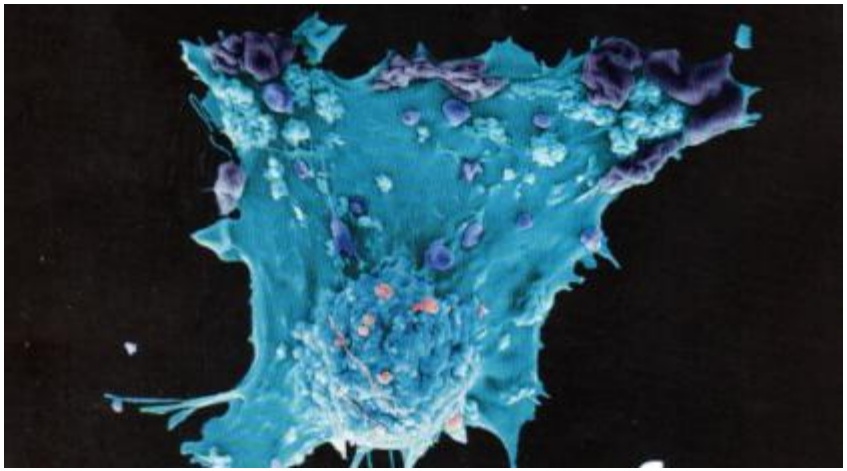
Rosalind Franklin

Physics World

Volume 26 No 7 July 2013







Where there is no vision,
the people perish…

Proverbs 29:18

“You can’t always get what you want…”

“…you get what you need!”