Does the
DA VINCI CODE
Hold the Key to Room Temperature Superconductivity?

Paul M. Grant

Visiting Scholar, Stanford

IBM Research Staff Member Emeritus

EPRI Science Fellow (Retired)

Principal, W2AGZ Technologies

The Road to Room Temperature Superconductivity

Loen, Norway

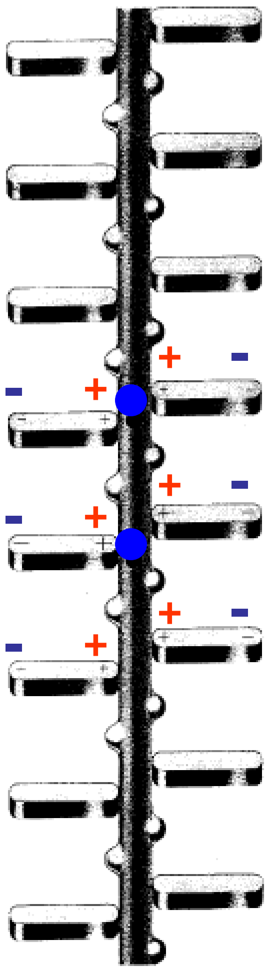
17-22 June 2007

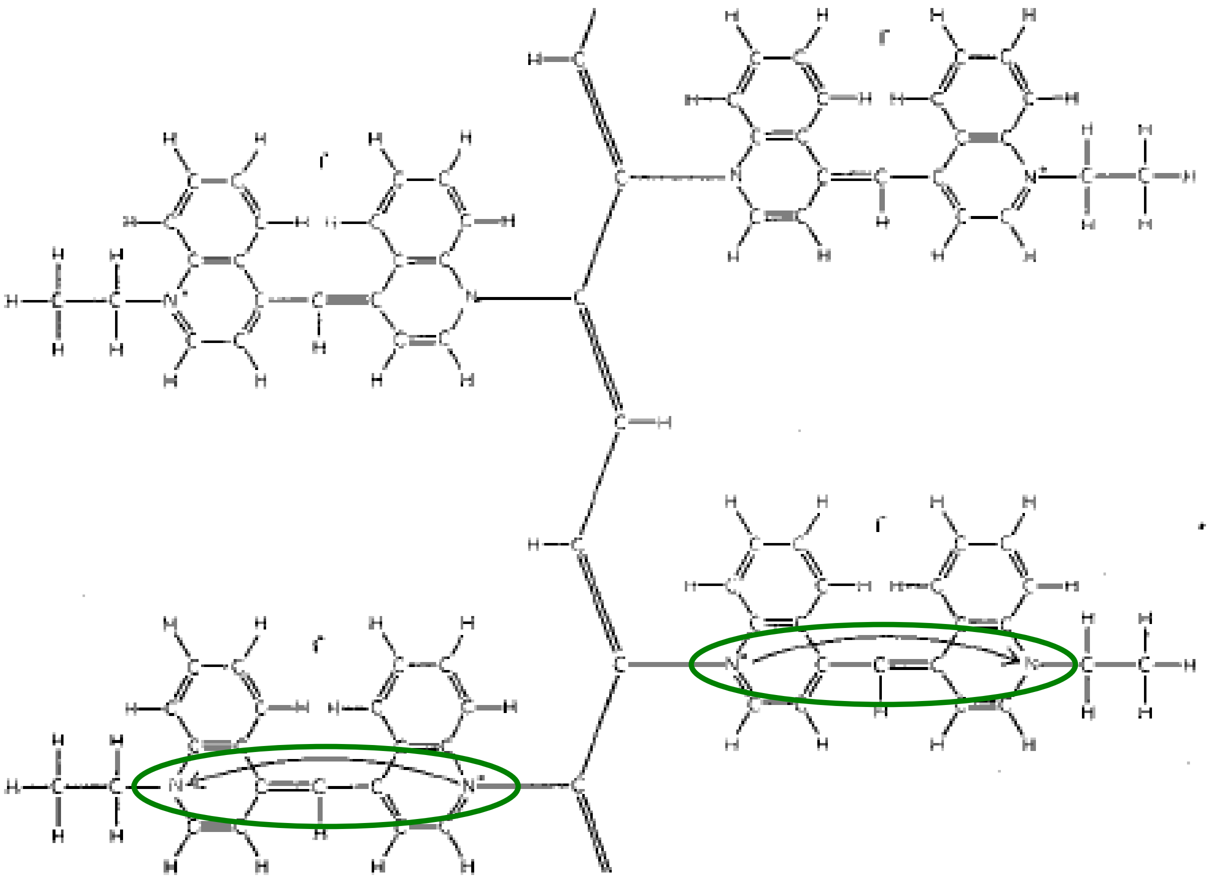
http://www.w2agz.com/rtsc07.htm

Road2RTS

London (1950)

Little, 1963





Diethyl-cyanine iodide

"Bill Little's BCS"

$$T_C = a\Theta e^{-\frac{1}{\lambda - \mu^*}}$$

~~$\lambda k\Theta \ll E_F$~~

Where

Θ = Exciton Characteristic Temperature (~ 22,000 K)

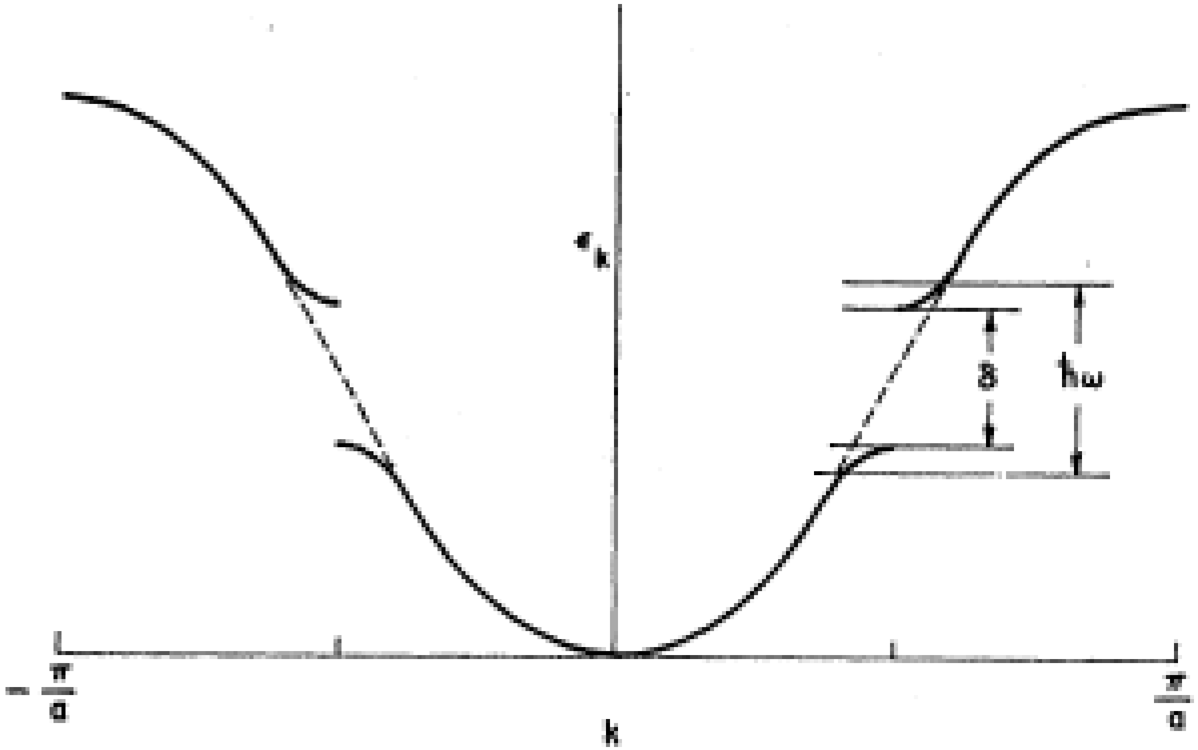
λ = Fermion-Boson Coupling Constant (~ 0.2)

μ^* = Fermion-Fermion Repulsion (?)

a = "Gap Parameter, ~ 1-3"

Tc = Critical Temperature, ~ 300 K

Spine is a Semiconductor!



False Alarm:

SUPERCONDUCTING FLUCTUATIONS AND THE PEIERLS INSTABILITY IN AN ORGANIC SOLID*

L.B. Coleman, M.J. Cohen, D.J. Sandman, F.G. Yamagishi, A.F. Garito and A.J. Heeger

Department of Physics and Laboratory for Research on the Structure of Matter, University of Pennsylvania, Philadelphia, Pennsylvania 19174, U.S.A.

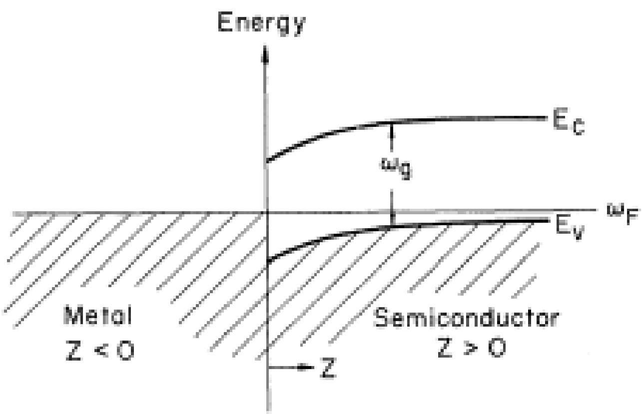
(*Received* 20 *February* 1973 *by E. Burstein*)

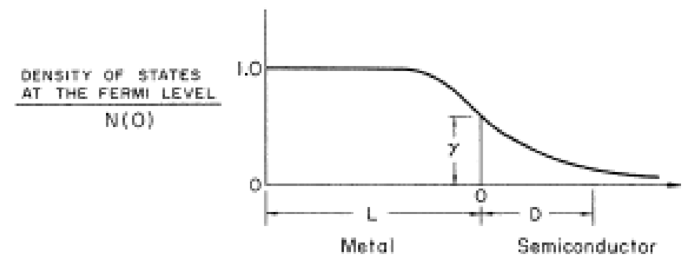
Allender-Bray-Bardeen (1973)

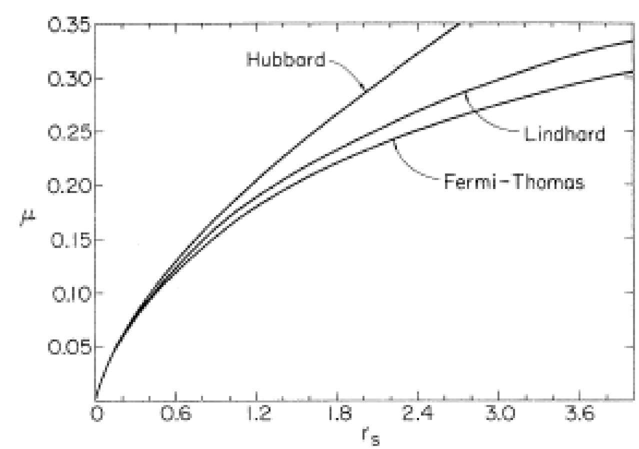
PHYSICAL REVIEW B VOLUME 7, NUMBER 3 1 FEBRUARY 1973

Model for an Exciton Mechanism of Superconductivity*

David Allender,† James Bray, and John Bardeen
Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801
(Received 7 August 1972)







Electron-Exciton Interaction

Exciton c-a Operators

$$H_{el-ph} = \sum_{\mathbf{k}\mathbf{q}\nu} g^{\mathbf{q}\nu,mn}_{\mathbf{k}+\mathbf{q},\mathbf{k}} \, c^{\dagger m}_{\mathbf{k}+\mathbf{q}} c^{n}_{\mathbf{k}} \, (b^{\dagger}_{-\mathbf{q}\nu} + b_{\mathbf{q}\nu}) \qquad (1)$$

Electron-Exciton Coupling

$$\alpha^2 F(\omega) = \frac{1}{N(\varepsilon_F)} \sum_{mn} \sum_{\mathbf{q}\nu} \delta(\omega - \omega_{\mathbf{q}\nu}) \sum_{\mathbf{k}} |g^{\mathbf{q}\nu,mn}_{\mathbf{k}+\mathbf{q},\mathbf{k}}|^2 \times \delta(\varepsilon_{\mathbf{k}+\mathbf{q},m} - \varepsilon_F)\delta(\varepsilon_{\mathbf{k},n} - \varepsilon_F), \qquad (2)$$

$$\lambda = 2 \int \frac{\alpha^2 F(\omega)}{\omega} d\omega = \sum_{\mathbf{q}\nu} \lambda_{\mathbf{q}\nu}, \qquad (3)$$

$$\lambda_{\mathbf{q}\nu} = \frac{2}{N(\varepsilon_F)\omega_{\mathbf{q}\nu}} \sum_{mn} \sum_{\mathbf{k}} |g^{\mathbf{q}\nu,mn}_{\mathbf{k}+\mathbf{q},\mathbf{k}}|^2 \times \delta(\varepsilon_{\mathbf{k}+\mathbf{q},m} - \varepsilon_F)\delta(\varepsilon_{\mathbf{k},n} - \varepsilon_F). \qquad (4)$$

Davis – Gutfreund – Little (1975)

PHYSICAL REVIEW B VOLUME 13, NUMBER 11 1 JUNE 1976

Proposed model of a high-temperature excitonic superconductor*

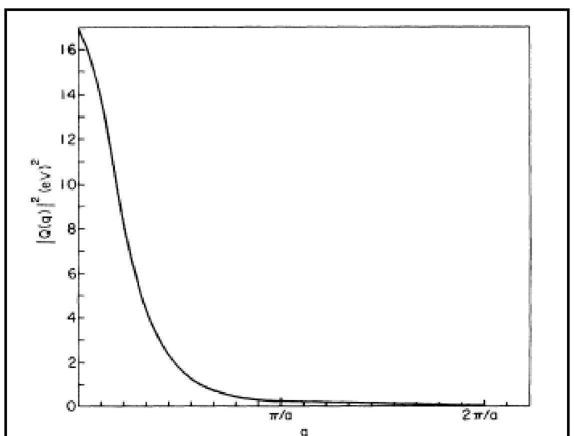
D. Davis,† H. Gutfreund,‡ and W. A. Little
Physics Department, Stanford University, Stanford, California 94305

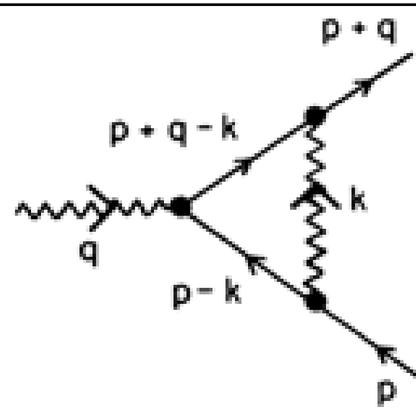
(Received 16 October 1975)

$$g^{q\nu,mn}_{\mathbf{k+q,k}} \longrightarrow$$

$$\phi^*(r_1 - R_j)\,\phi(r_1 - R_h)e^{i[kR_h-(k-q)R_j]}V(r_1r_2)\sum_{m,l,\nu}\left[u^{\nu}_{\alpha l}(q) + i\,v^{\nu}_{\alpha l}(q)\right]e^{-iqR_l}\,\Psi^*_{\nu}(R_{ml})\Psi_{00}$$

$$Q_\alpha(q) = \frac{1}{N^{3/2}}\int\sum_{j,k}\phi^*(r_1 - R_j)\,\phi(r_1 - R_h)e^{i[kR_h-(k-q)R_j]}V(r_1r_2)\sum_{m,l,\nu}\left[u^{\nu}_{\alpha l}(q) + i\,v^{\nu}_{\alpha l}(q)\right]e^{-iqR_l}\,\Psi^*_{\nu}(R_{ml})\Psi_{00}\,d^3r_1\,d^3\tau$$

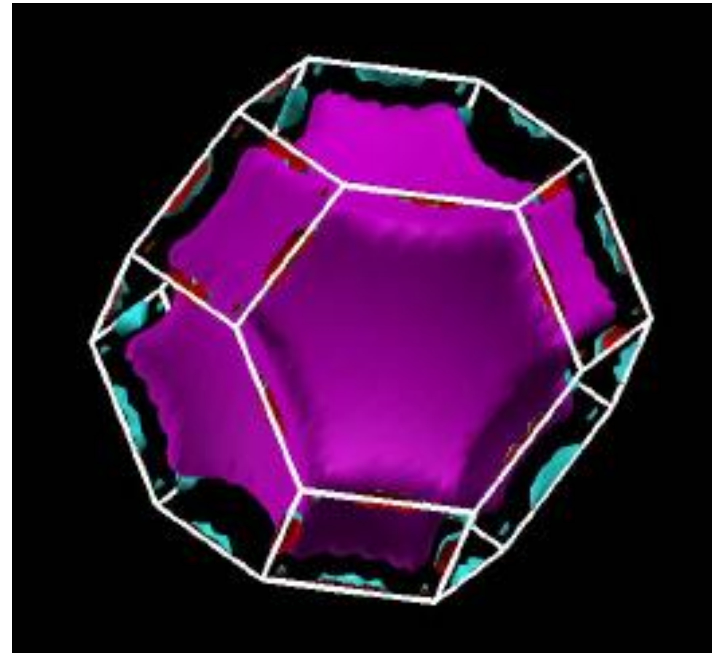


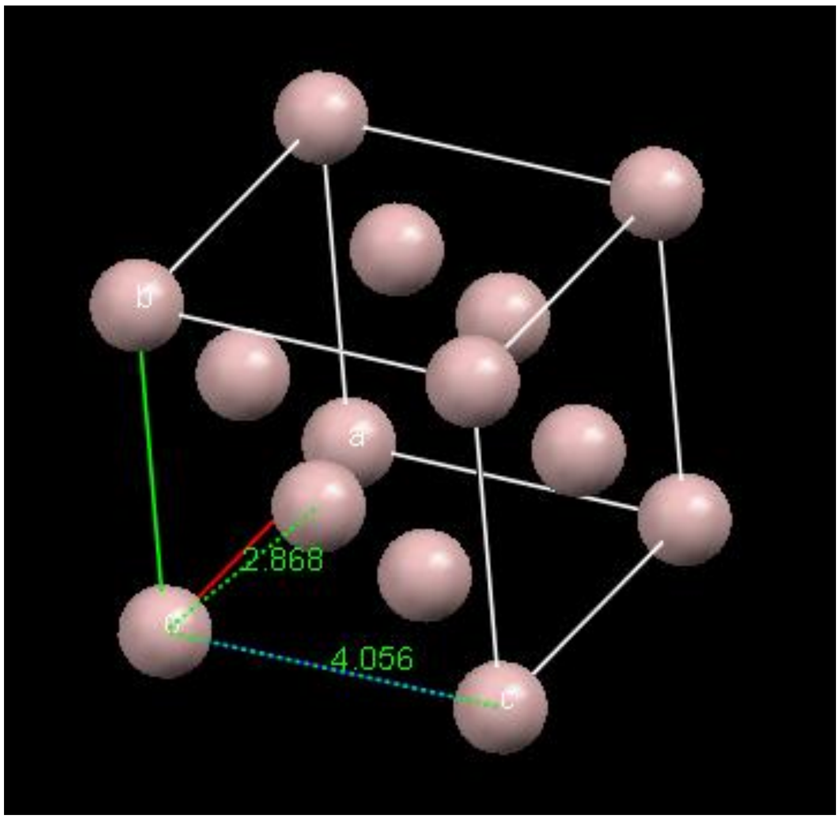


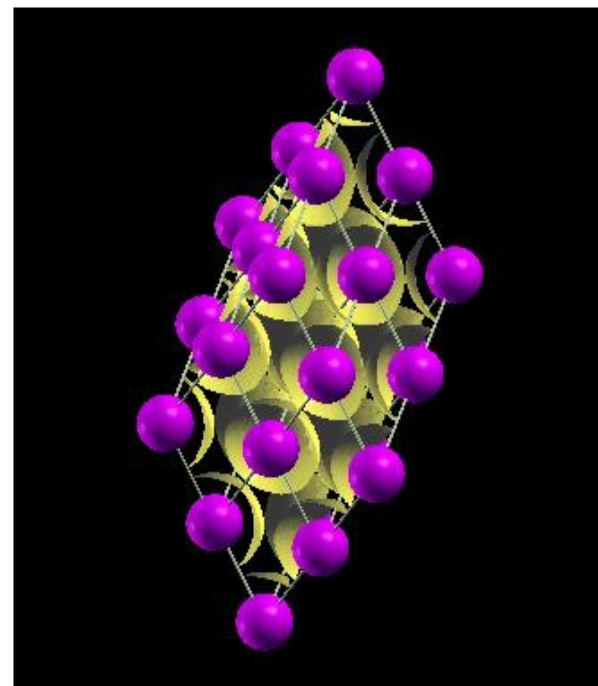
Migdal Issues:

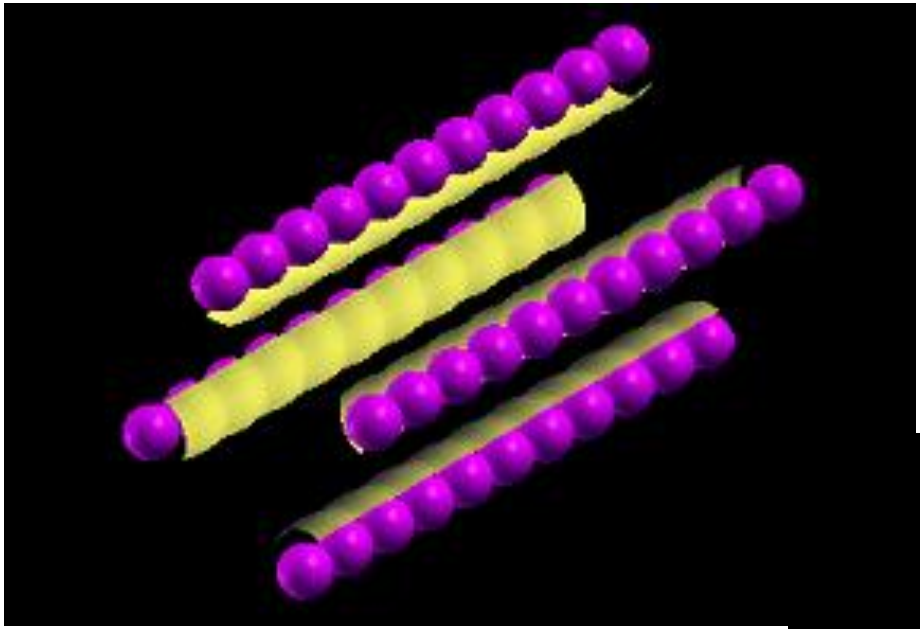
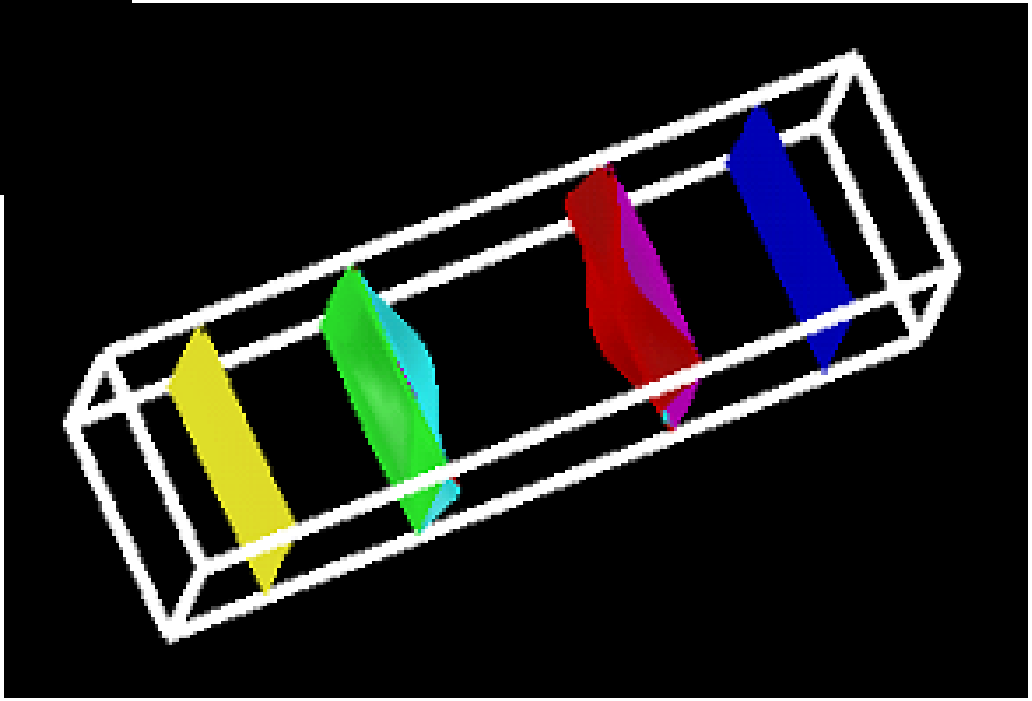
- Only small exciton q's, $v_q > v_F$, couple to the electrons.
- Thus vertex corrections are of order λ^2/θ and we're OK.
- DGL claim this is NOT the case for ABB.
- IMHO, this is an item amenable to numerical analysis.

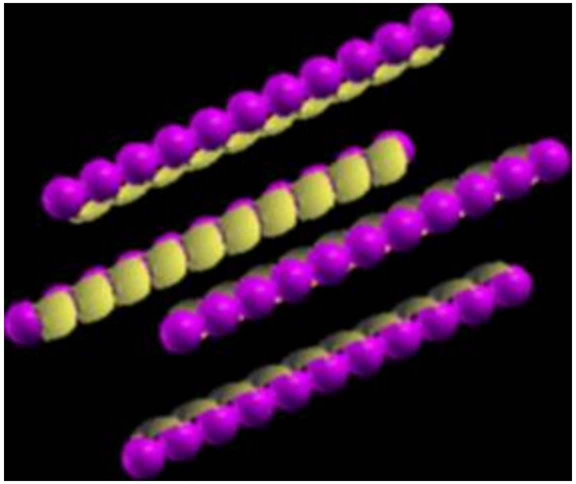
“3-D”Aluminum

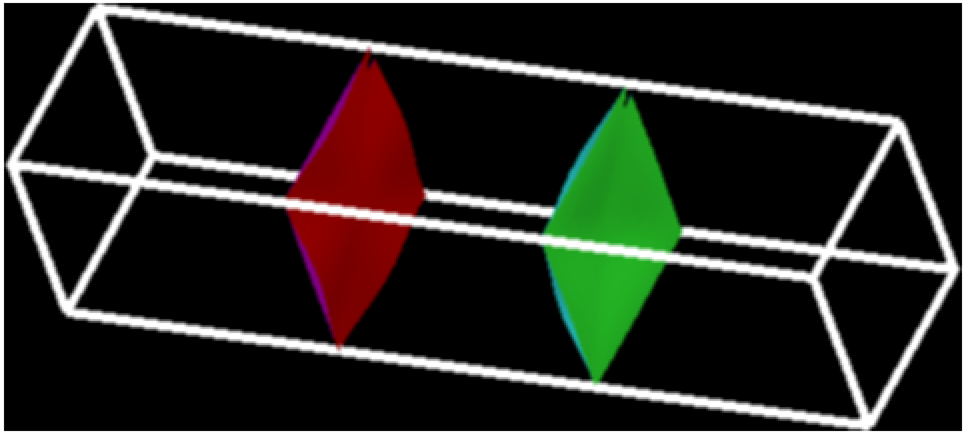










"Not So Famous Danish Kid Brother"

Harald Bohr

Silver Medal, Danish Football Team, 1908 Olympic Games

Almost Periodic Functions

"Electronic Structure of Disordered Solids and Almost Periodic Functions,"

P. M. Grant, **BAPS 18**, 333 (1973, San Diego)

<u>Definition I</u>: Set of all summable trigonometric series:

$$f(x) = \sum_n A_n e^{i\lambda_n x}$$

where $\{\lambda_n\}$ are denumerable.

Type (1) Purely Periodic: $\lambda_n = cn$, n = 0, ± 1, ± 2, ...

Type (2) Limit Periodic: $\lambda_n = cr_n$, $r_n \in$ {rationals}

Type (3) General Case: One or more λ_n irrational

==

<u>Definition II</u>: Existence of an infinite set of "translation numbers," $\{\tau_\varepsilon\}$, such that:

$$|\, f(x+\tau_\varepsilon) - f(x)\,| \le \varepsilon; \; -\infty < x < \infty$$

where $\varepsilon \ge 0$.

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<u>Parseval's Theorem</u>:

$$\sum_n |\, A_n\,|^2 = \lim_{L\to\infty} \frac{1}{2L} \int_{-L}^{L} |\, f(x)\,|^2 \, dx$$

<u>Mean Value Theorem</u>:

$$\int_{-\infty}^{\infty} f(x) e^{i\lambda x} dx = A_n \delta(\lambda - \lambda_n)$$

$$\text{Example}: f(x) = \cos x + \cos\sqrt{2}x$$

Rigid Ion Approximation

$$V(x) \equiv V_a(x) \otimes s(x)$$

$$s(x) = \sum_{n=-\infty}^{\infty} \delta(x - x_n)$$

$$x_n = na + b\cos\frac{2\pi na}{L}$$

$$s(x) = \sum_{\ell=-\infty}^{\infty} \sum_{m=-\infty}^{\infty} (-i)^{\ell} J_{\ell}\left[2\pi b\left(\frac{m}{a} + \frac{\ell}{L}\right)\right] e^{i2\pi\left(\frac{m}{a}+\frac{\ell}{L}\right)x}$$

Plane Wave Representation

$$\left|k\right\rangle = e^{ikx}$$

$$V(x) = \sum_{K} U(K) e^{iKx}$$

$$E(k) = \frac{\hbar^2 k^2}{2m} + U(0) + \sum_{K \neq 0} \frac{\left|U(K)\right|^2}{\frac{\hbar^2}{2m}\left[k^2 - \left(k - K\right)^2\right]} + \ldots$$

$$V(x) = \sum_{n=-N}^{N} U(n) e^{i\frac{2\pi}{a} r_n x}, \quad r_n \text{ rational}$$

$$\{r_n\} = \{\mu_n / \nu\}, \quad \{\mu_n\} \in I, \quad \nu = LCD$$

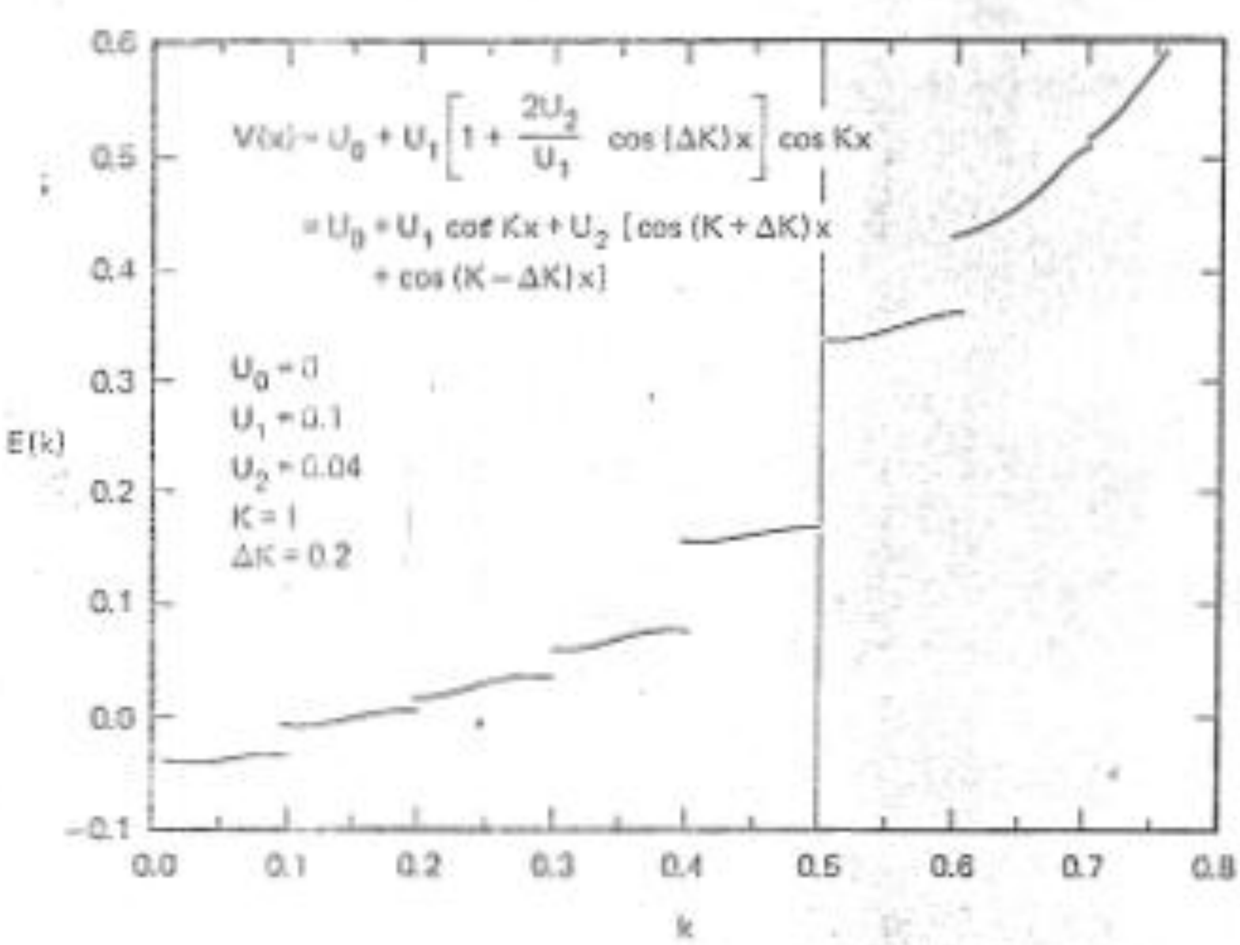
$$\psi_k(x) = \frac{2\pi}{\nu a} \sum_{-\infty}^{\infty} \chi(n) e^{i\frac{2\pi n}{\nu a} x} e^{ikx}, \quad \{n\} \in I$$

$$\lim_{\nu \to \infty} \frac{2\pi}{\nu a} \sum_{n=-\infty}^{\infty} \chi(n) e^{i\frac{2\pi n}{\nu a} x} e^{ikx} \Rightarrow \int_{-\infty}^{\infty} \chi(k' - k) e^{ik'x} dk'$$

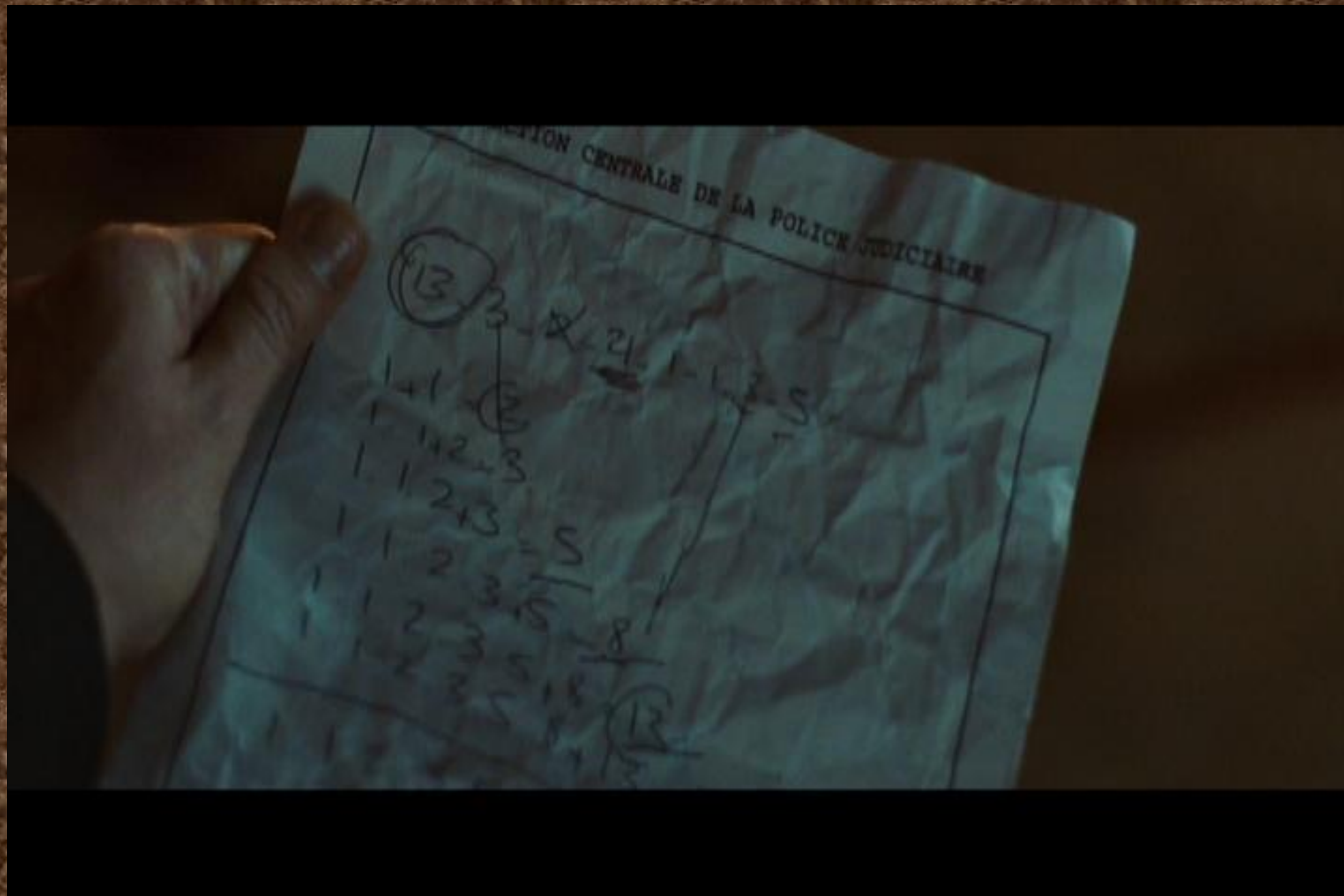
APF "Band Structure"

"Electronic Structure of Disordered Solids and Almost Periodic Functions,"

P. M. Grant, **BAPS 18**, 333 (1973, San Diego)



Da Vinci Code


CENTRALE DE LA POLICE JUDICIAIRE

Fibonacci Chains

"Monte-Carlo Simulation of Fermions on Quasiperiodic Chains,"

P. M. Grant, **BAPS March Meeting** (1992, Indianapolis)

$$G_n \equiv G_{n-1} \,|\, G_{n-2}, \quad n = 3, 4, 5, ..., \infty$$

Where $G_1 = a,\ G_2 = ab$

And $\lim\limits_{n\to\infty} N_a(G_n) / N_b(G_n) \equiv \tau = (1+\sqrt{5})/2 \approx 1.618...$

Example: $G_6 = abaababaab\ (N = 13)$

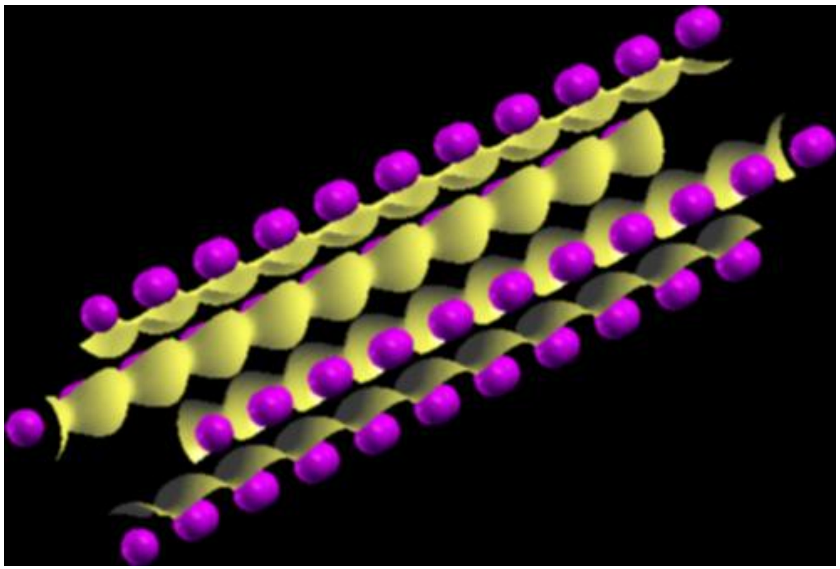
Let $a = c\tau b,$ subject to $\langle a, b\rangle$ invariant,

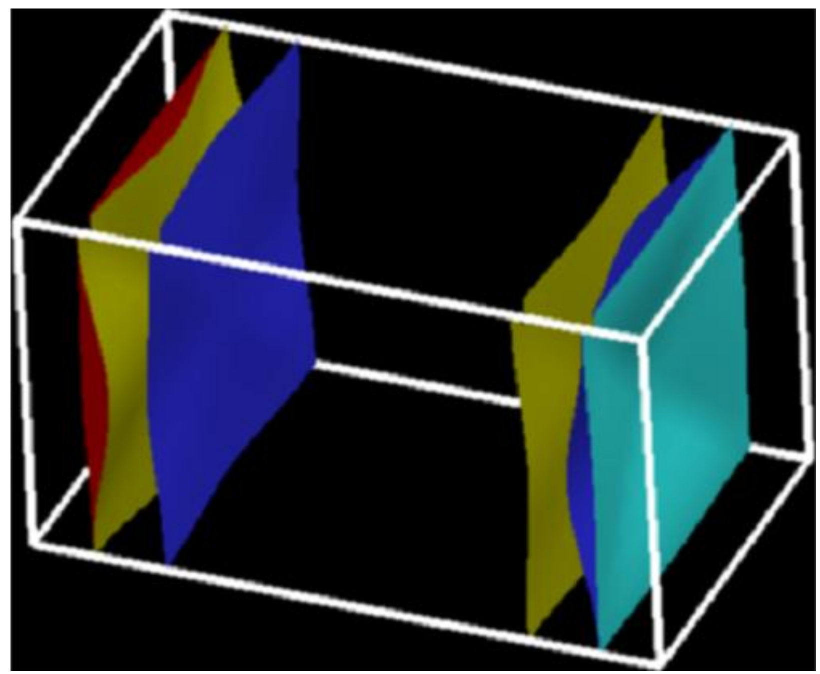
And take a and b

to be "inter-atomic n-n distances,"

Then $b = \tau\langle a, b\rangle / \left[(1+c)\tau - 1\right].$

Where c is a "scaling" parameter.





64 = 65