

LANDAU'S NOBEL PRIZE IN PHYSICS



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Member of the Royal Swedish Academy of Sciences

2013 Member of the Nobel Committee for Physics

OUTLINE

- ✘ Description of the Nobel Prize procedure
- ✘ Landau's Nobel Prize (with some discussions about Pyotr Kapitsa)

Testament

Jag undertecknad Alfred Bernhard Nobel förklarar härmed efter mycket betänksamt min yttersta vilja i afseende på den egendom jag vid min död kan efterlemnna vara följande:

Alla delar min återstående ^{realiserbar} förmögenhet förfogas på följande sätt: Kapitalen, af utredningsmännens realiserade till säkra värdepappers, skall utjåna en fond hvars ränta ärligen utdelas som friskolor till dem som under det förlupne året hafva gjort min lighet den största nytta. Råntan delas i fem lika delar som tillfalla: en del den som inom fysikens område har gjort den viktigaste upptäckt eller uppfinning; en del den som har gjort den viktigaste kemiska upptäckt eller förbättring; en del den som har gjort den viktigaste upptäckt inom fysiologien eller medicinen; en del den som inom litteraturen har producerat det största i idealiskt riktning; och en del åt den som har verkat mest eller bäst för folkens förbättrande och afkaffande eller minskning af stridande armar samt bildande och upprättande af fredningsgrepp. Priset för fysik och kemi utdelas af Svenska Vetenskapsakademien; för fysiologi och medicin af Karolinska Institutet i Stockholm; för litteratur af Akademin i Stockholm samt för fredsfaktorn ett utskott af fem personer som väljas af Norska Stortinget. Det är min uttryckliga vilja att vid prisutdelningarna intet afseende fästas vid någon slags nationalitetstillhörighet såvida ut den värdigaste skälles pris uttänningen kan är Skandinaver eller ej.

Detta testamente är beträffande det enda giltiga och upphäver alla mina föregående testamentariska bestämningar om sådana skulle förefinnas efter min död.

Skettligen anordnar jag såsom förut varit min uttryckliga önskan och vilja att efter min död prästerna uppkäras och att sedan detta skett och tydliga döds-testen af kompetenta läkare intygats liket förbrännes i särskild kremationsugn.

Paris den 27 November
1895

Alfred Bernhard Nobel



"The whole of my remaining realizable estate shall be dealt with in the following way: the capital, invested in safe securities by my executors, shall constitute a fund, the interest on which shall be annually distributed in the form of prizes to those who, during the preceding year, shall have conferred the greatest benefit on mankind. The said interest shall be divided into five equal parts, which shall be apportioned as follows: one part to the person who shall have made the most important **discovery** or **invention** within the field of physics; one part to the person who shall have made the most important chemical discovery or improvement; one part to the person who shall have made the most important discovery within the domain of physiology or medicine; one part to the person who shall have produced in the field of literature the most outstanding work in an ideal direction; and one part to the person who shall have done the most or the best work for fraternity between nations, for the abolition or reduction of standing armies and for the holding and promotion of peace congresses. The prizes for physics and chemistry shall be awarded by the Swedish Academy of Sciences; that for physiology or medical works by the Karolinska Institute in Stockholm; that for literature by the Academy in Stockholm, and that for champions of peace by a committee of five persons to be elected by the Norwegian Storting. It is my express wish that in awarding the prizes no consideration be given to the nationality of the candidates, but that the most worthy shall receive the prize, whether he be Scandinavian or not."

[my underlining]

NOBEL FOUNDATION

A private institution established in 1900 based on the will of Alfred Nobel. The Foundation manages the assets made available through the will for the awarding of the Nobel Prize in Physics, Chemistry, Physiology or Medicine, Literature and Peace.

PHYSICS AND CHEMISTRY

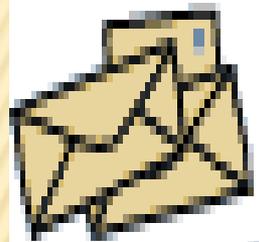
Prize-Awarding Institution:

The Royal Swedish Academy of Sciences

By the terms of Alfred Nobel's will the Nobel Prizes in Physics and Chemistry have been awarded by the Royal Swedish Academy of Sciences since 1901.

The Nobel Committees at the Academy are responsible for the selection of candidates among the nominees. When the committees have made their selection among the nominated candidates and presented their recommendation to the Academy, a vote is taken for the final choice of Laureates.

The Academy's decisions are announced immediately after the vote in early October each year.



Nomination

Nobel
Committee

Latest February 1

Selection

Prize-Awarding
Institution

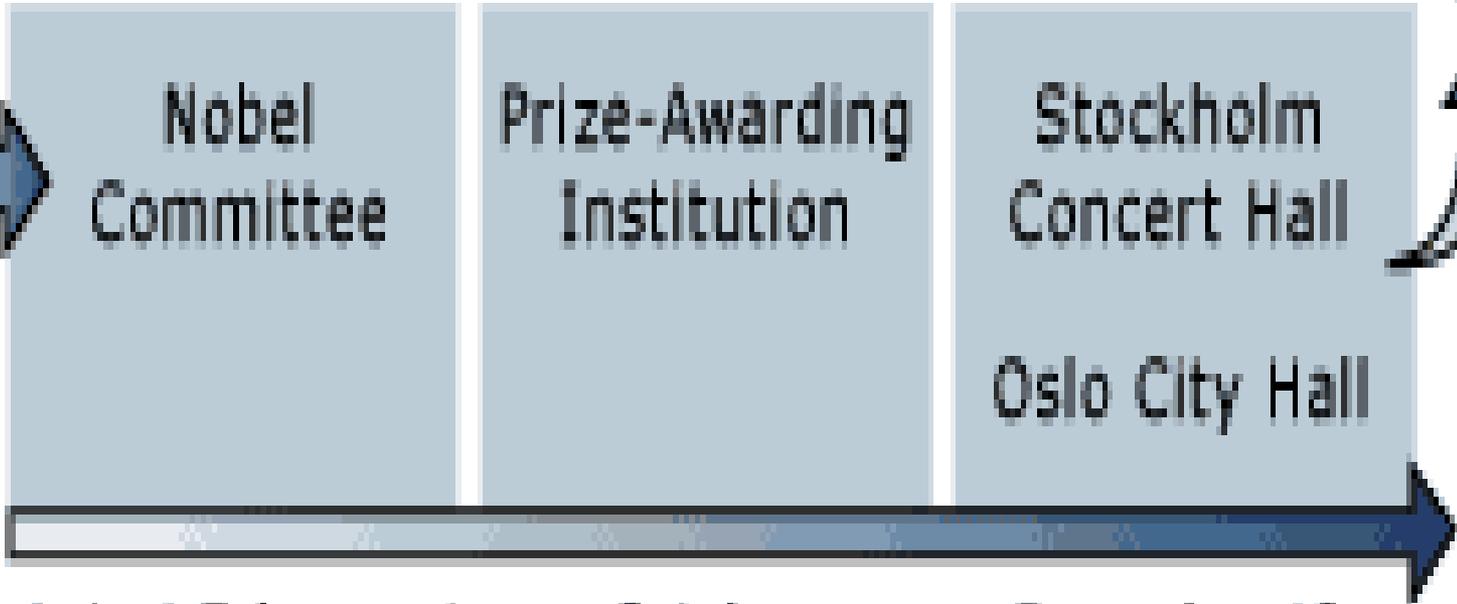
October

Award Ceremonies

Stockholm
Concert Hall

Oslo City Hall

December 10



The 2013 Nobel Committee for Physics



NOMINATIONS AND SELECTIONS OF PHYSICS LAUREATES

- ✘ Nomination to the Nobel Prize in Physics is by invitation only. The names of the nominees and other information about the nominations cannot be revealed **until 50 years later.**
- ✘ The Nobel Committee for Physics sends confidential forms to persons who are competent and qualified to nominate.
- ✘ A person who is not nominated a particular year cannot be considered for the prize that year. A prize cannot be awarded posthumous (after death)

Who can nominate

1. Swedish and foreign members of the Royal Swedish Academy of Sciences;
2. Members of the Nobel Committee for Physics;
3. Nobel Laureates in Physics;
4. Permanent and assistant professors in the sciences of Physics at the universities and institutes of technology of Sweden, Denmark, Finland, Iceland and Norway, and Karolinska Institutet, Stockholm;
5. Holders of corresponding chairs in at least six universities or university colleges selected by the Academy of Sciences with a view to ensuring the appropriate distribution over the different countries and their seats of learning; and
6. Other scientists from whom the Academy may see fit to invite proposals.

Procedure

September – *Nomination forms are sent out.* The Nobel Committee sends out confidential forms to around 3,000 people

February – *Deadline for submission.* The completed nomination forms must reach the Nobel Committee no later than 31 January of the following year. The Committee screens the nominations and selects the preliminary candidates. About 250–350 names are nominated as several nominators often submit the same name.

March-May – *Consultation with experts.* The Nobel Committee sends the names of the preliminary candidates to specially appointed experts for their assessment of the candidates' work.

June-August – *Writing of the report.* The Nobel Committee puts together the report with recommendations to be submitted to the Academy. The report is signed by all members of the Committee.

September – *Committee submits recommendations.* The Nobel Committee submits its report with recommendations on the final candidates to the members of the Academy. The report is discussed at two meetings of the Physics Class of the Academy.

October – *Nobel Laureates are chosen.* In early October, the Academy selects the Nobel Laureates in Physics through a majority vote. The decision is final and without appeal. The names of the Nobel Laureates are then announced.



December – *Nobel Laureates receive their prize.* The Nobel Prize Award Ceremony takes place on 10 December in Stockholm, where the Nobel Laureates receive their Nobel Prize, which consists of a Nobel Medal and Diploma, and a document confirming the prize amount.



EXAMPLE OF A PRIZE FOR DISCOVERY



1935

James Chadwick

"for the discovery of the neutron"

EXAMPLE OF A PRIZE FOR INVENTION

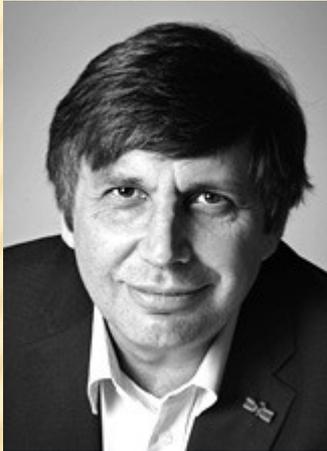


1960

Donald Arthur Glaser

*"for the invention of the
bubble chamber"*

SHARED PRIZE



2010

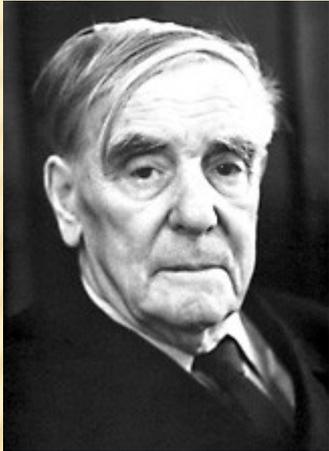
Andrei Geim



Konstantin Novosëlov

*” for groundbreaking experiments
regarding the two-dimensional material
graphene”*

DIVIDED PRIZE, 1978



Pyotr Leonidovich Kapitsa

“for his basic inventions and discoveries in the area of low-temperature physics”

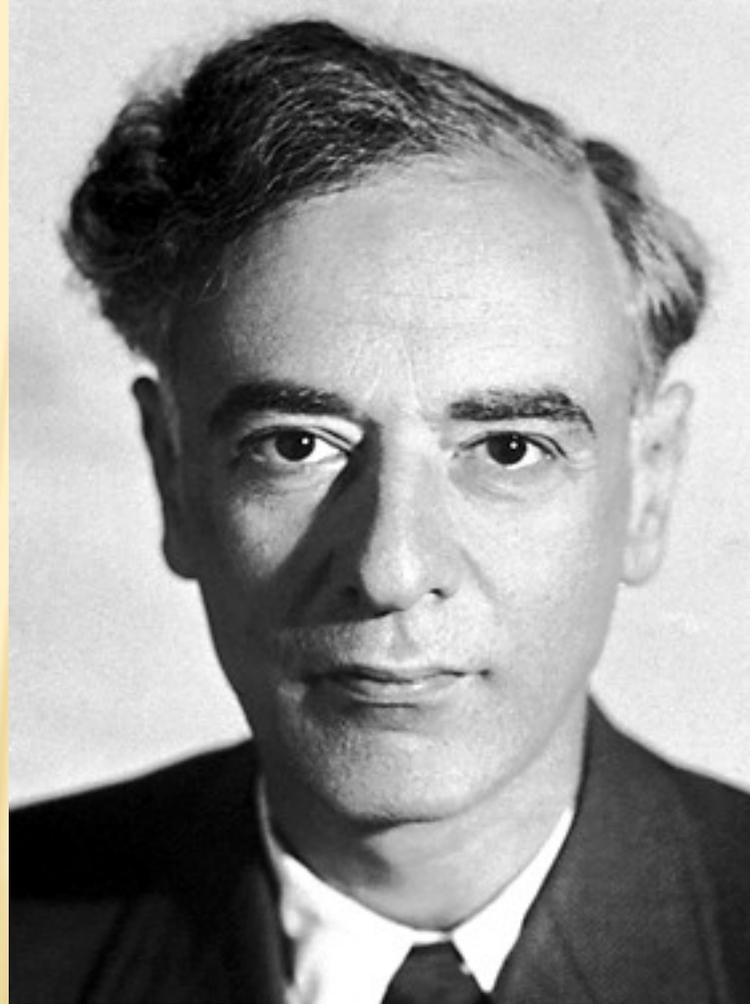


Arno Allan Penzias and Robert Woodrow Wilson

“for their discovery of cosmic microwave background radiation”

THE NOBEL PRIZE IN PHYSICS 1962

Lev Landau, 1908-1968



ACKNOWLEDGEMENT

- ✘ I am thankful for access to the Nobel Archive, the Royal Swedish Academy of Sciences
- ✘ Letters of nominations, scientific evaluations of various candidates, and minutes are open to members of the Academy and historians of science
- ✘ I acknowledge Alexander Balatsky, NORDITA in Stockholm, and with PhD in physics from the Landau Institute for Theoretical Physics, for valuable discussions

NOMINATIONS OF LANDAU ALONE

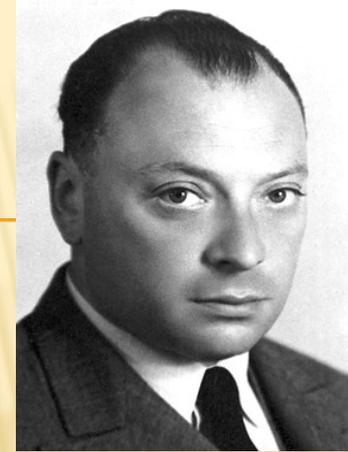
- ✘ 1954, R.E. Marshak, University of Rochester, USA:
second sound in liquid helium (Journal of Physics of the USSR, **5**, 81 (1941))
- ”In my opinion Landau is the leading Russian physicist and has made many important contributions to theoretical physics of which the above is probably the most outstanding”

EVALUATION OF LANDAU 1954 BY OSKAR KLEIN, MEMBER OF THE NOBEL COMMITTEE



- ✘ Klein discusses only the Hell theory
- ✘ Klein concludes that there are some uncleared items with the Hell problem, and Landau cannot presently be awarded the Nobel Prize

1958



- ✘ Landau nominated by **Wolfgang Pauli**:
- ✘ "I would like to propose for the award of the Nobel Prize for Physics in 1958 Prof. L. Landau (Moscow) for his investigations in the field of the theory of the superfluid state of He"
(Pauli died December 15, 1958)

1959



- ✗ Landau is nominated by **Werner Heisenberg**:
- ✗ Quantum theory of diamagnetism, superfluid helium, quantum field theory

”aber das Gesamtwerk scheint mir so bedeutend, dass man Verleihung des Nobelpreises an ihn jeder Weise rechtfertigen kan”

”but his complete works seem to me so important that Nobel Prize award to him can be justified in every way”

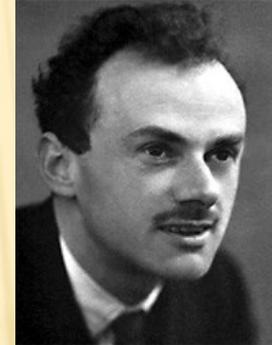
1960

- ✘ Landau is again nominated by **Werner Heisenberg**

1961

- ✘ No nominations

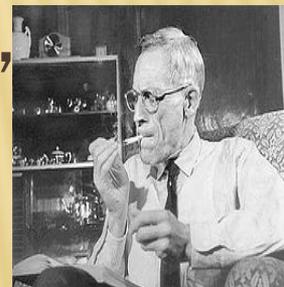
NOMINATIONS OF PYOTR KAPITSA



- ✘ 1946, nomination by Paul Dirac
- ✘ 1947, nominations by Wolfgang Pauli, Niels Bohr, Theodor Svedberg, William Watson
- ✘ 1948, nominations by Niels Bohr, Theodor Svedberg
- ✘ 1950, nomination by Paul Dirac
- ✘ Additional 18 nominations until 1960

NOMINATION OF KAPITSA AND LANDAU

- ✘ 1956, nomination by Niels Bohr
- ✘ 1957, nominations by Lev A. Artsimovich, Mikhail A. Leontovich
- ✘ 1958, nominations by Lev A. Artsimovich, Mikhail A. Leontovich
- ✘ 1960, nomination by Niels Bohr



OTHER COMBINATION

- ✘ 1960, nomination by M. Lunc, Warsaw:
Shared prize between Landau and Nikolay N. Bogolyobov



1962

- ✘ Landau suffers a severe car accident on January 7.
- ✘ January 10. Nomination by **Werner Heisenberg**
- ✘ January 26. Nomination by **John R. Pellam**, CalTech

1962

Fysik

MAX-PLANCK-INSTITUT FÜR PHYSIK UND ASTROPHYSIK

INSTITUT FÜR PHYSIK
Prof. W. Heisenberg

MÜNCHEN 23, den 10. Jan. 1962
AUMEISTERSTRASSE 6
TELEFON 363201

KVA:s Nobelkommittéer
Inkom den 13. 1 1962

An den
Herrn Präsidenten des
Nobelkomitees für Physik
der Königl. Akademie der Wissenschaften
Stockholm 50 (Schweden)

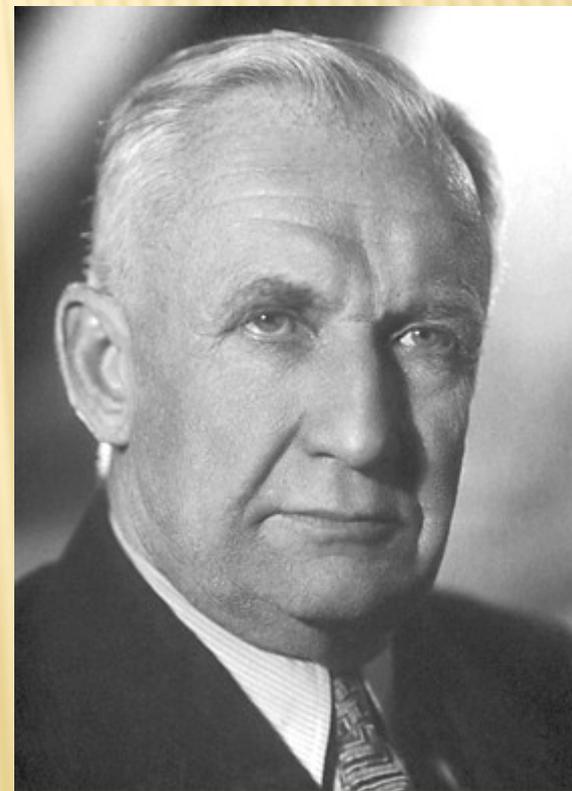
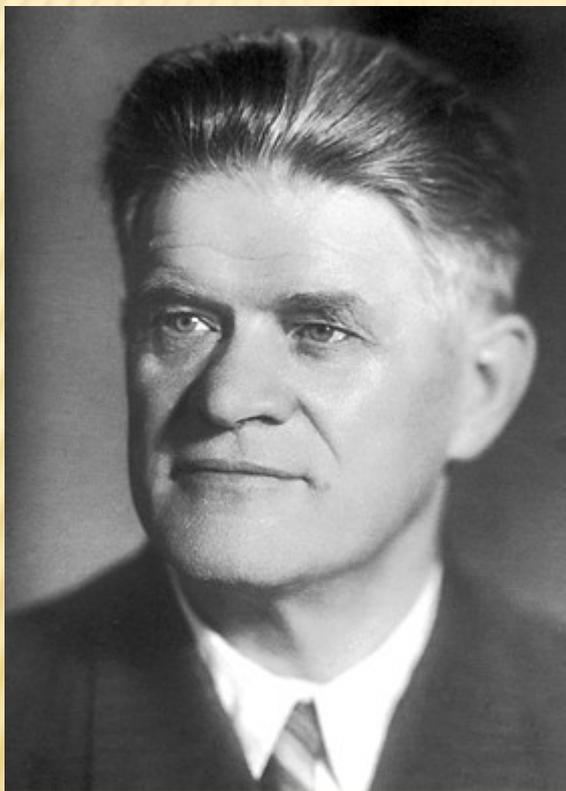
Sehr verehrter Herr Präsident!

Für den Nobelpreis für Physik des Jahres 1962 möchte ich noch einmal Herrn L. L a n d a u in Moskau vorschlagen. Wie Sie wissen, hatte ich Herrn Landau schon früher vorgeschlagen und als Begründung seine Untersuchungen über die Quantentheorie des Diamagnetismus, des superfluiden Heliums und insbesondere seine Arbeiten zur Quantenfeldtheorie genannt. Ich habe auch erwähnt, daß man bei Landau, der ja ein sehr vielseitiger theoretischer Physiker ist, vielleicht nicht eine einzige besonders glanzvolle Entdeckung hervorheben kann, daß aber sein Gesamtwerk so bedeutend ist, daß man die Verleihung des Nobelpreises an ihn in jeder Weise rechtfertigen kann. Auch früher sind die Statuten der Stiftung ja schon in dieser Weise ausgelegt worden. Ich denke etwa an die Verleihung des Preises an Debye, Bothe und Born. Nachdem in den vergangenen Jahren verschiedene russische Kollegen den Nobelpreis in Empfang genommen haben, kann man ja wohl auch annehmen, daß aus einer solchen Verleihung für Landau sich keine Schwierigkeiten ergeben würden.

Mit den besten Empfehlungen
Ihr sehr ergebener

W. Heisenberg

NOBEL PRIZE IN PHYSICS 1958



Павел Алексеевич Черенков Вилья Михайлович Франк Игорь Евгеньевич Тамм

CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

KVA:s Nobelkommitt er

Inkom den 20.1 1962

W. C. C. : W. C. C.

January 26, 1962

The Nobel Committee for Physics
Stockholm 50
Sweden

Dear Sirs:

Thank you for the invitation to nominate a candidate for the Nobel Prize for Physics for 1962.

My nomination is for Lev Davidovich Landau of the Institute for Physical Problems, Moscow.

The justification is based on a series of momentous contributions to the theory of liquid helium over a period of some twenty years. Specifically, the first of this series:

The Theory of Superfluidity of Helium II, by L. Landau, Journal of Physics USSR, V (1), 71 (1941)

set up the quantum mechanics for liquids or "quantum hydrodynamics". Specifically the idea of the energy gap Δ was introduced for "roton" excitations and the commutation rules for circulation operators introduced. The special rotation conditions requiring discretely (as opposed to continuously) varying circulation properties were expounded and constituted the foundation for "quantized rotations".

This early treatment of the liquid helium II problem was followed by the Letter in 1949:

On the Theory of Superfluidity, L. Landau, Physical Review (Letter) 75, 884 (1949).

in which Landau presented the form of the energy spectrum (ϵ vs p) for the elementary excitations. This spectrum, which both encompasses and connects the phonon region and the roton region, has since been amply verified experimentally in various ways.

About the same time Landau, in collaboration with I.M. Khalatnikov, published two major papers:

The Theory of the Viscosity of Helium II.
I. Collisions of Elementary Excitations in Helium II
II. Calculation of the Viscosity Coefficient
by L.D. Landau and I.M. Khalatnikov, J. Exp. Theor. Physics, USSR 19, 637 and 709, respectively (1949).

In these the energy spectrum for excitations was applied to second order processes to provide scattering cross-section calculations for phonon-phonon, phonon-roton, and roton-roton collisions. Extension of these

results to second sound attenuation by Khalatnikov and subsequent experimental verification has confirmed Landau's theory also in its second order application.

In recent years Landau has turned his attention to the properties of the light isotope, helium 3. Specifically in connection with liquid helium 3, the following publications:

The Theory of a Fermi Liquid, L.D. Landau, JETP USSR 30, 1058 (1956);
JETP (US) 3, 920 (1956-7)
Oscillations in a Fermi Liquid, L.D. Landau, JETP USSR 32, 59 (1959);
JETP (US) 5, 101 (1957)
Contributions to the Theory of the Fermi Liquid, L.D. Landau, JETP
USSR 35, 97 (1958); JETP (US) 8, 70 (1959)

treat the enticing helium 3 problem. Landau has predicted a new form of wave propagation in liquid helium 3 which he has named "zero sound". Experimental state of the art has not provided opportunity for testing this latest prediction.

Thus Landau's contributions to the theory of liquid helium have extended over a period of nearly two decades and are still pointing the way to experimentalists in this exerting field.

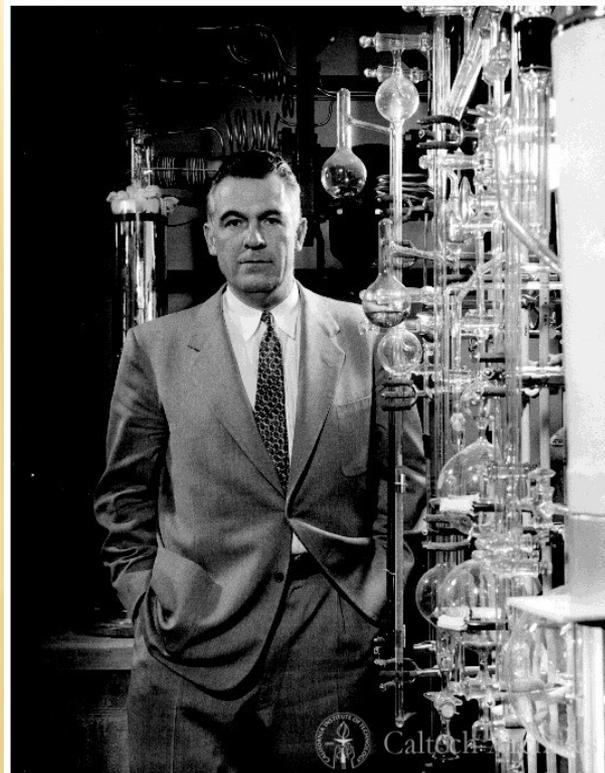
Unfortunately I have no reprints of any of the above publications. In case the Committee does not already possess copies of any (or all) of these items please notify me and I will have photo-copies (in English) prepared and forwarded. In connection with Landau's over-all impact on the field of the field of low temperature physics I enclose reprints of a talk presented on the occasion of his winning the Second Fritz London Award.

Sincerely yours,

John R. Pellam

John R. Pellam
Professor of Physics

Enclosures: 3



NOTE:

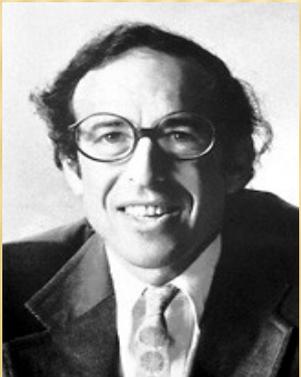
Richard Feynman obtained seven nominations in 1962, of which four came from CalTech. John Pellam was not one of them



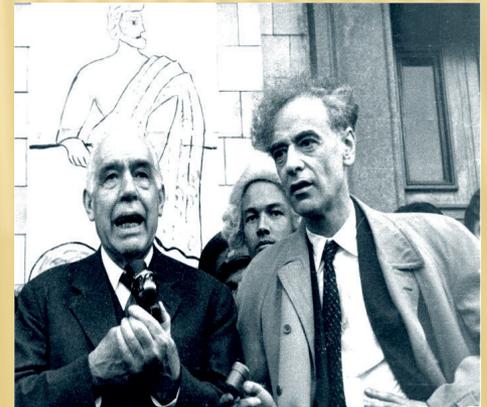
Nobel Prize in Physics 1965

NOMINATION BY NIELS BOHR

- ✘ Written together with Aage Bohr, Ben Mottelsen, Chr. Møller, Léon Rosenfeld
- ✘ Dated **January 28, 1962**
- ✘ Arrived in Stockholm on **February 28, 1962**, thus too late
- ✘ Niels Bohr died November 18, 1962



NP 1975



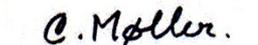
sound", som snart efter fandt sin bekræftelse ved Peshkovs eksperimenter.

Som det vil fremgå af den i denne skrivelse anførte begrundelse af vort forslag, har vi ikke ment at burde fremhæve noget enkelt af Landaus mange betydningsfulde bidrag til den fysiske videnskab, men langt snarere at lægge vægt på, at han skridt for skridt har beriget vor tids fysik på en måde, til hvilken et sidestykke vanskeligt kan findes, og som minder om, hvordan forskere som Lord Rayleigh og Lorentz med deres enestående analytiske evner formåede at klarlægge de problemer, som videnskaben i deres tid stillede overfor.


Aage Bohr


Niels Bohr


Ben R. Mottelson

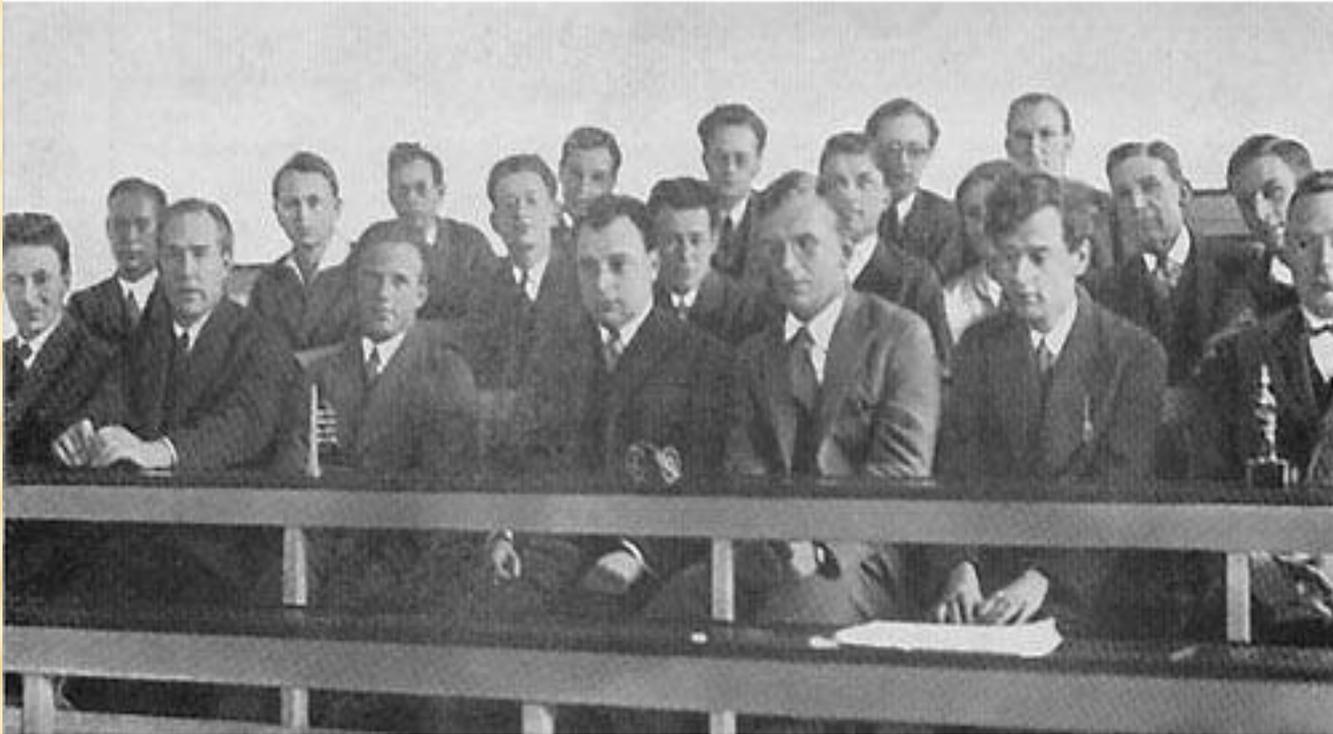

Christian Møller


Léon Rosenfeld

NIELS BOHR (ENGLISH TRANSLATION BY ML):

“As is apparent from reasons put forward in support of our proposal, we have not intended to emphasize any particular of Landau’s many important contributions to physics, but much more to put weight on the fact that he has in publication after publication enriched the physics of our time in way which is difficult to find a parallel to, and which reminds of how scientists such as Lord Rayleigh [NP 1904] and Lorentz [NP 1902] with their extraordinary analytical abilities managed to clarify those problems that confronted science during their time.

Copenhagen 1930



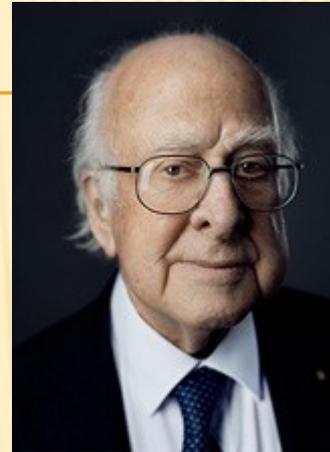
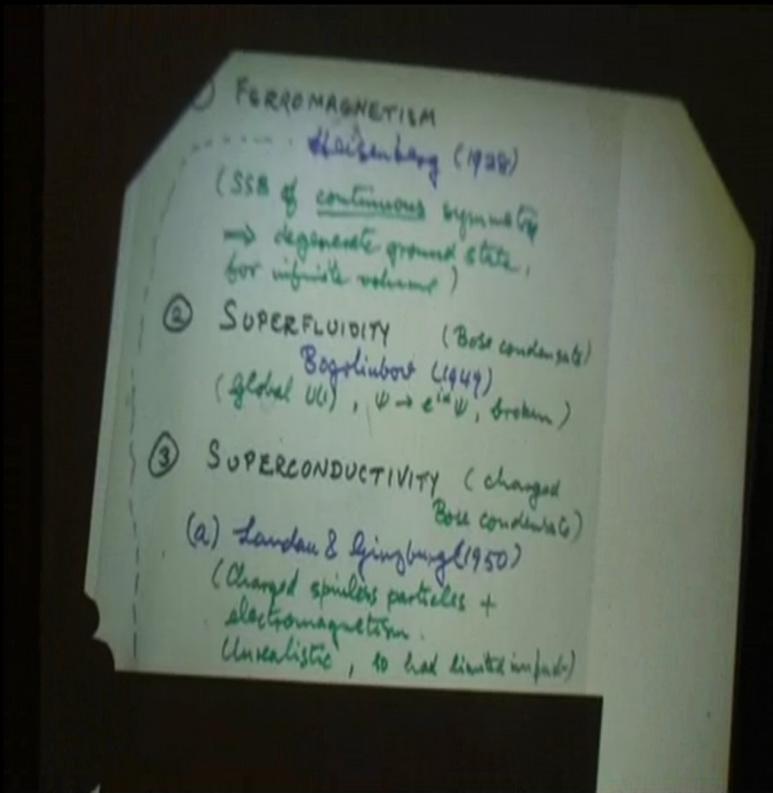
Klein, Bohr, Heisenberg, Pauli, Gamow, Landau,

EVALUATION BY IVAR WALLER, MEMBER OF THE NOBEL COMMITTEE

- ✘ Waller mention the late nomination by Niels Bohr et al. and writes:
- ✘ "The last proposal [by Bohr] is mentioned here because it expresses aspects of Landau's work which has given him an exclusive position in contemporary physics"
- ✘ Waller discusses mainly superfluid helium and highlights the 1956-59 papers

FINAL CONCLUSION OF THE NOBEL COMMITTEE

- ✘ Landau's importance has above all been that he with extraordinary intuition has opened and showed the way for the further development of research in many areas of condensed matter and thereby to an unusual degree inspired and stimulated this research
- ✘ The Nobel Prize in Physics 1962 awarded to Lev Landau *"for his pioneering theories for condensed matter, especially liquid helium"*
- ✘ **Note: the famous Ginzburg-Landau paper from 1950 on superconductivity is never mentioned!**



NP 2013

Peter Higgs

13:32



15:33

SV 2015-09-22

From Peter Higgs's "Klein Lecture 2009"

1950 PAPER

P. 546 in "Collected papers of Landau":

Л. Д. Ландау и Б. Л. Гинзбург, К теории сверхпроводимости, *Журнал Экспериментальной и Теоретической Физики*, 20, 1064 (1950).

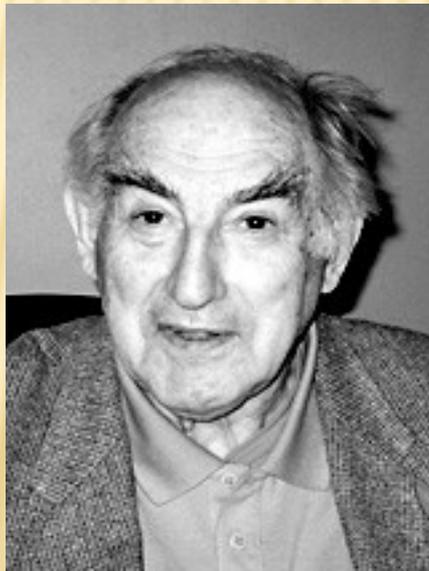
К ТЕОРИИ СВЕРХПРОВОДИМОСТИ

В. Л. Гинзбург и Л. Д. Ландау

Существующая феноменологическая теория сверхпроводимости не является удовлетворительной, так как не позволяет определить поверхностное натяжение на границе нормальной и сверхпроводящей фаз и не дает возможности правильно описать разрушение сверхпроводимости магнитным полем и током. Настоящая статья посвящена построению теории, свободной от этих недостатков. Найдены уравнения для вводимой в теорию Ψ -функции "сверхпроводящих электронов" и для векторного потенциала. Проведено решение уравнений для одномерного случая (сверхпроводящего полупространства и плоских пластин).

THE NOBEL PRIZE 2003

- ✘ Jointly to Alexei A. Abrikosov, **Vitaly L. Ginzburg**, and Anthony J. Legget "for pioneering contributions to the theory of superconductors and superfluids"



DECEMBER 10, 1962

- ✘ Presentation speech by Ivar Waller:
- ✘ "Professor Landau has unfortunately not yet fully recovered from the severe car accident which he sustained at the beginning of this year. He is therefore not here to receive his Nobel Prize which is instead handed to him today by the Ambassador of Sweden in Moscow. On behalf of the Swedish Academy of Sciences I wish to express the hope that Professor Landau will soon completely recover"



THANKS FOR THE ATTENTION!