E-NEWSLETTER

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THE SOCIETY OF ACOUSTICS SINGAPORE

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I.CONFERENCE NEWS

i.The ICSV28(28th International Congress in Sound and Vibration) was successfully held in Singapore as an hybrid event with 160 physical participants and 201 online attendants.

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ii.**The First Online ASEAN International Acoustics Workshop**. Was successfully held online on the 9 May 2023,Tuesday with 52 participants from eight nationalities of UK,Russia,Spain,India, Indonesia,Malaysia,Singapore,and Thailand.

II.ANNONCEMENTS

The Society of Acoustics(Singapore) will be sending out invoices to members with outstanding membership subscriptions. Members are encouraged to make payment in support of the Society.

The E-Newsletters will be made available to industrial contacts in an effort to promote the activities of the Society.

The Society is also exploring the possibility of organising zoom seminars/workshops and other professional events in collaboration with acoustic societies of the ASEAN countries.

Membership Certificates will soon be made available to all members who had made full payments of membership dues

The Society aims to increase membership by inviting all persons, including those from the institution of higher learning and other related societies such as the Institute of Architects, Singapore and the members of the mechanical engineering division of the Institution of Engineers, Singapore who are qualified in the various field of Acoustics to join our Society.

We are especially keen to invite students to join our society and we are establishing the Youth Chapter soon.

III.INTERNATIONAL ACOUSTICS NEWS

ACOUSTICS 23,SYDNEY will be held in the Convention Centre,Sydney from 4 to 8 December 2023. It will be a joint meeting of the Acoustical Society of Australia,Acoustical Society of America,Western Pacifici Acoustics Conference(WESPAC) and the Pacific Rim Underwater Acoustics Conference.

Conference website: https://acoustics23sydney/org

IV.MEMBERSHIP SUBSCRIPTION

Fellow	S$70
Member	S$50
Associate	S$30
Student	S$15
Corporate	S$200

FEE BASED ON ANNUAL RATE

FOR MORE INFORMATION PLEASE CONTACT: Dr. Woon Siong Gan at email: wsgan5@gmail.com

Membership application forms can be downloaded from the society website: www.acousticssingapore.com. Please complete and email to wsgan5@gmail.com

V.ARTICLES

The following article is a condensed form of the paper to be presented at the Acoustics 2023 Sydney.

Transport Theory and the Founding of Condensed Matter Physics

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Abstract

In 1966 Woon Siong Gan coined and invented the name transport theory in condensed matter physics. Today transport theory is the backbone theory of condensed matter physics and the whole condensed matter physics can be represented by transport theory. His PhD thesis pioneered the application of statistical mechanics to ultrasound propagation in semiconductors in the presence of high magnetic fields and low temperatures with the phase transition from the spherical energy surface of metal to the warped energy surface ot semiconductor. The usual treatment is using the many-body theory of quantum field theory.Phase transition is an important topic in condensed matter physics..Thus his PhD thesis also played a role in the founding of condensed matter physics.In this paper transport theory is applied to phase transition, an important topic on condensed matter physcs. The advantage of using transport theory is its broad converage of both particles interaction and description of the singularity characteristics of phase transition. An example for illustration is that of magnetization which has Ising model describing spins interaction and the Lee Yang theory describing the singularity behaviour of the partition function at the critical point of phase transition.

. Key Words: transport theory,condensed matter physics,phase transition,particles interaction,singularity characteristics.

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1.Introduction

The name transport theory[1] in condensed matter physics was coined and invented by Woon Siong Gan[1] in 1966 during his PhD studies in the physics department of Imperial College London.Condensed matter physics is the combination of solid state physics and liquid state physics and with the introduction of phase transition. During the 1960s ,liquid state physics is still an unsolved discipline,unlike solid state physics . The reason is due to the random nature and the nonperiodic arrangement of atoms in the liquid structure.Hence the statistical treatment has to be used. .and statistical mechanics will be appropriate In 1967, Philip Warren Anderson and Volker Heine proposed to change the name of the solid state theory group of the Cavendish Laboratory,Cambridge University to condensed matter theory group.. Condensed matter physic is the introduction of statistical mechanics and phase transition to solid state physics. Phase transition is an important .component of condensed matter physics. Transport theory approach is a more broader approach to phase transition in view of its more complete coverage of both the particles interaction aspect and the singularity aspect of phase transition. My PhD thesis[1] pioneered the use of statistical mechanics to the treatment of ultrasound propagation in semiconductor in the presence of high magnetic fields and low temperature and the use of warped energy surface for semiconductor instead of the spherical energy surface of metal.It described topological phase transition with the change in the topology of the energy surface ot semiconductor to wqarped energy surface from the spherical energy surface of metal or insulator. The statistical mechanics treatment is used compared with the usual many-body theory of electron-phonon interaction. Hence my PhD thesis also played a role in the founding of condensed matter physics. Today the whole field of condensed matter physics can be described by transport theory. Transport theory is the backbone theory of condensed matter physics . So the invention of transport theory is equivalent to the founding of condensed matter physics.Transport theory has a broad nature . It consists of two key components: the particles interaction such as electron-phonon interaction, phonon-phonon interaction,and electron-electron interaction and the singularity behaviour of the transport properties at the critical point of phase transition. So transport theory has the same coverage and contents as condensed matter physics.

When the characteristics of transport phenomena reach the critical point stage,,phase transition will occur and there will be singularity behaviour of the transport properties at the critical point of phase transition.

2.Transport Theory and Phase Transition

Phase transition is an important discipline in condensed matter physics and transport theory approach and transport theory explanation of phase transition can be used as an illustration of of the transport theory as a backbone theory of condensed matter physics. Magnetization is a second order phase transition from the paramagnetism to ferromagnetism. The transport property of magnetization drops to zero at the critical temperature of phase transition. Iron is an example of a ferromagnet. . As temperature decreases at low temperature, the constituent spins are spontaneously aligned as a result of the local magnetic fields from neighbouring spins. When the spins are properly aligned ,second order phase transition takes place.Magnetization can be explained by transport theory There are two components of magnetization. These are spins interaction and which is explained by the Ising model and the singularity behaviour of the partition function and transport property during phase transition.Magnetization,a transport property is zero at the critical point of phase transitionThe partition function is zero at the critical point of phase transition. This shows that phase transition can be compltely described by transport theory.:the particles interaction and the singularity characteristics. Another example is turbulence. Turbulence is a phase transition from the laminar flow phase to the turbulence flow phase . Turbulence can be described by the combination of both particles interaction which is water molecules interaction and singularity behaviour of the transport properties during phase transition with the Reynolds tend to infinity or the viscosity tend to zero

3.Three Important Examples of Transport Theory

There are three important examples of transport theory: Anderson localization, quantum Hall effect,and Onsager reciprocal relations. They are all Nobel physics prize winning topics. This raised the status of transport theory

3.1 Anderson Localization

In condensed matter physcis, Anderson localization is the absence of diffusion of waves in a disordered medium. This phenomenon is names after Philip Warren Anderson[2] who was the first to suggest that electrons localization is possible in a lattice potential ,provided the degree of randomness(disorder) in the lattice is sufficiently large,as can be realized for example in a semiconductor with impurities or defects . Anderson localization is a general wave phenomenon that applies to the transport of electromagnetic waves, acoustic waves ,quantum waves, spin waves etc.

3.2 Quantum Hall effect

The quantum Hall effect is a typical realization of topological effects in condensed matter physics. It is a quantized version of Hall effect which is observed in two-dimensional electron systems subjected to low temperatures and strong magnetic fields, in which the Hall resistance exhibits steps that takes on quantized values.The integer quantum Hall effect was discovered by von Klitzing.

3.3 Onsager Reciprocal Relatons

The Onsager is sometime also known as the fourth law of thermodynamics. It was discovered by Lars Onsager[4]. In thermodynamics,the Onsager reciprocal relations express the euqlity of certain ratios between flows and forces in thermodynamic systems out of equilibrium,but where a notion of local equilibrium exists. Reciprocal relations occur between different pairs of forces and flows in a variety of physical systems. For example, conside fluid systems described in terms of temperature,matter density,and pressure. In this class of systems,it is known that temperature differences lead to heat flows from the warmer to the colder parts of the system.Similarly,pressure differences will lead to matter flow from high-pressure to low-pressure regions What is remarkable is the observation that when both pressure and temperature vary,,temperature differences at constant pressure can cause matter flow and pressure differences at constant temperature can cause heat flow.Perhaps, surprisingly,the heat flow per unit of pressure difference and the density flow per unit of temperature difference are equal.This equality was shown to be necessary by Lars Onsager[4] using statistical mechanics as a consequence of the time reversibility of microscopic dynamics.

Anderson localization,quantum Hall effect,and Onsager reciprocal relations are important topics in condensed matter physics.and they are all transport theories or theories of transport phenomena.This shows that condensed matter physics.is the physics describing transport phenomena. Hence the invention of transport theory plays a role in the founding of condensed matter physics.

4.Transport Phenomena and Condensed Matter Physics

To show the role transport theory played in the founding of condensed matter physics,it is necessary to analyze the constituents of transport phenomena because transport theory is the theory o.f transport phenomena. In physics, transport phenomena are all irreversible processes of statistical nature stemming from the random continuous motion of molecules, mostly observed in fluids. Every aspect of transport phenomena is grounded in two primary concepts:the conservation laws and the constitutive equation, The conservation laws ,which in the context of of transport phenomena are formulated as continuity equations,describing how the quantity being studied must be converved. The constitutive equations describe how the quantity in question responds to various stimuli via transport.Prominent examples include Fourier's law of heat conduction and the Navier-Stokes equations which respectively the response of heat flux to temperature gradients and the relationship between fluid flux and the forces applied to the fluid. These equations also demonstrate the deep connection between transport phenomena and thermodynamics, a connection that explains why transport phenomena are irreversible.

Transport phenomena also include electron transport,,heat transport, and particles interaction. These are all important components of condensed matter physics When the parameters of the transport phenomena reach a stage producing singularity behaviour ,phase transition will occur as what happens in condensed matter physics. This shows that transport phenomena are same as the phenomena described by condensed matter physics, or the theory of the phenomena in condensed matter physic is same as transport theory.This shows the role played by transport theory or the theory of transport phenomena in the founding of condensed matter hysics

5.Singularity Behaviour of Phase Transition

Joseph Mayer[5] has the vision of a singularity at condensation or phase transition has singularity behaviour.The concept of an essential singularity at condensation was independently advanced by A F Andreev[6] for a lattice gas. The result was proved with full mathematical rigour by S N Isakov[7]. There is also singularity in the partition function during phase transition . Also singularity behaviour of transport properties such as specific heat,thermal conductivity, magnetic susceptibility ,magnetisation, viscosity etc was also discover by Woon Siong Gan[8]. Phase transition is an important component of condensed matter physics.This showed that transport theory played a role in the founding of condensed matter physics.

6.Comparison between the Two Approaches to Phase Transition:Landau Theory and Transport Theory

Sofar there are two approaches to phase transition:the Landau theory[9] of spontaneous symmetry breaking(SSM) and the transport theory approach or singularity approach of Woon Siong Gan[8]. The Landau theory is a phenomenology and a mean field theory. It does not describe the microscopic phenomena. The transport theory approach[8] on the other hand includes the rigour of partcles interaction such as electron-phonon interaction besides the singularity behaviour at phase transition.

A.The Landau theory

. The Landau theory[9] is applied to second order phase transition. There is SSB at the ground state of the free energy at the critical point of second orderphase transition or at the critical temperature and the value of the order parameter which is magnetization is zero at the critical point. One can write down in the vicinity of the critical temperature,a phenomenological expression for the free energy as a Taylor expression of the order parameter. Consider a system that breaks some symmetry below a phase transition which is characterized by an order parameter η. This order parameter is a measure of the order before and after a phase transition. The order parameter is often zero above some critical temperature and non-zero below the critical temperature. In a simple ferromagnetic system like the Ising model, the order parameter is characterized by the net magnetization in which becomes spontaneously non-zero above a critical temperature. In Landau theory[9] one considers a free-energy functional that is an analytic function of the order parameter. In many systems with certain symmetries, the free energy will only be a function of even powers of the order parameter,for which it can be expressed as the series expansion

$$\mathrm{F(T,\eta)} - F_0 = \mathrm{a(T)}\ \eta^2\ \frac{b(T)}{2}\eta^4 + \qquad (1)$$

where F = free energy,T=temperature,η=order parameter, a,b=constants.

In general, there are higher-order terms present in the free energy but it is a reasonable approximation to consider the series to fourth order in the order parameter as long as the order parameter is small.

B.The Transport Theory

Unlike Landau theory[9]the transport theory [1] of phase transition invented by Woon Siong Gan1] has two components. One is the particles interaction portion such as the Ising model for spins interaction magnetization and the singularity portion of phase transition such as the singularity behaviour of the transport properties during phase transition discovered by Woon Siong Gan[8] and the singularity behaviour of the partition function during phase transition described by the Lee Yang theory[10]and the singularity behaviour mentioned by Joseph Mayer[5]. The transport theory is not phenomenology and is a rigorous theory such as that involving pafticles interaction like electron-phonon interaction of the BCS theory for superconductivity.

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VI. PRODUCTS ON ACOUSTICS

EASE Training Singapore: 21-23 August 2023

EASE 5 First Edition represents the latest state of EASE® software development. Coming from the well-respected EASE 4 platform, the new EASE 5-FE software has been rewritten with a strong focus on accessibility and usability. EASE 5-FE is geared towards simplifying the entire project cycle: Creating the room model, placing loudspeakers, assigning materials, and triggering precise calculations.

The next EASE training event in Singapore will concentrate on the new modelling features within the EASE 5-FE software. Attendees will be provided with a fully-featured, time limited version of the EASE software prior to the training event.

Information on this EASE training event including online registration can be found at:
https://guzbox.com.au/ease-training-singapore/

This EASE training event is provided by GUZ BOX design + audio and certified by AFMG®

VII. ACOUSTICAL NEWS

The ASEAN Acoustics Commission was founded in March 2023. It comprises of the national acoustical associations and societies from Indonesia,Malaysia,Singapore, and Thailand. This is for the purpose of regional cooperation in parallel with the WESPAC(Western Pacific Acoustics Commission). Members of the individual acoustical associations and societies of the comprising countries will automatically become individual members of the Acoustics Commission with no additional membership fees needed. The Acoustics Commission will organize regional acoustical conferences and publish an e-newsletter periodically.

VIII.REPORT ON CONFERENCES

The Regional Conference on Acoustics and Vibration (RECAV) organised by the Society of Acoustics(Singapore) and the Association of Acoustics and Vibration Indonesia(AAVI) was successfully held in Bali,Indonesia from 27 to 28 Nov 2017. There were 110 presentations from 14 countries with 60% of them from Indonesia.

There were also some 18 exhibition booths. This reflected strong local participation and the international nature of the conference.

The 28th International Congress on Sound and Vibration(ICSV28) jointly organised by the International Institute on Acoustics & Vibration(IIAV) and the Society of Acoustics(Singapore) was held successfully as a hybrid event with 160 physical participants and

201 online attendance. It was held at the Marina Bay Sands from 24 to 28 July 2022 . .

IX. BID FOR FUTURE INTERNATIONAL CONFERENCES

The Society of Acoustics(Singapore) will be bidding for hosting the ICA 2031 in Singapore in 2031.

Government Bodies

www.mom.gov.sg

www.nea.gov.sg

www.lta.gov.sg

Technical and Research Sites

Corporate Sites

www.metaultrasound.com

www.noisecontrols.com (The Society welcomes interested parties to contribute relevant websites to the above e useful links. For more information, please contact us. Thank you.)

Disclaimers

President: Woon Siong Gan

E-Newsletter compiled by Woon Siong Gan