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Analysis of Second Sound Convective Heat Transfer & Effect of Temperature Gradient in Super Fluid Helium-II

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Abstract **- Superfluid helium Transport wonders can be portrayed utilizing the two-fluid Landau-Khalatnikov model and the Gorter-Mellink common grating. We have proceeded with our past work gave to the plan of an arrangement of conditions to depict the heat and mass vehicle in superfluid helium, and its numerical arrangement.**

The precision of the estimations is at any rate ±0.5 percent. The outcomes are in great concurrence with the theoretical expectations of both Tisza and Landau yet will in general support the previous' hypothesis over the latter's. The way that subsequent sound produced in the superfluid can enlist on a mouthpiece stomach drenched in the fluid is examined.

Blend, portrayal, investigation of physical properties - specifically, dependable to high weights - of the accessible high Tc superconducting mixes and endeavors to unwind the instrument in charge of superconductivity have all been useful in accomplishing materials with ever higher superconducting progress temperatures. This has been the significant inspiration to the work detailed in this proposition which gives a record of the amalgamation and characterization of the new superconducting mixes (Y,RE)Ba2Ca3Sr4Cu50x and (Y,RE)Ba2Ca3Cu40x and of high weight considers on some superconducting mixes.

Keywords- **superfluid helium, Blend, Landau-Khalatnikov etc.**

I. INTRODUCTION

Helium was first liquefied by Kammerlingh Onnes in Leiden in 1908. During the late 1920s and mid 1930s it was seen that the fluid had some weird properties, yet it was not until 1938 that it was found autonomously by Allen and Misener and by Kapitza that it displayed frictionless stream and was what we currently call a superfluid. Right away a short time later Fritz London recommended that superfluidity could have some association with Bose-Einstein buildup, which was known as a theoreticalplausibility in a perfect Bose gas.

II. LITERATURE REVIEW

Described that Heat-transfer problems arise in many industrial and environmental processes, particularly in energy utilization, thermal processing, and thermal control. Energy cannot be created or destroyed, but so-common it is to use energy as synonymous of exergy, or the quality of energy, than it is commonly said that energy utilization is concerned with energy generation from primary sources (e.g. fossil fuels, solar), to end-user energy consumption (e.g. electricity and fuel consumption), through all possible intermediate steps of energy valorisation, energy transportation, energy storage, and energy conversion processes.

III. RESEARCH METHODOLOGY

1. Calculation Analysis

Soon after London delivered these original thoughts he and Tisza proposed that the superfluid period of the fluid could be portrayed by a two-fluid model, the dense and non-consolidated iotas being distinguished separately with the superfluid and typical segments. In 1941 Landau composed a striking paper wherein he proposed that superfluidity can be comprehended regarding the extraordinary idea of the thermally energized conditions of the fluid: the outstanding phonons and rotons.

2. Second Sound

The expression for c2 refers to a wave where the density remains constant. What follows from Eqn. 14, the second sound is the propagation of the oscillations of temperature (or entropy) at constant density. The constant density is maintained by out of phase oscillations of the normal and superfluid components of the system. The second sound is, therefore, observed by similar methods used to

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measure ordinary sound; the sound generator and detector (i.e. microphones) are, however, replaced by a heater and a thermometer.

3. Calculation of Second Sound

It follows from Jain's theory that the system below Tλ develops a kind of collective binding that could be defined by an energy gap Eg (T) between the normal and superfluid states of the g system. We have

$$E_g(T) = \frac{h^2}{4md_\lambda^3}(d_T - d_\lambda)$$

Once again as suggested by Jain Eg (T) can be used to obtain g the superfluid density p through

$$\rho_s(T) = \frac{E_g(T)}{E_g(0)}\rho$$

and ρn through ρn = ρ – ρs We used the values of Eg (T) obtained by Jain to determine ρs and ρn tabulated ~longwith their values determined by Wood and Hollis Halett [40] from the temperature variation of experimental values of c 2 . We find that the two results agree closely.

The following relation for c2 as a function of temperature was obtained by Peshkov

$$c_2 = \sqrt{\frac{TS^2\rho_s}{C\rho_n}}$$

By using C from the data o and s from Kapitza's data tabulated , the value calculated as a function of temperature by using our values of was p n and Ps

Table I: Values of second sound as a function of temperature.

temp. (K)	second sound (theor.) (m/sec)	second sound (expt)* (m/sec)
0.2	120.415	
0.3	118.718	
0.4	107.316	
0.5	102.353	
0.6	074.244	83
0.7	059.880	46.5
0.8	050.617	29
0.9	043.061	21.6
1.0	039.842	18.9
1.1	037.387	18.3
1.2	032.653	18.4
1.3	029.441	19.1
1.4	027.192	19.7
1.5	025.596	20.1
1.6	024.205	20.3
1.7	022.784	19.9
1.8	020.952	18.7
1.9	018.523	16.4
2.0	015.116	12.2
2.1	009.908	

IV. EXPERIMENT PROCEDURE

1. Thermal Excitation Spectrum of Helium-II

A huge number of research reports OQ the NIS spectra of He-II under different exploratory conditions have been appropriated. The plenitude of preliminary outcomes and related information thusly assembled has been starting late investigated by Glyde and 60 Svensson. The common thought of the likely watched range is the spot names of different modes as used in the composing have been exhibited in the engraving to empower the discourse. The range is found to have abstract simultaneousness with the range foreseen through Landau.

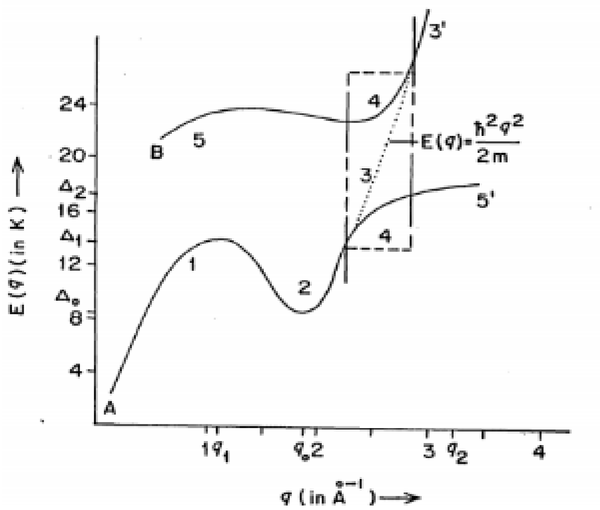

Fig.1. The Typical nature of the Thermal Excitation Spectrum as .observed experimentally by the neutron inelastic scattering.

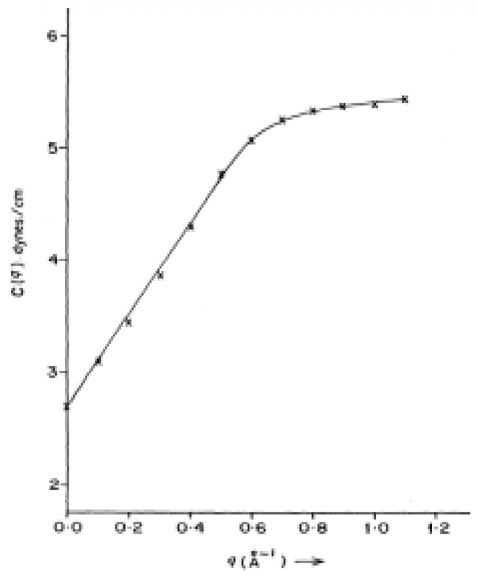

Fig.2.Variation of C (q) (force constant) as a function of q (wave vector).

2. Excitations in HE-II and Their Analysis

1. Phonon like Excitation.

Excitations with q < qr (segment 1 of the dispersion) are rightly identified to be phononlike. This follows from the fact that the He-II is a close-packed system of the 4 wave packets representing the He atoms. The wave packets obviously have spherical shape of diameter λ/2 whereλ \ is the de Broglie wavelength of the particle}. These wavepackets have equal diameter λ/2 = d in the ground state of the system.

V. HEAT TRANSFER & EFFECT OF TEMPERATURE GRADIENT IN SUPER FLUID

The Landau-Khalatnikov two-fluid model and the shared rubbing component of Gorter-Mellink are fruitful phenomenological portrayals of the properties of superfluid Helium, and were utilized as a premise to build up a lot of rough incomplete differential equations (PDE) for the superfluid flow. The numerical joining of the subsequent PDE was executed with regards to a general class of limited component (FE) approximations enlarged with a limited contrast (FD) calculation with upwind plan to settle the arrangement. A Beam-Warming calculation is utilized for time joining.

1. Measurement Setup

- **Wind tunnel**

The experiment is performed in a pressurized tube shaped vessel (∅200 mm × 500 mm) where a liquid helium round fly creates from a spout with inside distance across Dn = 5 mm (see20 for subtleties). The temperature can be ceaselessly fluctuated from 4.2 K to 1.7 K, with the goal that old style (He I) and superfluid (He II) flows can be accomplished in a similar device separately above and beneath the superfluid progress temperature

$T\lambda \simeq 2.17K$.

- **Hot-wire**

The probes are manufactured using standard Platinum-Rhodium (90%Pt-10%Rh) Wollaston wires of diameter 1.3 µm. The length of the sensitive etched part of the wires is lw ≈ 400 µm. The wire is welded on the stainless steel prongs of a homemade ceramic mounting.

VI. CONCLUSION

LHe-4 has kept on entrancing physicists for its superfluid be-havior. LHe-4 displays a fluid to fluid stage change (from its ordinary stage He I to superfluid stage He II) at T = 2.17 K. He has a few unordinary and entrancing properties, for example, zero protection from direct stream, zero entropy, extremely high thermal conductivity, thermo mechanical and mechanicaloric impacts, and so forth. To clarify these properties, London recommended in 1938 that superfluidity is identified with the event of an arranged state in force space (p = 0 state), as would be normal for a Bose-Einstein condensate. From that point forward, various endeavors have been made to comprehend LHe-4 however the minuscule cause of its remarkable properties has not been unmistakably comprehended.

The main measurement recognized as 'working style' reflects parts of the organization, for example, business activity in moral way; trust in compromise, and straightforwardness in correspondence. The subsequent measurement, 'work environment the executives', incorporates issues of worker concern, for example, ability of individuals, administration, and structure of association while the third measurement, 'vision and authority', incorporates issues of authoritative initiative concern, for example, capabilities of CEO, managing rising issues, and market openings.

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