

# Physics at Queen Mary College

1963

## Abstract of text on Research

There is a wide range of research in the Department, with a number of large and small groups and of individuals having their own interests. We regard the training of research students—who will shortly number 40-50—as an important part of the teaching work of the Department and try to engage in research work which is effective in providing worth while training. Work at present in progress is summarized below.

### **Low-temperature physics, sub-millimetre spectroscopy etc. (Dr R Heastie, Professor GO Jones, Dr DH Martin, Dr FE Neale, Rooms 114-120, 308, 407, 506)**

Subjects of current interest are the study of the solidified inert gases and the spectroscopy of solids at extreme infra-red (sub-millimetre) wavelengths.

We are studying the optical and elastic properties of polycrystalline argon, krypton etc. by various methods and are preparing methods of growing single crystals. Work at sub-millimetre wavelengths carried out has so far included studies of ionic crystals, ketones and anti-ferromagnetics. Experiments have been carried out at liquid helium temperatures and have also used super conducting bolometers working at these temperatures. We are continuing with studies of long molecules, of the solidified inert gases, of liquid helium II, and of the magnetic properties of crystals. The development of better sources, particularly harmonic generators, now forms an important part of this work.

Until quite recently, our low-temperature experiments were based on miniature helium and hydrogen liquefiers designed and built in the Department. However, as part of the equipment of the new building we now have installed an A. D. Little (Collins) helium liquefier and are in the course of adapting our experiments to use this central supply of liquid helium. Experiments in the liquid hydrogen range—which are quite common in this laboratory because of our interest in the solidified inert gases—will, however, probably continue to employ miniature liquefiers for some time.

### **Nuclear magnetic resonance (Dr J G Powles Rooms 109, 110)**

We are studying molecular thermal motions in liquids and solids. The macroscopic nuclear magnetic parameters reflect the nature, rate and extent of these motions. Materials now of particular interest are simple organic and inorganic liquids, glass-forming substances such as glycerol and various polymers, crystals containing water of crystallization, and crystals having phase transitions in the solid state. The apparatus available for these studies includes a Varian 12" electromagnet and 3 permanent magnets. Most of the associated electrical equipment has been built in the laboratory.

### **Nuclear physics (Dr A Ashmore, Dr WH Range, Rooms 122, 123)**

We are able to make use of the facilities offered by the National Institute for Research in Nuclear Science at the Rutherford High Energy Laboratory, Harwell. Current experiments include measurements of triple scattering parameters and of polarization effects, using the 50 MeV proton linear accelerator. Work in the Department consists of the preparation of these experiments, of experiments for the 7GeV proton synchrotron, and the development of methods for data handling on the experiments.

### **Astrophysics (Dr JA Bastin, Professor GO Jones, Rooms 701, 702)**

Arising out of the improvement in extreme infra-red, sub-millimetre and millimetre wave techniques, we have recently begun to perform astrophysical experiments at millimetre wavelengths. A number of reflecting telescopes (60" or 200" in diameter) in various mountings have been assembled in the laboratory and employed on the roof of the physics building, on a mobile laboratory—a 4-ton lorry—which has traveled to Switzerland, and at the College playing fields at Dytchleys, Essex, in studies of the sun, moon, planets and atmosphere at millimetre wavelengths.

### **Architectural acoustics (Dr EJ Irons)**

A study is being made, in collaboration with the Building Research Station of the DSIR, of methods of artificially increasing the reverberation times of auditoria. Experiments have been performed in a disused factory in Hackney, in the Great Hall of Queen Mary College and in the Royal Festival Hall.

### **Ferroelectrics (Dr J C Burfoot, Room 508)**

We are studying ferroelectric domains by electrical methods, by etching, by deposition, with polarised light, and with an electron probe. Theoretical implications of the movements of domain walls are being considered, and we are investigating details of the transition to the non-ferroelectric state at the Curie temperature. We have also investigated the use of barium titanate in computer circuits, where it has possible applications, and are growing single crystals of various ferroelectrics.

### **X-ray crystallography (Dr E Sándor, Rooms 307, 310)**

We are studying the diffuse scattering of X-rays by molecular crystals (such as hexamethylenetetramine and anthracene) at various temperatures, attempting to separate the thermal diffuse scattering of the molecules from their disorder scattering, and to derive from the former the frequency spectrum of the molecular vibrations.

At present the group is equipped only for photographic registration of the diffuse scattering, but an automatic counter diffractometer is on order. The group also co-operates with other research groups in the Department and in other Departments of the College which require the use of X-ray techniques.

### **Theoretical physics (Dr RO Davies, Dr S Doniach, Professor R K Eisenschitz, Dr JW Leech, Mr G Mandel, Dr DJ Newman)**

The subjects studied follow, in part, the range of subjects studied in the experimental researches of the Department. In solid-state physics the main subjects studied are the space and time correlations of dynamical quantities and their application to the Mössbauer effect and to transport properties, the ground state electron structure of solidified inert gases, and the numerical evaluation of their thermodynamic properties, and the coupling of excitons and photons in solids. The line breadths of the low excited levels of rare-earth compounds are studied in relation to the spectroscopy of the sub-millimetre region.

Studies of the liquid state include the use of collective movement theory in the determination of transport and thermodynamic properties, electronic levels and electrical conductivity.

In nuclear physics a study is made of the collective movement theory of heavy nuclei and its application to collisions.

Research students in theoretical physics work in a suite of six small rooms (Rooms 216, 8, 9; 221, 2, 4), each room accommodating two students.