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23rd April 1997

Dear Colleague

Further to your ongoing relationship with Prof Peter Evans I would like to take this opportunity to ask you to help us with publicising our Postgraduate Opportunities within your institution.

Please would you display the enclosed poster on an appropriate notice board. Of course we would be happy to reciprocate.

Yours faithfully

Prof P S Hall
Director of Postgraduate Studies

Enc

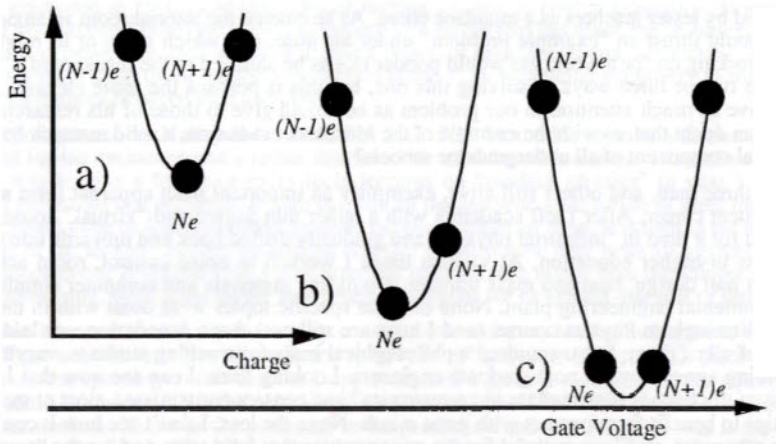

Figure 2. Energy as a function of the charge on the "Dot" and the gate voltage. The black dots represent the charge quanta associated with integer numbers of electrons on the "Dot".

trode to the other. However if the energy of the system changes when an electron is added or removed from the 'dot' the transfer becomes energetically forbidden, provided

$$kT < e^2/2C$$

In the absence of thermal excitation, this results in a device which becomes conducting whenever

$$V_g = \frac{-(N+\frac{1}{2})e}{C}$$

Thus unlike a conventional transistor the "Quantum Dot" provides a device which can be switched at a number of discrete gate voltages.

The term artificial atom arises from the fact that the system has energy levels very much like a many electron atom. Unlike normal atoms the number of electrons can easily be changed by adjusting the gate potential. Thus changing the gate potential is effectively the same as changing the number of protons in the nucleus of a real atom!

While "Quantum Dots" and similar devices are proving fascinating for physicists, they are also beginning to present a challenge for technologists who are currently investigating their potential applications.

G. Tungate

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THE UNIVERSITY OF BIRMINGHAM

School of Physics and Astronomy 1997 Newsletter

From Microelectronics to Nanoelectronics

The 1997 Moon Lecture

Professor Klaus von Klitzing

Max-Planck-Institüt für Festkerperforschung, Stuttgart, Germany

Professor von Klitzing is the third Nobel Laureate to have presented the Moon Lecture. Now the Director of the Max-Planck-Institüt für Festkerperforschung, Stuttgart, he was awarded the 1985 Nobel Prize for Physics for his role in the discovery of the Quantum Hall Effect (QHE). Professor von Klitzing is also the head of a large active research group within the Max-Planck-Institüt which is evident from his extensive list of publications. One of his comments, aimed at the younger members of the audience, was to persevere in getting your research published, as the original QHE paper of 1980 had first been rejected on the grounds of insufficient data.

The demands for ever increasing computing power, speed and miniaturisation continue to drive the semiconductor industry to produce smaller and smaller devices and to fit more and more transistors onto a single chip. To date this has been achieved via a simple reduction in size of the standard transistors through improvements in semiconductor processing. There will come a stage, however, at which this process will no longer be possible. This arises because devices will have become so small that the very quantum nature of electrons within them becomes important. However, this will also introduce new physics and new phenomena which, as Professor von Klitzing alluded to, could be utilised in the transition from "Microelectronics to Nanoelectronics" and produce a whole new generation of electronic devices.

across as disappointing. By contrast, I was much impressed by Oliphant when I returned in 1947/8 (to add a third year to a war degree course 1942-44). Likewise, in that year Dee seems in retrospect at least to have been helpful and I recall no abrasivness at the tutorials with him. ....

Dr. Paul Cooper BSc 1951 PhD 1954

My association with the Nuffield cyclotron began in October 1951 when I became a research student of John Walker. I was not a direct beam user but made use of the neutrons produced when it was used to accelerate deuterons onto a beryllium target. Neutrons were slowed down in the shielding water tanks above the cyclotron and provided a useful flux of thermal neutrons above the tanks. My cloud chamber was sited on top of the water tanks close to the high voltage power supply compound for the cyclotron. In 1952 there was an incident similar to that mentioned by Jasper McKee[3]. A stranger entered the laboratory and climbed over the 3 ft high fence surrounding the compound. He touched the 10kV supply and was knocked unconscious. The marks of his boot studs were found imprinted on the concrete floor where the current had passed through him. I went to attend to the cloud chamber and saw the "body" lying there so ran to the control room to alert Fred Stewart. He promptly hit the panic button and went to the rescue. The stranger survived and higher, much more secure fencing was installed.

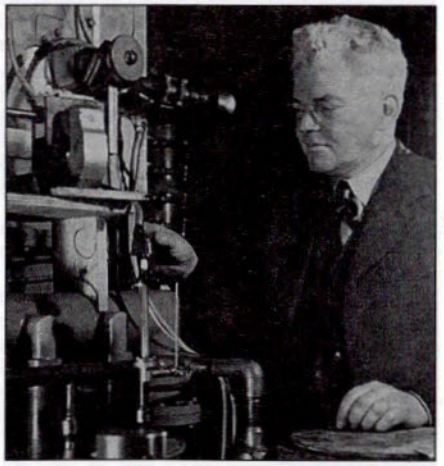
Television arrived in the Midlands and my memories tie in with those of Harry Shaylor[4]. The vision and sound carrier frequencies from Sutton Coldfield were respectively 61.75 MHz and 58.25 MHz. With the wide vision bandwidth there was considerable local interference with the picture from the 6th harmonic of the 10 MHz acceleration frequency. An extensive programme of screening was carried out.

Considerable cooling was needed and this was provided by water pipes soldered to various components. The water consumption was about 80,000 gallons per 24 hours when working. Water came directly from the mains and after use was discharged directly to the drains. At full consumption this amounted to about 1/1000th of Birmingham's daily water consumption. Severn Trent would not approve of such an arrangement nowadays.

Dennis Goddard

As a post graduate student, I was engaged in completing the construction of the cyclotron between 1945 and 1948. Under the supervision of John Fremlin, I was responsible for the designing and building of the vacuum system. We had to construct from scratch two 15 inch diffusion pumps using a drawing from E.O. Lawrence in California and we made stainless steel ducting to connect these to the vacuum chamber housing the "dees". The engineering, was done by the department's workshop. I remember we had considerable trouble getting the system leak free as the Phosphor bronze vacuum chamber proved to be very porous. I made a small mass spectrometer to help in the leak detection.

I wasted a lot of my time pursuing my favourite hobby of photography and still have a few prints of parts of the cyclotron. I am enclosing one or two including one of Prof. Oliphant alongside the vacuum system. Unfortunately, I had to leave the department when my three years were up and I went into



industry so I never actually saw the whole machine working. The only time I have been back to the department was a few years ago to attend the Poynting centenary when I was most surprised to find the cyclotron looking

[3]Proc. Synchrotron 40th Anniversary Reunion, p 129
[4]Proc. Synchrotron 40th Anniversary Reunion, p 107

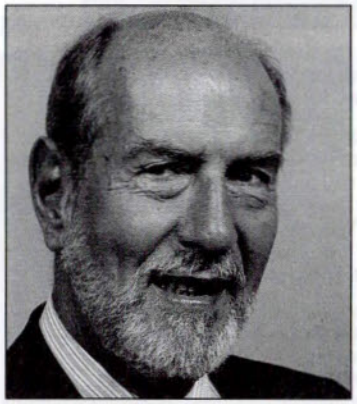
with the Sun's atmosphere, and this idea is gaining considerable acceptance. Measurements of high energy particles in the heliosphere have shown the importance of shock processes in accelerating parts of the Solar wind and HI-Scale instruments on Ulysses are adding to our knowledge of these complex structures in three dimensions. The European Space Agency project SOHO carries another instrument with which George has been involved. LASCO detects the huge ejections of mass from the Sun known as CMEs (Coronal Mass Ejections) and the processes of particle acceleration are again under study.

Professor Simnett has an international reputation both in Solar Physics and in Space Instrumentation and his appointment to a personal chair in the Astrophysics and Space Research Group recognises his long term achievements in this demanding field.

Mike Cruise

Retiring Professors

Professor Morrison



Professor G C Morrison was appointed to the Chair of Nuclear Structure Physics in 1973. He brought with him extensive expertise both in the field of isobaric analogue states and in heavy ion reaction studies that he had been researching at the Argonne National Laboratory in the United States. At that time, the Nuclear Structure group, as it was then known, although one of the leading European groups in the field of polarised beam physics, was not yet involved in the developing field of spectroscopy with heavy-ion beams. George initiated a programme of heavy-ion research on the Variable Energy Cyclotron at Harwell with his first graduate student - Brian Fulton. This programme was further extended at the Nuclear Structure Facility at Daresbury in the 1980s. The Birmingham group's expertise in heavy-ion physics has since developed from these initial programmes.

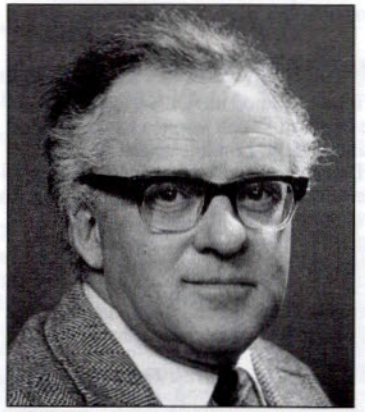
George Morrison is internationally recognised in the field of nucleus nucleus collisions and has served on many national and international nuclear physics committees. He is also an elected member of the Executive Committee of the European Physical Society.

Within the University, his work in the Faculty of Science led him to be appointed Dean in 1988. In 1990, he was appointed Head of the School of Physics and Space Research. Under George's stewardship the school has regained its grade 5 in the recent Research Assessment Exercise.

George's strong commitment to staff-student events has been proven on several occasions when he has given up weekend golf to walk the fells and enjoy a 'quiet' drink with the students.

John Nelson

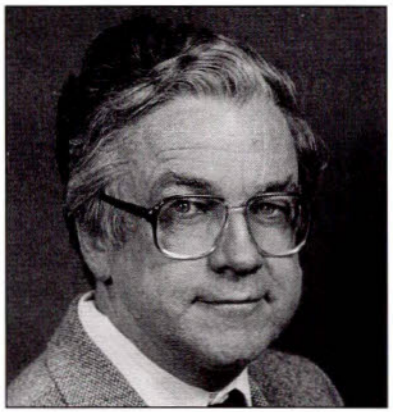
Professor W F Vinen



Professor Vinen, FRS (slightly mysteriously, known as 'Joe' to his friends) was appointed Professor of Physics in 1961. He arrived in Birmingham from Cambridge where he had recently demonstrated the quantum of circulation in liquid helium. He established

Professorial Appointments

John Nelson



John Nelson joined the Nuclear Structure group in 1971 having completed a two-year National Research Council of Canada Fellowship. As a Research Officer at Oxford, he had previously been working at the Rutherford High Energy Laboratory on studies of two-nucleon transfer reactions with polarised proton beams and had made the first measurements of analysing powers of (p,t) and (p,^{3}He) reactions. The availability of polarised Deuteron and ^{3}He beams from the Radial Ridge Cyclotron allowed him to continue this research at Birmingham. These two nucleon transfer studies were continued at the Daresbury Nuclear Structure facility with ^{14}C beams which John was among the first to use.

John and Jim Lowe had also been investigating proton capture reactions on ^{15}N at the Oxford tandem accelerator and, by a curious twist, this led them to a Birmingham-Rutherford collaboration studying anti-proton capture on hydrogen. K-X rays from anti-protonic hydrogen were measured for the first time in experiment PS174 at CERN and provided an elegant measurement of the properties of the anti-proton proton interaction at zero energy.

In 1984, John recognised the exciting development studying nuclear matter at high temperature with beams of ^{16}O at CERN, and his proposal, one of the first from the UK, to participate in this field was supported by the SERC Nuclear Structure Committee under the chairmanship of Manchester's then Head of Theoretical Nuclear Physics, and now Birmingham University's Vice Chancellor, Professor J.M. Irvine. This has led to a successful series of experiments in NA36 as well as in the NA49 experiment, where John's expertise in data acquisition design has become widely respected.

The Relativistic Heavy Ion group under John's leadership and, with Ryszard Zybert, Peter Jones and numerous students, has achieved an international reputation.
John was made Head of the Nuclear Physics Group in 1990 following Professor Morrison's appointment as Head of the School of Physics and Space Research.

George Morrison

George Simnett

George joined the Department of Space Research in the 1970s and set up an active programme of Solar Physics using Space techniques. He has been involved in a wide range of space missions, Ulysses, SMM, SOHO and recently SMEI.

The Sun is our closest star and therefore the one we can study in most detail. In general we understand the steady state nucleosynthesis and radiative transfer in the sun; it is the transient phenomena like flares and mass ejections that are so poorly understood. In most of these processes, particles like protons and electrons are accelerated to extremely high energy compared to that expected from a stable star.
George's research programs have improved our understanding of the transient phenomena on the Sun. He promoted the idea that solar flares are created by proton beams interacting

much as I had left it and to see the vacuum system still working.

Professor Jack Dodd

Wrote of an incident involving a pair of High Voltage rectifiers, the cyclotron pit, a low-loader and a driver who would not accept that a physicist could sling heavy equipment from a crane. After professional reslinging of the control unit the loading went with disastrous consequences, the old unit fell into the pit to destroy not only itself but also the new one.[5]

Jack mentions many names, but space permits only a morsel of his letter to be printed

...Professor Philip Moon was the senior person whom we saw most and a really nice person he was. I well remember my introduction to him. About my third day I went into afternoon tea; I didn't know anyone and found myself addressed by a character who was leaning against a wall. He asked me how I was settling down. "Oh all right " I said, then thinking I should carry on the conversation , went ahead "and what do you do around here". "Oh I'm Professor Moon". Well as far as I was concerned professors were people who wore ties, didn't wear old sports jackets and had pressed trousers - I soon found that England was a different place to New Zealand...

Then there was the theoretical team. In the lead was Professor Rudolf Peierls, who was a great personality and a friend of all. He was another of those people which I, coming from the stuffy antipodes, did not think was a 'professor'. He rode to work on a bike! But what a great professor he was.

Jack had a tale about a spelling bee in which Professors Oliphant, Moon and Peierls were pitted against a team of technicians. The profs did abysmally despite being given words of similar difficulty to their opponents. The twist was the words had to be spelled backwards, the technicians were only given palindromes.

Peter Swinbank

... My association with the machine (*Nuffield Cyclotron*) began in the summer of 1949, when another final year student (Knowles) and I were sent to assist Carl Westcott and Richard Knight in the calibration of radiation monitors used round the machine. This was a third term project, which in those days was part of the undergraduate course. This experience not only introduced me to the cyclotron, but also gave me a long standing interest in problems of radiation safety and cemented a friendship with Richard Knight, which has lasted very nearly 50 years.

... I remember the years 1949-53 very well, with fire and flood and Sodium-22. I was delighted to find when I visited the department last autumn that the machine was still making Sodium-22...

Dennis Martin

...Sadly I have few detailed memories of the cyclotron - mostly we passed it while it was under construction. One "memory" I have seems so unlikely as to make me doubt its authenticity, but I have told the tale many times over the years. 'When Prof. Oliphant wanted to try out the power supply for the cyclotron he connected it to a large metal fence which completely surrounded the building, and the entire fence, when the current was switched on, glowed a fierce red and the enormous heat was dispersed into the air. I didn't see it - only heard about it . I'd love to know if it was true...

Professor A F Brown

It has taken me a long time to get down to accepting the invitation in the 1996 Newsletter to supply anecdotes to celebrate the cyclotron's 50th birthday.

The period where I was involved was prenatal from 1944-45 when the cyclotron was no more than a magnet with a few odd bits... During that period I was a member of a group from Oxford who were using the Nuffield Lab in the absence of Prof. Oliphant. ... One of our duties (or rather of Syd Cornick and his second-in-command Bill Boyd) was to run up the magnet on alternate Friday afternoons to keep the damp out of the coils.

The rest is hearsay, mainly from Bill Boyd and Denis Bracher who had been there since its conception, and concern the alleged meanness of one Nimmo (then with Oliphant in the USA) who tried to do everything on the cheap: scrounging busbars and mounting

[5]Peter Swinbank reported that the sound of Oliphant's laughter when he heard about this was even louder than the clatter!

them in parallel on the walls to save buying high current cables: refusing to hire proper lifting gear with disastrous results when makeshift derricks collapsed. While I have no reason to doubt these scurrilous stories I have no evidence to support them. Certainly we, working in a money-no-object field had been brought up with the standing instruction "never to make anything we could buy" and the contrast would have struck them.

Francis Fielding B.Sc. 1943

...the Cyclotron was nearly lost during the winter of 1941/2. I was fire watching one night when the alarm sounded. I and a colleague, Howard Smart, were sent to patrol the building. Suddenly, there was an almighty bang just behind us and sparks and flames came shooting from a doorway where an incendiary bomb had lodged on a concrete lintel.

Luckily, there was a bucket of water and a stirrup pump nearby, so we put our training to the test and succeeded in putting out the fire. Not until the next morning did we learn that some of the shower of incendiary bombs were of an exploding type, designed to explode when an attempt was made to put them out. Had we known this .....

As our Physics building was separate from the main University buildings, our fire watching was organised on a local basis. Now it so happened that members of the department used to disappear to the U.S. at intervals, and always went there with some of the department's petty cash, with which to purchase food items to sustain the fire watchers. We claimed to have the best fed fire watching team in the whole University.

Ken Chackett

My first recollection of the Nuffield cyclotron was the day in 1938 when the electric forklift was delivered. The sales engineer stressed the importance of leaving the gear lever in neutral for a few seconds while changing from forward to reverse and vice versa. Prof. Oliphant insisted on being the first to drive the machine and immediately set off at full lick between the Nuffield and Poynting buildings. He slammed the lever into reverse and came charging back only to rush forward again with a scream of tortured tyres. After half a dozen traverses he ground to a halt, jumped off in a cloud of smoke, bellowed "Yes! That's a good machine!", and walked off.

Now I understand that the cyclotron is used mainly, if not entirely on isotope production, particularly of ^{81m}Kr for medical use[6]. The 13 second half-life of this isotope had been accurately measured in the Poynting basement in 1961. So the dream of Lord Nuffield, that the cyclotron should be used for the benefit of humanity, is being fulfilled although in ways he could hardly have envisaged.

Austin Crathorn[7] B.Sc. 1948

My actual involvement with the machine (Nuffield Cyclotron) was as a product user from about 1950 when I sought to assign mass numbers to particular isotopes using a mass spectrometer. (D. F. Bracher and A. R. Crathorn Nature 169(1952)364)

Unfortunately I have forgotten the names of many helpful members of the Department who advised on targets and actually ran the cyclotron to irradiate them. I do recall the sad death of Geoff Fertel while he was, I think, making some adjustment to the HT equipment and on a happier note Marcus Oliphant's sending some bulky item back to be returned on a low-loader while he organised a torch to remove the pit railings.

My own requirements were target bombardment with deuterons and I suspect that our handling of targets and product isolation would alarm a modern radiation protection officer. However we did keep a wary eye on dose rates....

Anthony Barnard

....I was most interested in the article by my classmate Ken Freeman. ...

In "Vice-Chancellors News" the statement "Like Sir Robert Aitken before him, Max Irvine comes to us from Aberdeen..." may need an adjustment: my memory is that Dr. Aitken came to us in 1954 or 1955 from the University of Otoga, in New Zealand,

[6]The cycloton is actually used to produce ^{81}Ru which decays with a half life of 4.576 hrs by electron capture to produce ^{81m}Kr. This enables the ^{81m}Kr to be transported to hospitals from Exeter to Manchester.
[7]Persuaded to write by his wife J. D. I. McNab B. Sc Maths. 1948.

though he may well have been at Aberdeen earlier.

It is hard to believe that the Nuffield is still operating. I remember staying up all night with Professor Burcham, making an isotope for Amersham! The machine seemed old even then!...

Euan MacKenzie

... I would be grateful for assistance with an item in the 1996 newsletter. Bernard Hulley mentions purchasing a copy of Ken MacFadyen's book on transformers. I have been unable to locate it in "Books in print". As I have more than a passing interest in transformers (my father was a transformer engineer) I would very much like to purchase two copies. Would you be kind enough to give me the title, publisher etc.[8]

Peter Norman B.Sc. 1943-48

As usual I was grateful to receive the Physics newsletter. Your one of 1996 had much of interest for me - one or two of my contemporaries are still mentioned. I would much like to receive a copy of the history of Physics at Birmingham[9] booklet when it is printed. I well remember Dr Dee - Daddy Dee we called him.

People

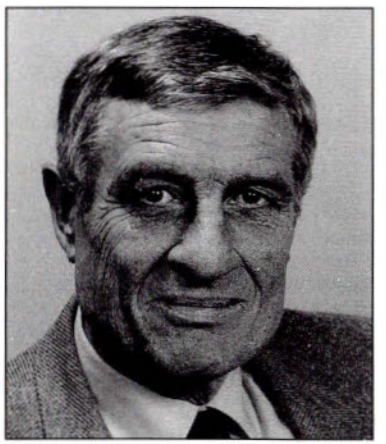
This year saw the retirement of several well known and respected members of staff, P.M. Hattersley, H.B. van der Raay, M.F. Vortruba and R.W. Whitworth from the academic staff and J. Blackband, E.E. Cartwright, J. Greaves, K.D.Grose, B.H. Hughes, C.P. McLeod, R.T. Orchard, A.K. Pathan, A.J. Roberts and A. Vortuba from the technical and support staff. We also saw the appointment of J. Barnard, D. Forbes R. Smith and the promotions of I.J. Bloodworth to Senior Scientific Officer, D.G. Charlton, A.M.I. Rae to Reader and G. Tungate to Senior Lecturer. It also brought the untimely death on the 27th March 1997 of Dr 'Mel' Jobes.

[8]Unfortunately the book in question is long out of print. If anyone can help Euan please let us know.
[9]We have had several requests for the Moon, Ibbs Booklet. Copies are still available, but we would welcome a small donation to cover the cost of production and postage.

Obituaries

Dr 'Mel' Jobes
5.2.1938- 27.3.1997

Mel was more than just a good Physicist and teacher, he was a friend to staff and students alike. As School Tutor, Mel came to know and be known by most of the students in the School. He will be sadly missed. Mel joined the Particle Physics Group of the Department in 1959. In 1992 he took over from Denis O'Connor the role of School Tutor. This was a role for which he was well suited, as he had both the authority and empathy to deal with the myriad of problems faced by students.



Mel was well rounded and loved life. He had a great appreciation for music and literature and was a keen sportsman. He was regularly seen socialising with staff and students at both formal and informal gatherings. For many of us, memories of Mel will include enjoying a drink with him after a day's walking. My personal recollections hold; Mel's warm smile, that characteristic twinkle in his eye and a rendition of Geordie folk songs which he gave on the way back from the Brecon Beacons.

John York Freeman
23.09.1923-28:01:1997

John who was one of the pioneers in particle physics died in Geneva after working for many years at CERN.