RUTHERFORD Bulletin 7

17 April - 1 May 1978

Another Mountain to Climb?

The symposium on Relativistic Heavy Ion Research, held at G.S.I. Darmstadt (Gesellschaft fur Schwerionenforschung-Institute for Heavy Ion Research) in early March, was attended by some 80 German scientists and about 50 from elsewhere including John Lawson and Marshall King from the Rutherford Laboratory.

The part of the programme dealing with heavy ion fusion was of particular interest to those pursuing theoretical studies on the subject at the RL; they are also encouraging university involvement and keeping a watching brief on developments in the USA.

Interest in heavy ion fusion arose in the United States where as a result of early work carried out by fusion scientists, an ERDA sponsored two-week 'workshop' was convened in the summer of 1976. This examined the possibilities of using heavy ions as an alternative to laser light and electrons to achieve fusion by imploding tiny pellets containing thermonuclear fuel (deuterium-tritium mixture), thus releasing very intense bursts of thermonuclear energy.

A further 'workshop' was organised in October 1977 to air the latest views on the subject, the Lab being represented by John and Marshall.

Work is now going ahead on various lines: at Argonne for instance, Rick Arnold and Ron Martin, two of the concept's originators, are pressing ahead with a demonstration accelerator system using linac injection into a circular machine and storage rings, a line which is being studied currently at the Rutherford Laboratory; Brookhaven workers are interested in several problems including bunch compression in circular machines; at the Lawrence Berkeley Laboratory they are concentrating on induction linacs as the main component and are studying problems in the theory of intense beam transport.

This approach differs from other fusion concepts in relying on expertise gained in accelerator development for high energy physics. At the same time, diagnostic techniques, similar to those used in laser compression experiments at the RL will ultimately be needed.

The whole field of heavy ion research opens up many new and hitherto unexploded avenues and some of those are mentioned in the following article by John and Marshall to whom the Editor expresses his thanks.

We welcomed the opportunity to hear what is happening in the world of heavy ions and to gain some experience of this impressive new Laboratory. The spectrum of topics under discussion ranged from nuclear reaction theory and experimental work, through biomedical research, to the design of future high energy heavy ion accelerators and storage rings - and the prospects for heavy ion-induced fusion. The latter aspect of the programme provided our main reason for participation: we were particularly interested in contacting other Europeans who might consider working on the challenging problems which this concept presents.

GSI is situated at Wixhausen, a village a few miles north of Darmstadt, on a pleasant open farmland site partly surrounded by forest. Started in 1969 under Professor Chris Schmelzer, (whom many of us remember from the early days at CERN), the Lab was planned for a staff of about 450, with financial support in the ratio 9:1 from the Federal and Hesse State Governments. The first stage of the programme is now complete, with a capital investment of some DM 155 million in the UNILAC accelerator and its associated experimental facilities. The Laboratory operates on an annual budget of about DM 50 million.

UNILAC accelerates various species of heavy ion ranging from Argon to Uranium, to energies of 3-9 MeV/nucleon, with intensities in the range 10^{11} -10^{13} ions per second. At any time, two alternative ion sources are set up, each followed by a 300 kV DC column, ready to inject different multi-charge state ions into the first "low-β" Wideröe section of the machine. An impressive serried array of sources is held in readiness colour coded according to whether they are dedicated to gaseous or metallic elements, or to uranium - which presents its own particular handling problems. The Wideröe section accelerates the ions to about 115 MeV/nucleon, at which point they are stripped to high charge state; an Alvarez linac stage follows, and finally a series of single-gap cavities accelerates the beam to full energy.

The spacious and carefully thought-out layout of the machine, its ancilliary equipment and the crowded but uncluttered experimental area, fed by three beam lines from a beam splitter, all impress the visitor. So too does the extremely high standard of general tidiness and housekeeping, a situation found not incompatible with the demands of a crowded experimental schedule.

Scientists from throughout Germany, and also from several other European countries (though not, as yet, including Britain) participate in the experimental programme. This covers nuclear physics, atomic physics, and biology, as may be seen in the following table:

SUMMARY OF RESEARCH TOPICS AT UNILAC

Nuclear research	Heavy ion reaction, nuclear structure. States with high angular momenta. Short lived nuclei near the stability boundary. Search for super-heavy elements.
Atomic research	Reactions with atomic electrons, (excitation, ionization, stripping) Atomic spectroscopy.
Applications	Radiation damage. Deep ion implantation. Biological effects.

In addition, there is continuing development work on new and improved ion sources, and on improving the control of the machine. It is found that the many inter-related critical adjustments make smooth and rapid changes from one ion to another very difficult.

Future hopes for extending the accelerator and incorporating storage rings are in a well-advanced state of design planning, and were described during the Symposium. These ideas are ambitious and involve a first stage (SIS) giving energies up to 1 GeV/nucleon, leading ultimately to energies of order ten times higher, (SUSA).

We heard also a general study of the problem from Berkeley, and accounts of future plans in Japan where the NUMATRON, and heavy ion linac plus synchrotron, is designed to give about 1 GeV/nucleon, and in France where the re-built Saturne is expected to produce its first ions next year.

Turning to the presentation of heavy-ion nuclear physics at relativistic energies, we sensed much excited speculation, with little firm knowledge as yet. When

contd bottom of p2

INTERNAL EVENTS

NIMROD LECTURE SERIES
Monday 17 April
1130
Lecture Theatre

Results from the Superconducting Solenoid at the ISR (High P_T and Lepton Production)

M Tannenbaum/Rockefeller University

SPECIAL NIMROD LECTURE
Tuesday 18 April
1430
Lecture Theatre

Calculating Jets and Large P_T Events by Porterbative QCD: A Review.

Professor S Frautschi/Orsay and Caltech

HEP SEMINAR
Wednesday 19 April
1100
R61 Conference Room

Physics with Pictorial Drift Chambers

W Allison/Oxford

NIMROD LECTURE SERIES
Monday 24 April
1130
Lecture Theatre

Phenomenology of Light Z^o's

R J N Phillips/RL

TRADE FILM SHOW AND DEMONSTRATION
Tuesday 25 April
1030
Lecture Theatre and R25 Heavy Lab

ROLAIR Systems (UK) Ltd, will be showing a film, presenting a short question and answer time with slides in the Lecture Theatre follwoed by a demonstration of their equipment. Fluid film technology is now an accepted method for the movement of heavy industrial loads, requiring only an appropriate compressed air supply and a good quality operating surface. Self driven units, including lifter tables if required, can be remotely controlled and the fluid medium can be air, inert gas or water. With a friction coefficient of approximately 0.001, low power low cost drive units can be used and a range of operating pressures and temperatures can be selected to suit the particular operation. Loads from one to several thousand tons are being moved on air film equipment.

SPECIAL LECTURE
Wednesday 26 April
1100
Lecture Theatre

The Spallation Breeder Concept

Professor A A Harms/McMaster University, Ontario

"A nuclear energy system embodying the integrated operation of fission reactions with spallation processes is being proposed as a nuclear power facility for the future. The dominant characteristics of such a system, commonly labelled the Spallation Breeder, will be discussed. It appears that this concept offers some definite advantages from the standpoint of fissile fuel breeding, nuclear waste management, deployment schedule and developmental options.

HEP SEMINAR
Wednesday 26 April
1100
R61 Conference Room

Meson Spectroscopy and Diffractive Resonance from Recent Spectrometer Data

A Martin/Durham

---

nuclei collide, complicated collective interactions involving sophisticated hydrodynamic and shock phenomena occur; what of interest can be learned from such phenomena? How can we infer by study of the debris what is happening? We heard esoteric talk of multi-quark objects, referred to colloquially as "quark bags"

Perhaps more fundamental is the search for positrons in collisions in which the total charge of the two nuclei is of order 170 or more. It is predicted that the intense charge will 'pull real pairs out of the vacuum', retaining the electron, but ejecting the positron. Will there be surprises here?

The idea of heavy ion fusion was novel to many of those present, and it is hardly surprising that first reactions showed signs of scepticism at such a bold and demanding proposal. Indeed, one has to be courageous and 'think big' when contemplating any form of fusion power station.

As the arguments developed, and perspective gained from last October's BNL Workshop became more apparent, the possible role of energetic heavy ions as superior competitors to lasers or electron beams for transferring energy quickly and efficiently to the tiny target pellets became clear.

In the final section on medical applications it was clear that ions in the intermediate mass range, say carbon to neon, could play an improtant role both in radiotherapy and diagnostics. This arises from their well defined range energy relationship, strong Bragg peak, and lack of scattering. Whether they will be so used would seem at present to be a matter of economics and social priorities rather than physics and biology.

To sum up, the field of relativistic heavy ions is seen as rather new and relatively unexlored territory. Whether gold will be found, fruit will grow, or the mountains found too high and rocky remains to be seen; what is clear is that there is no shortage of eager explorers.

Events to mark the closure of Nimrod

The closure of Nimrod is an important milestone in the life of the Laboratory and it would not be appropriate to permit such a significant date to pass without holding some Laboratory 'events' involving all the many people who have helped to build, run and use Nimrod.

Following the final shut-down and closure of Nimrod on Tuesday 6 June 1978 (RLN 6/78) an informal gathering of staff and others associated with the Nimrod programme will be held the same day.

There will be a dance on Friday 9 June in the Restaurant. (Further details including the sale of tickets will be announced later) and on the afternoon of Saturday, 10 June, the Laboratory will be "Open" for a "Families Day" when members of staff and those connected with the establishment will be able to bring their families to look round the Laboratory. A questionnaire will be circulated to members of staff to help anticipate the numbers who wish to attend.

The last 'event' planned so far is a more formal occasion to emphasise the more scientific aspects during the 15 year history of Nimrod. This will ential a number of lectures by distinguished scientists and attendance will be by invitation only.

Suggestions Awards

The following awards were approved at meetings of the Local Suggestions Awards Committee held on 9 January, 8 February and 16 March 1978:-

Mr C G Chandler	Administration	R56	£25
Mr J R Dagnell	"	R34	£5
Mr G W Scott	"	R1	£5
Mr E A Smith	"	R54	£5
Mr R E Smith	"	R25	£5
Mr R E Smith	"	R25	£10
Mr J Akhurst	Engineering	R18	£5
Mr P Almand	"	R18	£5
Mr P Almand	"	R18)	£10
Mr T Morgan	"	R18)	
Mr D Bailey	"	R18	£5
Mr J B Child	"	R18	£10
Mr C P Copeland	"	R18	£5
Mr G Elliman	"	R9	£5
Mr S Goodenough	"	R18	£10
Mr R P Hogan	"	R9	£10
Mr N Martindale	"	R18)	£10
Mr D Thorp	"	R18)	
Mr M F Mason	"	R25	£10
Mr N P Whitehouse	"	R8	£10
Mr A Dobbs	Instrumentation	R12	£10
Mr D D Abbley	Nimrod	R8	£10
Mr D D Abbley	"	R8	£10
Mr E Awdziejczyk	"	R8	£80
Mr H J Bradford	"	R6	£5
Mr H J Bradford	"	R6	£5
Mr R Greensmith	"	R6	£20
Mr R Greensmith	"	R6	£30
Mr G McGee	"	R6	£100
Mr G McGee	"	R6	£5
Mr A Smith	"	R6	£20
Mr A Smith	"	R6	£5
Mr K Waller	"	R2	£5
Mr H G Windless	"	R2	£10
Mr H G Windless	"	R2	£5
Mr C Adair	Technology	R25	£100
Mr C Adair	"	R25	£50
Mr C Adair	"	R25	£5
Mr J Flynn	"	R25	£10

EXTERNAL EVENTS

ELEMENTARY PARTICLE PHYSICS SEMINARS/NP DEPT, OXFORD - 1430 hrs.

27 Apr: Dr M Perry/DAMPT, Camb., - Quentam black holes.
4 May: Dr H Bingham/RL, UCB - Results from the Fermilab experiment.

HEP SEMINARS/DAMPT, CAMBRIDGE - 1500 hrs.

20 Apr: Dr M Green/Oxf - Lattice gauge theories - duality and frustration.
27 Apr: Dr S Rajpcot/IC - Natural left-right symmetric theory of weak and electromagnetic interactions.
4 May: Prof M Atiyah/Oxf - Construction of instantons for Yang-Mills fields.

THEORY GROUP SEMINARS/DARESBURY LAB - 1400 hrs.

17 Apr: Prof D King/Liverpool - Absorption studies on single crystal surfaces.
24 Apr: Dr I Grant/Oxf - Relativistic effects in valence shells of heavy atoms.
8 May: Dr F A Brieva/Oxf - Microscopic description of nucleon-nucleus scattering.

THEOR. PHYS. SEMINARS/AERA, CON RM, BLDG 8.9 - 1400 hrs.

25 Apr: Prof J Willis/Bath - Some Recent work in non-linear fracture mechanics.
9 May: Prof J E Enderby/Bristol - Ionic Liquids: Recent progress in understanding their structure.

NUCL PHYS DIV COLLOQUIUM/AERE, CONF RM, H8 - 1530 hrs.

20 Apr: Dr B W Dale/ESD - The internal combustion project at Harwell.

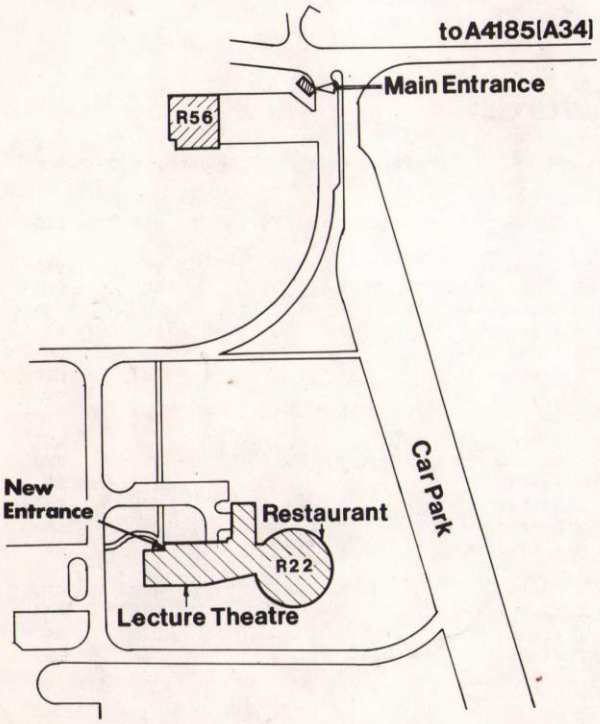
OVERSEAS VISITS

Dr R C Hwa, to Bielefeld Univ. Germany, 16-18 April, to give seminar and hold discussions.
Dr A R Gillman, to CERN, 16-21 April, to work on WA3 experiment.
Mr B Glossop, to Grenoble, 16 April-27 May, for commissioning, testing, training, on equipment at CNRS and ILL.
Dr A Astbury and Mr M D Percival, to CERN, 17-18 April, for discussions.
to CERN, Mr B Diplock and Mr D Evans, 17-18 April and Dr R W Newport, Mr W Turner, Mr B Edwards and Mr A Thorpe, 17-19 April, to attend meetings on optics and expansion systems of RCBC for EHS.
Dr M Edwards, to CERN, 17-21 April, to set up equipment for EMC.
Mr L Phillips, Mr D Holland and Mr K Miles, to DESY, 17-28 April, for installation work for JADE.
Mr W Walkinshaw and Mr J W Burren, to Monaco, 18-21 April, to attend International Scientific Seminar.
Dr L C W Hobbis, to Grenoble, 20-21 April, to attend ILL Scientific Council Sub Committees meeting.
Mr P P Haskell, to CERN, 23 April-12 May; OMICRON collaboration software implementation.
Mrs E Marsh and Mr G Stapleton, to Munich, 24-28 April, to attend EURIM 3 conference on information systems and networks.
Mr G M McPherson, to CERN, 1-19 May, to work on WA7 and OMICRON processors.

RESTAURANT NEWS

The new extension and entrance hall built at the rear of the R22 coffee lounge, was opened at the beginning of April. The entrance on the North will shorten the journey for people coming from R26/R27, MRC and NRPB and the enlarged toilet facilities will provide welcome relief at conference times.

Over the past few weeks the Grill Bar has offered a larger variety of items, each individually priced but with a minimum charge of 25p per customer. Omelettes are also available daily on the main servery and they are made to order, the prices ranging from 20-24 pence according to the filling.



TRADE EXHIBITION AT AERE

Gulton Europe are holding an exhibition in the Cockcroft Hall on Thursday, 27 April, 1000-1630 hours. On display will be the complete range (including a number of new instruments) of WEST temperature and pressure controller, programmers, sensors and radiation pyrometers and RUSTRAK miniature and full sized chart recorders.

DATE FOR YOUR DIARY

The Lecture Theatre will surely be the 'mecca' for all hi-fi enthusiasts on 10 May when the next talk in the RL Lecture series, entitled "Why Quadraphony is Dead", will be given by Professor P B Fellgett, Department of Cybernetics, Reading University. Full details in next issue.

FILM BADGE NOTICE

Period 5 commences Monday, 24 April
Colour Strip - GREEN for Bγ films and neutron packs.

Six monthly dosimeter change for people with surnames commencing Q,R,S and T.

Please change your dosimeters promptly and return all old ones.

MISSING EQUIPMENT

The following item of equipment has been reported missing from Rm 16, Bldg R36: Cordless Soldering Iron (ISOTIP), manufactured by WHAL Corp USA. RL No 14/6553.

Anyone knowing the present whereabouts of this item is asked to contact L Appleby, Ext 6125.

CHRISTIAN FELLOWSHIP

21 April: Visit of Joannie Yoder from Reading, who has had experience in the formation of home Bible Study groups and recently, in helping to rehabilitate young drug offenders.

28 April: Mrs G Newbold, who has been a lay-pastors wife for over 30 years, will be relating both the joys and difficulties of this experience. Ladies are especially invited to come along to both these meetings which will be held in the R2 Conference Room at 12.30 hours.

CRICKET

The practice net has been erected on the Sports Field and net practice will be available most dry lunch hours. Our entry into "The Downs League" has been accepted and weekly matches commence on Wednesday, 10 May. Further information, contact M Butler, Ext 6178.

RUTHERFORD LABORATORY BULLETIN *Published by the Scientific Administration Group*

Deadline for Insertions: 1000 hours Tuesday 25 April

Editor: H F NORRIS
Room 42 Building R20
Rutherford Laboratory
Chilton Didcot Oxon OX11 0QX
Abingdon (0235) 21900 Ext 484