

Extracts from College Annual Report

1984 - 1985

DEPARTMENT REVIEW

No session which sees a member of the department introduce, to general acclaim, an entirely novel theory of the fundamental forces of nature; in which the Nobel prize is awarded for discoveries to which the department made a major contribution; which witnesses the public recognition of the new window in astronomy opened by the IRAS satellite, and the start of preparations in the department for its successor; in which, yet again, a QMC student is adjudged the best graduating physics student in the University; no such session, in short, can be judged anything but outstandingly successful. And yet, celebration must be tempered. As the session closed, storm clouds of financial stringency gathered. They may yet dissipate, but we must prepare for the squall. We will cope, not by bending with the wind, but by a vigorous defence of our areas of excellence, and the promotion of new initiatives in teaching, research and scholarship. The account below describes the firm base for these activities that has been provided by the session under review.

It began, and ended, with the final staff transfers consequent upon the University's restructuring. Dr Roger Martin joined us from Westfield College, bringing expertise in satellite communications and the teaching of experimental physics. From the latter has already emerged a new undergraduate laboratory course that will be central to all future Physics degree programmes. At the end of the session Dr Dick Brown joined us from the dielectrics group at Chelsea College. With the cessation of teaching at the Westfield site our earlier recruits Dr Peter Williams and Dr Wladimir von Schlippe became completely integrated, the former taking over as Director of our part-time MSc and Diploma courses in Astrophysics, the latter joining the UA1 collaboration of our particle physics group. At the beginning of the session this group welcomed a New Blood lecturer, Dr Steve Lloyd from Oxford University. Dr Lloyd, with Dr Tony Carter and Mr Terry Pritchard, is preparing detectors for the OPAL experiment at the LEP colliding beam accelerator, also at CERN. We were awarded a second New Blood lectureship, in infra-red astronomy, to which Dr Glenn White, previously an SERC Advanced Fellow in the department, was appointed. Thus we begin the session 1985-86 with twenty-seven academic staff, and a younger age profile than we dared hope a few years ago.

I wish I could be so sanguine concerning our numbers of support staff. The complete freeze on filling vacant posts, announced in July following the UGC's notorious May letter, hit us severely. Despite our being joined by Mr D Newman-Coburn and Mr W Howard, transferring from Westfield, the departures of Mr W Askham, Mr G Piper and Mr D Adamson (the latter on leave-of-absence to take an MSc course) among our technical staff, and of Mrs Tina Blah, secretarial, came late in the session and leave us acutely short-staffed in certain key areas. Deep wounds need radical surgery. Haphazard losses such as these are not within our powers alone to cure: College-wide changes may be necessary.

Despite these disturbances research activity remained at a very high level. Michael Green's collaboration with John Schwarz of Caltech, generously funded by the Nuffield Foundation, culminated in publications which showed that certain classes of so-called superstring theories

satisfied essentially all the requirements of a plausible unified theory of particles and their interactions, including gravity. This was a major achievement which set the world of physics alight. At the end of the session the University conferred on Dr Green, heretofore Lecturer in Physics, the title of Professor of Physics.

The preliminary catalogue of infra-red sources, revealed by the Infra-Red Astronomy Satellite (IRAS) was published, along with many papers interpreting the data. Dr Peter Clegg, Dr Jim Emerson, Dr Stella Harris-Law and others thus saw their work of many years finally rewarded. Dr Clegg, Principal Investigator for the UK IRAS team, was awarded the NASA Public Service Medal at a ceremony in December. So successful was IRAS that the European Space Agency has chosen ISO, the Infra-Red Space Observatory, as a follow-up mission, due for launch in 1992. ISO will carry out detailed observations to supplement the IRAS whole sky survey. It came as no surprise that QMC should be chosen to play a leading role in the design, construction and commissioning of one of its four instruments, the Long Wavelength Spectrometer. Dr Clegg was again appointed Principal Investigator, with Dr Peter Ade as a co-investigator. Mr Derek Vickers, one of our Experimental Officers, is the Project Manager.

The Nobel Prize for Physics was awarded in 1984 to Professor Carlo Rubbia and Dr Simon van der Meer of CERN: the citation referred to 'their decisive contribution to the large project which led to the discovery of the field particles W and Z'. Nothing could more clearly illustrate the collective nature of the scientific enterprise, than the UA1 project. Among the collaborators, QMC had one of the largest representations after the CERN laboratory itself. Those involved at one time or another included Professor Peter Kalmus (currently spokesman for the UK groups), Dr Eric Eisenhandler, Dr Reg Gibson, Dr Graham Thompson, Dr Richard Keeler, Dr Alan Honma, Dr Richard Batley, Dr Paul Kyberd, Mr Gary Barnes and numerous research students. All of these received generous tributes from the Laureates in their acceptance speeches.

Members of our particle physics group were involved in several other major experiments besides UA1. That planned for the LEP accelerator has already been mentioned. Professor David Bugg instigated and carried out a short but vital measurement at Los Alamos National Laboratory, central to our understanding of the nucleon-nucleon interaction to which he has made notable contributions. Others have returned to the Rutherford Appleton Laboratory, for the first time since the accelerator NIMROD closed in 1978, to conduct neutrino experiments using the newly-commissioned accelerator ISIS. The neutrino blockhouse, a massive structure of over 6,000 tons, was completed for this purpose as the session ended.

Further clouds, also financial, hang over the work of our particle physicists. In the spring of 1985 a committee chaired by Sir John Kendrew reported on UK support for high energy physics. They found that the science was excellent but the cost excessive, and recommended cuts in expenditure that, at their worst, could emasculate our research. We await with some anxiety the outcome of the Kendrew Report.

By contrast the work of our polymer physics and molecular electronics group falls squarely within the interests of industry. Professor David Bloor organised and directed a NATO Advanced Research Workshop on the synthesis, structure and electronic properties of polydiacetylenes. QMC is a leading institution in this field, attracting research funding from SERC, industry and the EEC. Work began on quasi-two dimensional films, with the goal of creating new molecular electronic

devices. We were pleased to welcome Dr B Movaghar of GEC, whose appointment as a Senior Visiting Fellow is yet another sign of industry's interest in this work.

Professor Derek Martin, besides preparing further measurements of the cosmic background radiation, strengthened and extended the industrial links of the engineering physics group. During the session he also laid the groundwork for the establishment of the Centre for the Science and Technology of Measurement, an interdisciplinary unit which will combine research with postgraduate teaching, including short upgrading and refresher courses. Following his election last year to the Council of the Institute of Physics, Professor Martin was this year elected Honorary Secretary of the Institute.

Travels of note included Dr David Batchelder's visit to Poland, as a guest of the Polish Academy of Sciences; and Dr Bob Jones's longer stay at Institut Laue-Langevin, Grenoble, collaborating with our former colleague Professor Ubo Felderhof in research into disordered systems. As the session began, Dr John Beckman was granted leave-of-absence to take up the post of Research Director at the new Instituto de Astrofísica de Canarias. This appointment followed an extensive and fruitful period of collaboration with Spanish astronomers. We, in turn, welcomed Dr Jean-Marc Fontaine, on secondment from Centre d'Etudes Nucleaires, Saclay, as a Royal Society European Exchange Fellow; and Dr M J Litvak (University of Tel Aviv) and Dr M Ramon-Medrano (University of Madrid) to collaborate with Dr Derek Capper.

During the session seven PhD degrees were awarded. The MSc and Diploma in Astrophysics were awarded to nine, and six, students respectively. Forty-six students gained BSc degrees, of which eleven were classified First Class. On the recommendation of the External Examiners, Mr J H Burroughes was awarded the Granville Prize, for the best graduating student in the whole University. This honour has gone to a QMC student six times in the last eleven years.

At a ceremony in November, the Fellowship of the College was conferred upon a student of a somewhat earlier period, Dr Paul Dean (1951-58), who has been Director of the National Physical Laboratory since 1977. In December we were delighted to welcome graduates of even more distant times, including two from the class of 1921, to a Reunion.

Nostalgia, they say, is not what it was; but I cannot leave this excursion into the past without a reference to the researches of Emeritus Professor John Bastin. Since he left us last year, John has not only been awarded a Leverhulme Travelling Fellowship, but has also been engaged in a study of the work done at East London College, now QMC, by Eric Marsden. Marsden, with Hans Geiger, was a close colleague of Lord Rutherford. It was their work which first suggested, and then clinched, the nuclear theory of the atom, and much of Marsden's pioneering work was carried out here in the years around 1910. He was a founding father of nuclear physics, and fitting forbear of our current research teams. We hope that an extended account of this fascinating period in our history will appear elsewhere.

To return to the present — 1984-85 was a most exhilarating session, in which preparations began for a considerable expansion in collaborative and inter disciplinary research, short post-experience courses, postgraduate numbers, and the range and variety of undergraduate programmes. None of this would have been possible without the vision and guidance of Professor John Charap, who at the end of the session relinquished his duties as Senator, Dean of the Faculty of Science, and Head of Department, for a well-earned sabbatical. We wish him a peaceful year.

RESEARCH GRANTS AND AWARDS

Dr PA Ade

£1,951 from the Science and Engineering Research Council for observations at UK IRT U/F/9 and U/F/84 submillimetre mapping and photometry of thermal galaxies and observations of dark globules;
£2,594 from the Science and Engineering Research Council for observations at UK IRT U/G/2 submillimetre observations of dark clouds;
£25,100 from the Science and Engineering Research Council for assistance with far infra-red instrumentation.

Dr D N Batchelder

£19,856 from the Science and Engineering Research Council for photo-induced charge transfer interactions in polydiacetylene LB films.

Dr J E Beckman

£856 from the Science and Engineering Research Council for observations at INT La Palma 1/F/57 —abundance of ^9Be in population II stars.

Professor D Bloor

£3,000 from GEC Hirst Research Centre for studies of 1D charge carrier motion in He-ion bombarded polydiacetylene crystals.

Professor D Bloor and Dr M B Hursthouse (Department of Chemistry)

£140,114 from the Science and Engineering Research Council for organic non-linear optical materials structural aspects and polydiacetylenes.

Professor D V Bugg and Dr C Wilkin

£3,000 from the Science and Engineering Research Council for fission studies and radon monitoring investigations.

Professor JM Charap

£40,100 from the Science and Engineering Research Council for QCD and its applications;
£41,530 from the Science and Engineering Research Chemical for particle and field theory.

Dr P E Clegg

£1,596 from the Science and Engineering Research Council for observations at South African Astronomical Observatory S/a.9/F/5 and S/1 .9/F/7 Balmer line profiles of helium weak stars for Log G determination.

Dr M B Green

£39,950 from the Science and Engineering Research Council for algebraic and geometrical structure of relativistic string theories.

Professor P I P Kalmus

£223,263 from the Science and Engineering Research Council for particle physics experiments 1985-87.

Dr G J White

£918 from the Science and Engineering Research Council for support for proposed VLA survey of bipolar sources; £7,890 from the Science and Engineering Research Council for observations at UKIRT U/F/36 and 39 detailed submillimetre mapping of dense molecular cloud cores etc.; £924 from the Science and Engineering Research Council for observations at Kitt Peak NS/44/83 support for observation with the Kitt Peak 12 metre telescope; £6,874 from the Science and Engineering Research Council for observations at UKIRT and CFHT U/G/13, U/G/15 and U/G/60 and NS/52/84; £7,434 from the Science and Engineering Research Council for indium antimonide mixers; £42,694 from the Science and Engineering Research Council for observational and interpretational support for submillimetre molecular studies of star formation regions; £2,847 from the Science and Engineering Research Council for observations at Nobeyama telescope, Japan — NS/4/85; £1,189 from the Science and Engineering Research Council for observations on 12M millimetre telescope Kitt Peak; £14,989 from the Science and Engineering Research Council (Rutherford Appleton Laboratory) for indium antimonide mixers.

Dr E G Wilson

£27,700 from the Science and Engineering Research Council for the physics of electron motion in low dimensional structures.

PUBLICATIONS**P A R Ade, M J Griffin, C T Cunningham, J V Radostitz, S Predko and I G Nolt**

The Queen Mary College/University of Oregon photometer for submillimetre continuum observations. *Infrared Physics* 24, 1984, p 403.

D N Batchelder and D B Bloor

'Resonance Raman spectroscopy of conjugated macromolecules' in *Advances in Infrared and Raman Spectroscopy* Volume II; edited by R J H Clark and R E Hester. Chichester: Wiley-Heyden, 1984, p 133.

B Baud, E Young, C A Beichman, D A Beintema, J P Emerson, H J Habing, S Harris, R E Jennings, P L Marsden and P R Wesselius

High sensitivity IRAS observations of the Chamaeleon I dark clouds. *Astrophysical Journal* 278, 1984, p L53.

C I Beard, D V Bugg, J A Edgington, J Hall and others

Evidence against the S-meson. *Physics Letters*, 146B, 1984, p 299.

C A Beichman, R E Jennings, J P Emerson, B Baud, S Harris, M Rowan-Robinson, H H Aumann, T N Gautier, F C Gillett, H J Habing, P L Marsden, G Neugebauer and E Young

The formation of solar type stars: IRAS observations of the dark cloud Barnard 5. *Astrophysical Journal Letters* 278, 1984, p L45.

C A Beichman, A Leene, J P Emerson, S Harris, R E Jennings, E Young, B Baud, W Rice, P Hacking, F C Gillett, F J Low and G Neugebauer

IRAS observations of Lynds 255: anomalous low surface brightness emission at 12 and 15 μm in a region of low mass star formation. *Bulletin of the American Astronomical Society* 16, 1984, p 522.

D Bloor

Conducting polymers: the next generation of plastics. *Spectrum* 188, 1984, p 8.

'The preparation and properties of ordered and disordered diacetylene polymers' in *Proceedings of NATO ASI Quantum Chemistry of Polymers*; edited by: J Ladik, J M Andre and M Seel. Dordrecht: Reidel, 1984, p 191.

D V Bugg

Experiments at LEAR. *Europhysics News* 15, 1984, p 5.

NN - π d Amplitudes up to 580 MeV. *Journal of Physics G* 10, 1984, p 47.

NN - π d Amplitudes up to 800 MeV. *Journal of Physics G* 10, 1984, p 717.

Nucleon-nucleon experiments and phenomenology. *Nuclear Physics A*416, 1984, p 227.

Nucleon-nucleon phenomenology. *Comments on Nuclear and Particle Physics* 12, 1984, p 287.

D M Capper, J J Duiwich and M J Litvak

On the evaluation of integrals in the light-cone gauge. *Nuclear Physics B*241, 1984, p 463.

A A Carter and others

Antibaryon production in the central region at the ISR. *Nuclear Physics B* 246, 1984, p 1.
Properties of jets in high ET events produced in pp collisions at $\sqrt{s} = 65 \text{ GeV}$. *Zeitschrift fur Physik C*25, 1984, p 13.

A A Carter and T W Pritchard

The performance of a prototype precision drift chamber for colliding beam experiments. *Nuclear Instruments and Methods* 225, 1984, p 308.

W Cudlip, J P Emerson, I Furniss, W M Glencross, R E Jennings, K J King, J H Lightfoot and W A Towison

Far-infrared photometry of the rho Ophiuchi dark cloud. *Monthly Notices of the Royal Astronomical Society* 211, 1984, p 563.

T De Jong, P E Clegg, B T Soifer, M Rowan-Robinson, H J Habing, J R Houck, H H Aumann and E Raimond

IRAS observations of Shapley-Ames galaxies. *Astrophysical Journal* 278, 1984, p L67.

C T Cunningham, P A R Ade, E I Robson and J V Radostitz

The submillimetre and millimetre spectrum of NGC5128. *Monthly Notices of the Royal Astronomical Society* 211, 1984, p 543.

C T Cunningham, M J Griffin, G Gee, P A R Ade and I G Nolt

A submillimetre map of the W51 region. *Monthly Notices of the Royal Astronomical Society* 210, 1984, p 891.

K J Donovan, P D Freeman and E G Wilson

Acoustic solitary wave polaron motion in polydiacetylene crystals. *Materials Science* 10, 1984, p 61.

E Eisendhandler, W R Gibson, P I P Kalmus, G Thompson and others (The UA1 collaboration)

Angular distribution and structure functions from two-jet events at the CERN SPS $\bar{p}p$ Collider. *Physics Letters* 136B, 1984, p 294.

Associated production of an isolated large-transverse-momentum lepton (electron or muon), and two jets at the CERN $\bar{p}p$ Collider. *Physics Letters* 147B, 1984, p 493.

D* production in jets at the CERN SPS Collider. *Physics Letters* 147B, 1984, p 222.

Experimental observation of events with large missing transverse energy accompanied by a jet or a photon(s) in $\bar{p}p$ collisions at $\sqrt{S} = 540$ GeV. *Physics Letters* 139B, 1984, p 115.

Observation of muonic Z^0 decay at the $\bar{p}p$ Collider. *Physics Letters* 147B, 1984, p 241.

Observations of the muonic decay of the charged intermediate vector boson. *Physics Letters* 134B, 1984, p 469.

J P Emerson

'IRAS observations of external galaxies' in *Proceedings of the Workshop on Star Formation*; edited by R D Woistencroft. Occasional Report No. 13 of the Royal Observatory Edinburgh, 1984, p 31.

J P Emerson, P E Clegg, G Gee, C T Cunningham, M J Griffin, L M J Brown, E I Robson and A J Longmore

IR observations of the peculiar galaxy Arp220. *Nature*311, 1984, p 237.

J P Emerson, S Harris, R E Jennings, C A Beichman, B Baud, D A Beintema, P L Marsden and P R Wesselius

IRAS observations of near young objects with bipolar outflows: L1551 and HH46-47. *Astrophysical Journal* 278, 1984, p L49.

C Galiotis, R J Young, P H J Yeung and D N Batchelder

The study of model polydiacetylene/epoxy composites, I. The axial strain in the fibre. *Journal of Materials Science* 19, 1984, p 3640.

C Galiotis, R T Read, P H J Yeung, R J Young, I F Chalmers and D Bloor

High-modulus polydiacetylene single-crystal fibers. *Journal of Polymer Science. Polymer Physics Edition* 22, 1984, p 1589.

T N Gautier, M G Hauser, C A Beichman, F J Low, G Neugebauer, M Rowan-Robinson, H H Aumann, N Boggess, J P Emerson, S Harris, J R Houck, R E Jennings and P L Marsden

IRAS images of the galactic centre. *Astrophysical Journal*278, 1984, p L57.

G Gee, J P Emerson, P A R Ade, E I Robson and I G Nolt

Submillimetre observations of the cold dust halo of NGC 7027. *Monthly Notices of the Royal Astronomical Society* 208, 1984, p 517.

W K Gear, E I Robson, P A R Ade, M G Smith, P E Clegg, C T Cunningham, M J Griffin, I G Nolt and J V Radostitz

Millimetre wave observations of flat spectrum radio sources. *Astrophysical Journal* 208, 1984, p 102.

F C Gillett, G Neugebauer, G Helou and J P Emerson

IRAS observations of 47 Tuc. *Bulletin of the American Astronomical Society* 16, 1984, p 526.

M B Green and J H Schwartz

Anomaly cancellations in ten dimensions require $S_0(32)$ or $E_8 \times E_8$. *Physics Letters* 149B, 1984, p 117.

Covariant formulation of chiral superstrings. *Physics Letters* 136B, 1984, p 367.

Field theory of superstrings. *Nuclear Physics* B243, 1984, p 475.

Properties of superstring field theories. *Physics Letters* 140B, 1984, p 33.

Properties of the covariant formulation of superstring theories. *Nuclear Physics B*243, 1984, p 285.

H J Habing, G Miley, E Young, B Baud, N Boggess, P E Clegg, T De Jong, S Harris, E Raimond, M Rowan-Robinson and B T Sofier

Infrared emission from M31. *Astrophysical Journal* 278, 1984, p L59.

S Harris, B Baud, C A Beichman and J P Emerson

'IRAS observations of galactic star formation' in *Proceedings of the Workshop on Star Formation*; edited by R D Wolstencroft. Occasional Report No. 13 of the Royal Observatory Edinburgh, 1984, p 31.

M G Hauser, F C Gillett, F J Low, T N Gautier, C A Beichman, G Neugebauer, H H Aumann, B Baud, N Boggess, J P Emerson, J R Houck, B T Soifer and R G Walker

IRAS observations of the diffuse infrared background. *Astrophysical Journal*278, 1984, p Li 1.

W Hayes, T Hattori and D Bloor

Photo-induced absorption and luminescence in polydiacetylenes. *Journal of Physics* C17, 1984, p L881.

J R Houck, B T Soifer, G Neugebauer, C A Beichman, H H Aumann, P E Clegg, F C Gillett, H J Habing, M G Hauser, F J Low, G Miley, M Rowan-Robinson and R G Walker

Unidentified point sources in the IRAS minisurvey. *Astrophysical Journal*278, 1984, p L63.

R B Jones

Memory function moment analysis of dynamic light scattering data. *Journal of Physics* A17, 1984, p 2305.

R B Jones and R Schmitz

Effective elasticity of a solid suspension of spheres I. Stress-strain constitutive relation. *Physica* 125A, 1984, p 381.

Effective elasticity of a solid suspension of spheres II. Effective moduli in lowest multipole approximation. *Physica* 126A, 1984, p 1.

R J Lacey and D N Batchelder

Pressure dependence of the 2 eV electronic transition of a polydiacetylene. *Journal of Physics* C17, 1984, p 4529.

S L Lloyd and others

(TASSO Collaboration)

An improved measurement of electroweak couplings from $e^+e^- - e^+e^-$ and $e^+e^- - \mu^+\mu^-$
Zeitschrift für Physik C22, 1984, p 13.

Determination of the average lifetime of bottom hadrons. Physics Letters 149B, 1984, p 524.

Determination of the τ lifetime in high energy e^+e^- annihilations. Physics Letters 141B, 1984, p 264.

Evidence for local compensation of baryon number in e^+e^- annihilation. Physics Letters 139B, 1984, p 126.

Experimental test of the flavour independence of the quark gluon coupling constant. Physics Letters 138B, 1984, p 317.

Inclusive electron production from heavy quarks in e^+e^- - annihilation at 34.6 GeV centre of mass energy. Physics Letters 146B, p 1984, p 443.

Jet production and fragmentation in e^+e^- annihilation at 12-43 GeV. Zeitschrift für Physik C22, 1984, p 307.

Measurement of R and search for the top quark in e^+e^- — annihilation between 39.8 and 45.2 GeV. Physics Letters 138B, 1984, p 441.

Measurement of the radiative width of the η' (958) in two photon interactions. Physics Letters 147B, 1984, p 487.

Observation of F meson production in high energy e^+e^- annihilation. Physics Letters 136B, 1984, p 130.

Observations of hard processes in collisions of two quasi-real photons. Physics Letters 138B, 1984, p 219.

Observation of the reaction $\gamma\gamma - p^+p^- \cdot \pi^+\pi^-$. Physics Letters 142B, 1984, p 135.

Photon pair production by e^+e^- annihilation and search for supersymmetric photinos at energies greater than 40 GeV. Zeitschrift für Physik C26, 1984, p 337.

Production and muonic decay of heavy quarks in e^+e^- annihilation at 34.5 GeV. Zeitschrift für Physik C22, 1984, p 219.

Properties of charm jets produced in e^+e^- annihilation near 34 GeV. Physics Letters 135B, 1984, p 243.

Upper limits on the production rate of the decuplet baryons Δ and Σ^* in e^+e^- annihilations at 34.4 GeV. Zeitschrift für Physik C26, 1984, p 181.

A J Longmore, R M Sharples, A T Tokunaga, R J Rudy, E I Robson, P A R Ade and J V Radostitz

Continuum emission from the nucleus of NGC 1275. *Monthly Notices of the Royal Astronomical Society* 209, 1984, p 373.

F J Low, D A Beintema, T N Gautier, F C Gillett, C A Beichman, G Neugebauer, E Young, H H Aumann, N Boggess, J P Emerson, H J Habing, M G Hauser, J R Houck, M Rowan-Robinson, B T Soifer, R G Walker and P R Wesselius

Infrared cirrus: new components of the extended infrared emission. *Astrophysical Journal* 278, 1984, p 115,

P L Marsden, F C Gillett, R E Jennings, J P Emerson, T De Jong and F M Olon

Far infrared observations of the Crab Nebula. *Astrophysical Journal* 278, 1984, p L29.

G Miley, G Neugebauer, P E Clegg, S Harris, M Rowan-Robinson, B T Soifer and E Young

A 25 micron component in 3C 390.3. *Astrophysical Journal* 278, 1984, p L79.

B Movaghar, D Murray, K J Donovan and E G Wilson

Anomalous electric field dependence of carrier drift in one-dimensional systems, example: organic PDA-TS. *Journal of Physics C*17, 1984, p 1247.

G Neugebauer, B T Soifer, G Miley, E Young, C A Beichman, P E Clegg, H J Habing, S Harris, F J Low and M Rowan-Robinson

IRAS observations of radio-quiet and radio-loud quasars. *Astrophysical Journal* 278, 1984, p L83.

G Neugebauer, H J Habing, R Van Duinen, H H Aumann, B Baud, C A Beichman, D A Beintema, N Boggess, P E Clegg, T De Jong, J P Emerson, T N Gautier, F C Gillett, S Harris, M G Hauser, J R Houck, S R Pottasch, E Raimond, M Rowan-Robinson, B T Soifer, R G Walker, P R Wesselius and E Young

The Infrared Astronomical Satellite (IRAS) Mission. *Astrophysical Journal* 278, 1984, p Li.

F M Olon, B Baud, H J Habing, T De Jong, S Harris and S R Pottasch

IRAS observations of OH/JR stars. *Astrophysical Journal* 278, 1984, p L41.

J P Phillips

Constraints on visual opacities in planetary nebulae. *Astronomy and Astrophysics* 140, 1984, p 141.

The dynamics, evolution and formation rate of planetary nebulae. *Astronomy and Astrophysics* 137, 1984, p 92.

J P Phillips and S P Pottasch

Distances, radii, and masses of the planetary nebulae. *Astronomy and Astrophysics* 130, 1984, p 91.

J P Phillips, C Sanchez Magro and C Martinez Roger

Near infrared scanning of planetary nebulae. *Astronomy and Astrophysics* 133, 1984, p 395.

N J Poole and D N Batchelder

Absorption and adsorption of oxygen by a polydiacetylene. *Molecular Crystals and Liquid Crystals* 105, 1984, p 55.

S R Pottasch, B Baud, D Beintema, J P Emerson, H J Habing, S Harris, J R Houck, R E Jennings and P L Marsden

IRAS measurements of planetary nebulae. *Astronomy and Astrophysics* 138, 1984, p 10.

P Radmore and P L Knight

Two-photon ionisation: interference and population trapping. *Physics Letters* 102A, 1984, p 180.

P Radmore and M A Lauder

Making atoms transparent: trapped superpositions. *Acta Physica Austriaca*, 56, 1984, p 103.

M Rowan-Robinson, P E Clegg, C A Beichman, G Neugebauer, B T Soifer, H H Aumann, D A Beintema, N Boggess, J P Emerson, T N Gautier, F C Gillett, M G Hauser, J R Houck, F J Low and R G Walker

The IRAS minisurvey. *Astrophysical Journal* 278, 1984, p L7.

S D D V Rughooputh, D Phillips, D Bloor and D J Ando

Spectroscopic studies of polydiacetylene solutions and glasses. *Chemical Physics Letters* 106, 1984, p 247.

Chromism of a polydiacetylene with weakly interacting sidegroups. *Polymer Communications* 25, 1984, p 242.

B T Soifer, M Rowan-Robinson, J R Houck, T De Jong, G Neugebauer, H H Aumann, C A Beichman, N Boggess, P E Clegg, J P Emerson, F C Gillett, H J Habing, M G Hauser, F J Low, G Miley and E Young

Infrared galaxies in the IRAS minisurvey. *Astrophysical Journal* 278, 1984, p L7 1.

P G Williams

Light-quark mass ratios and vacuum flavour symmetry breaking. *Physics Review* 29D, 1984, p 1032.

W N Wybourne, B J Kiff and D N Batchelder

Anomalous thermal conduction in polydiacetylene single crystals. *Physical Review Letters* 53, 1984, p 580.

RJWylde

Millimetre-wave Gaussian beam-mode optics and corrugated feed horns. *IEE Proceedings* H 131, 1984, p 258.

E Young, B T Soifier, F J Low, G Neugebauer, M Rowan-Robinson, M G Miley, P E Clegg, T De Jong and TN Gautier

The infrared properties of galaxy clusters: IRAS observations of the Hercules Cluster (Abell 2151). *Astrophysical Journal* 278, 1984, p L75.