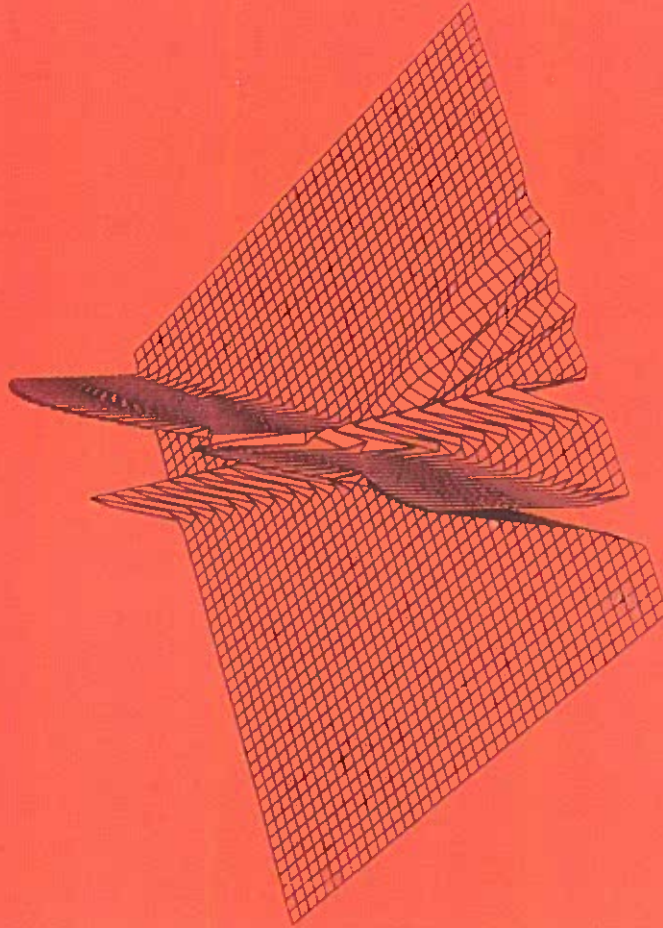


Heriot-Watt University

## Department of Mathematics



ANNUAL REPORT 1991-92

HERIOT-WATT UNIVERSITY

## DEPARTMENT OF MATHEMATICS

ANNUAL REPORT 1991-92

There is a record number of undergraduate and postgraduate students in the Department of Mathematics. In order to widen access to students wishing to study engineering and science the department ran two intensive remedial mathematics courses in August/September 1992. These will enable approximately fifty students to start degree courses at Heriot-Watt in 1992.

The CALM (Computer Assisted Learning in Mathematics) project under the direction of Dr C E Beevers has made significant progress this year. The project for the provision of access material which was financially supported by the Department of Trade came to a successful conclusion. The Mathematics Department is now a principal resource centre for the UK Mathematics Courseware Consortium funded by the UFC under the Teaching and Learning Technology Programme.

The department was delighted at the recognition given to the research excellence of Vladimir Sverák (Research Associate) and Stefan Müller (PhD student) who were awarded two of the ten prizes for young European mathematicians. The prizes of FF10,000 each were presented by M Jacques Chirac, Mayor of Paris at the 1992 European Congress of Mathematics in Paris.

The first extended research programme of the International Centre for Mathematical Sciences took place during the year and attracted a large number of researchers to the department. The programme, which was devoted to Mathematical Problems in Materials Science, was particularly successful in bringing together people with diverse backgrounds to work on common problems.

Of particular value was the year long visit of Professor R D James of the University of Minnesota, a pre-eminent researcher in crystal microstructure and shape memory alloys. Professor James delivered a popular lecture on Smart Materials at the Edinburgh International Science Festival and was interviewed for science programmes on both the BBC Radio 4 and the BBC World Service.

Professor J M Ball was awarded an honorary degree at Ecole Polytechnique Fédérale de Lausanne in May 1992. Dr J Howie was elected Fellow of the Royal Society of Edinburgh, the eighth member of the Department to be so honoured. Dr K J Brown completed a three year term as Head of Department and was succeeded by Professor J Carr.

Professor J Carr

Head of Department

STAFF

Head of Department

Professors

- Dr K J Brown
- J M Ball
- M van den Berg<sup>1</sup>
- J Carr<sup>2</sup>
- J C Ellbeck
- J Howie<sup>3</sup>
- R J Knops<sup>3</sup>
- O Penrose
- J H Williamson

Professor Emeritus

Readers

- K J Brown
- A A Lacey

Senior Lecturers

- C E Beevers<sup>4</sup>
- R N Hillis<sup>5</sup>
- A R Prince

Lecturers

- J Bree
- D E R Clark
- B P Dodds
- D B Duncan
- N D Gilbert<sup>6</sup>
- D A Johnston
- G R McGuire<sup>7</sup>
- R S Marlow<sup>7</sup>

Research Associates

- S Bricher<sup>9</sup>
- A J Duncan<sup>10</sup>
- H Feddersen<sup>11</sup>
- N Firoozye<sup>12</sup>
- Jin Liang<sup>13</sup>
- P M Sutcliffe<sup>14</sup>
- V Šverák

Computing Officers

- Mrs M G Foster
- D Smith<sup>16</sup>

Visiting Mathematicians

- Professor R D James<sup>17</sup>
- Professor D James<sup>18</sup>

Secretaries

- Miss I Fraser
- Mrs M Gardiner<sup>19</sup>
- Mrs P Hampton
- Miss B Kollmer<sup>20</sup>
- Miss D Lyon<sup>21</sup>

- From 1.8.92
- Head of Department from 1.8.92
- Vice-Principal 1988-93
- Deputy Head of Department
- On leave 1.7.90 - 31.8.92
- From 1.9.92 - 31.8.93
- From 1.9.91 - 31.8.92
- Part-time
- From 15.9.91 - 14.7.93
- until 31 December 1992
- From 1.9.90 - 31.12.92

Visitors to the Department

The following made long-term visits:

- A De Simone (Minnesota/Roma 2)
- M N Dyer (Eugene)
- V Z Enof's'kil (Kiev)
- R D James (Michigan)
- D James (Michigan-Dearborn)
- T Nagai (Kyushu Institute of Technology)

In addition short-term visits were made and seminars given by the following:

- G J Ackland (Edinburgh)
- K Aderogba (Lagos)
- T Akbay (Imperial)
- G Alberti (Pisa)
- M Al-Jiboory (Salford)
- H W Alt (Bonn)
- P Aston (Surrey)
- A J Baker (Glasgow)
- R C Ball (Cambridge)
- J Barrett (Imperial)
- J Blouey (Sussex)
- T B Benjamin (Oxford)
- M Berger (Massachusetts)
- L J Bernstein (San Diego, California)
- H K D H Bhadeshia (Cambridge)
- K Bhattacharya (Courant Institute)
- K Binder (Mainz)
- R Bishop (UMIST)
- J F Blouey (Sussex)
- E Boithausen (Zurich)
- A Bossavit (Electricité de France)
- A Braides (Brescia)
- D Brochet (Paris XI)
- A Brokman (Jerusalem)
- L Bronsard (Carnegie Mellon)
- K A Brown (Glasgow)
- C Budd (Bristol)
- R Buitelaar (Utrecht)
- G Buttazzo (Pisa)
- J W Cahn (NIST)
- M Carriero (Lecce)
- A Cerezo (Oxford)
- M A Chaplain (Bath)
- S J Chapman (Oxford)
- M Chipot (Metz)
- J Christian (Oxford)
- P C Christiansen (Lyngby)
- J A Coles (INSERM, Bordeaux II)
- C Conca (Santiago)
- M Copetti (Brazil)
- A G Crocker (Surrey)
- A de Masi (L'Aquila)
- G Dal Maso (Trieste)
- D Dew-Hughes (Oxford)
- G Dolzman (Bonn)
- T C Dorlas (Swansea)
- F Dunlop (Palaiseau)
- U Ebel's (Cambridge)
- C M Elliott (Sussex)
- G J Ellis (Galway)
- M Esteban (Paris-Dauphine)
- P C Fife (Utah)
- N B Firoozye (Minnesota)
- I Fonseca (Carnegie-Mellon)
- A Fordy (Leeds)
- B Forrest (Palma de Mallorca)
- F S M Fortunato (Edinburgh)
- C Frank (Bristol)
- P Fratzl (Vienna)
- J E Furter (Warwick)
- H Garcke, Bonn
- G Giacomini (Rutgers)
- M E Glicksman, (RPI, Troy)
- A Goldman (Minnesota)
- R Granek (Cambridge)
- R D Greenough (Hull)
- D F Griffiths (Dundee)
- M Gunzburger (Virginia)
- I L'Heureux (Ottawa)
- Y Hohlov (Moscow)
- D Hilhorst (Paris-Sud)
- D Hömberg (Essen)
- W Horn (Essen)
- S H Howison (Oxford)
- Hua Lua (Sheffield)
- A Hubert (Erlangen-Nurnberg)
- H Huppert (Cambridge)
- J Hyde (Oxford)
- N Ianiro (Rome)
- F Issard-Roch (Paris-Sud)
- M A Joboory (Salford)
- W C Johnson (Carnegie-Mellon)
- Feng Kang (Academia Sinica, Beijing)
- S Kartha (Cornell)
- M Katsoulakis (Carnegie Mellon)
- M Keane (Deift)
- J Keener (Utah)
- A Khachatryan (Rutgers)
- A-C Kim (Pusan)
- D Kinderlehrer (Carnegie-Mellon)
- J Kingman (Bristol)
- D Kirby (Southampton)
- P Kirmann (Stuttgart)
- B Klebanov (Moscow)

- J F Knott (Birmingham)  
R V Kohn (Courant Inst)  
H Lanchon-Ducaquis (ENSEM Lorraine)  
J Landau (Kings College, London)  
M V Lawson (Bangor)  
A Leaci (Lecce)  
J L Lebowitz (Rutgers)  
D P G Liburdy (AEA Technology)  
J Lopez-Gomez (Madrid)  
D G Lord (Salford)  
B Lu (Sussex)  
M Luskin (Minnesota)  
M Lutz (California, Berkeley)  
S Marsh (NRL)  
R Mackay (Warwick)  
P McMullen (UCL)  
A Mielke (Stuttgart)  
P D Miller (Tucson)  
A R Mitchell (Dundee)  
T Miyazaki (Nayoya Inst. of Tech.)  
I Mohri (Hokkaido)  
H Morton (Liverpool)  
S Müller (Bonn)  
A K Nandakumar (Bangladesh)  
J Naudts (Antwerp)  
G A Niblo (QMW)  
B S Niethammer (Bonn)  
A Novick-Cohen (Haifa)  
J R Ockendon (Oxford)  
S S Okayd (Obafemi Awolowo, Nigeria)  
G Olson (Northwestern)  
E Orlandi (Rome - La Sapienza)  
L A Ostrovskii (Gorky)  
J Palls (Rio de Janeiro)  
D F Parker (Edinburgh)  
G Parry (Bath)  
I Pawlow (Warsaw)  
R L Pego (Maryland)  
M A E Perez (EIS de Caminos)  
J Piggott (British Gas, Newcastle)  
J Pouget (Paris VI)  
E Presutti (Rome, Tor Vergata)  
S J Pride (Glasgow)  
T Pruschke (Haile)  
C R Purdy (McMaster)  
H Rauh (AEA Technology/Oxford)  
P J P Raymond (Paul Sabatier Toulouse)  
C M Ringel (Bielefeld)  
E F Robertson (St Andrews)  
J C Robson (Leeds)  
J M Roquejoffre (Palaiseau)  
A L Roytburd (Maryland)  
P Rybka (Warszawa)  
H T Savage (Madrid)  
M Schatzman (Lyon)  
A G Schiljper (Shell)  
R Schneck (Beer-Sheva)  
D Schryvers (Antwerp)  
A C Scott (Lyngby/Tucson)  
J Sethna (Cornell)  
N Shemetov (CMAF)  
J A Simmons (NIST)
- L W Small (San Diego)  
A Solomon (Open University)  
S Spector (S. Illinois)  
H Spohn (TU Munich)  
B Stoth (Bonn)  
D Summers (Napier)  
P J Swart (Carnegie-Mellon)  
Tang Qi (Sussex)  
L Thompson (Edinburgh)  
R Toral (Illes Balears)  
R G Tross (Ottawa)  
L Triolo (Rome, Tor Vergata)  
L Truskinovsky (Minnesota)  
J W Tucker (Sheffield)  
V Tveergaard (Lynby)  
K Uhlenbeck (Austin)  
A Umantsev (Northwestern)  
D Vassiliev (Sussex)  
J R Willis (Bath)  
M Winter (Stuttgart)  
S Wolf (Washington)  
S Zheng (Fudan)  
R W Zimmerman (California, Berkeley)
- J F Knott (Birmingham)  
R V Kohn (Courant Inst)  
H Lanchon-Ducaquis (ENSEM Lorraine)  
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A L Roytburd (Maryland)  
P Rybka (Warszawa)  
H T Savage (Madrid)  
M Schatzman (Lyon)  
A G Schiljper (Shell)  
R Schneck (Beer-Sheva)  
D Schryvers (Antwerp)  
A C Scott (Lyngby/Tucson)  
J Sethna (Cornell)  
N Shemetov (CMAF)  
J A Simmons (NIST)
- Invited Lecture, EC project meeting, Nice, 15-17 November 1991, 'Some open problems in finite elasticity'.  
Seminar, Université de Paris Dauphine, 3 December 1991, 'Théories Nonlinéaires et linéarisées pour les cristaux'.  
Seminar, Carnegie-Mellon University, 27 March 1992, 'Attractors for damped nonlinear wave equations'.  
Plenary lecture, 1st Joint meeting of London and American Mathematical Societies, Cambridge, 29 June 1992, 'Energy minimization and microstructure'.  
Colloquium, Universidad Complutense de Madrid, 30 September 1992, 'Elasticity models for crystal microstructure'.  
Invited lecture, British Theoretical Mechanics Colloquium, University of Keele, April 1992, 'The CALM project'.  
Seminar, Department of Mathematics, Brunel University, May 1992, 'Computer assessment in mathematics'.  
Invited lecture, IMA Symposium on 'New Vistas in Mathematical Education', Dundee University, May 1992 (with Dr G R McGuire), 'Reflections on computer aided learning in mathematics'.  
Seminar, Department of Mathematics, Heriot-Watt University, June 1992, (with M G Foster and C McAndrew), 'The CALM structure'.  
Invited talk at Institute for Computer Based Learning, Heriot-Watt University for National Committee on Education, June 1992, (with C McAndrew), 'Experiences with CALM'.  
Seminar, Department of Mathematics, University of Michigan-Dearborn, August 1992, 'The CALM project'.  
Invited lecture, Mini-conference on the 'Use of Computers in Higher Education', Laval University, Quebec, August 1992, (with D James), 'Factors in the successful implementation of CAL in mathematics'.  
Invited lecture, 7th International Congress on 'Mathematical Education', Laval University, Quebec, August 1992, 'Experience of CALM at Heriot-Watt'.  
Invited lecture, Interactive Learning Conference, Heriot-Watt University, August 1992, (with C McAndrew), 'CALM 2 - Authorware in action'.  
Invited lecture, International Symposium on 'Operator Calculus and Spectral Theory', Pfaizakademie Lambrecht, Germany, December 1991, 'Capacity, measure and spectrum of the Dirichlet Laplacian'.  
Seminar, University of Erlangen-Nürnberg, 11 February 1992, 'Heat flow and brownian motion for regions in euclidean-space'.  
Seminar, ETH Zurich, 26 March 1992, 'On the spectrum of the Dirichlet laplacian'.
- Invited Papers and Seminars given by members of staff  
Professor J M Ball  
Dr C E Beevers  
Dr M van den Berg

Dr M van den Berg

Seminar, University of Sussex, 27 April 1992, 'Heat flow and brownian motion for regions in euclidean space'.  
Seminar, Ruhr-Universität Bochum, 29 June 1992, 'Über die Wärmeleitungsgleichung'.  
Seminar, Dublin Institute for Advanced Studies, 30 June 1992, 'Heat flow, brownian motion and electrostatic capacity'.

Professor J Carr

Invited Lecture, EC project meeting, Nice, 15-17 November 1991, 'Phase transitions in cluster dynamics'.  
Invited lectures at conference on "Dynamical Systems" Oberwolfach, 13-17 January 1992, 'Coagulation-fragmentation problems'.  
Seminar, University of Glasgow 6 February 1991, 'Self-similarity in coarsening'.  
2 Invited Lectures at University of Utrecht, 8 and 9 April 1992, 'Dynamical systems'.  
Invited Lecture, BMC, University of Strathclyde, 7 April 1992, 'Self-similarity in coarsening models'.

Dr A J Duncan

Conference talk, Workshop on "Geometric Topology", Haifa, 10 - 16 June 1992, 'Pictures over 1-relator products of groups'.

Dr D B Duncan

Invited talk, Symposium on "Evolutionary Problems", Durham, 4-14 July 1992, 'High order schemes for the nonlinear Klein-Gordon equation'.

Professor J C Eilbeck

Seminar, Royal Institution Mathematics Masterclass, Heriot-Watt, 9 November 1992, 'Chaos and fractals'.  
Seminar, University of St Andrews, 21 February 1992, 'Numerical studies of bifurcation in reaction diffusion systems'.  
Seminar, University of Salerno, 24 March 1992, 'Solitons on lattices'.  
Seminar, Universidad de La Laguna, Tenerife, 29 May 1992, 'Numerical studies of reaction-diffusion equations'.  
Invited talk, "Wave Phenomena II" conference, University of Alberta, 17 June 1992, 'Numerical studies of solitons on lattices'.  
Invited talk, NATO-MIDIIT Advance Study Institute on "Future Directions of Nonlinear Dynamics in Physical and Biological Systems", Danish Technical University, Lyngby, 31 July 1992, 'Solitons on lattices'.

Dr H Feddersen

Seminar, Technical University of Denmark, 19 June 1991, 'Numerical calculations of lattice solitons'.

Mrs M G Foster

Invited talk, Brunel University 8 May 1992, 'Assessment and monitoring of large classes in mathematics - developments at Heriot-Watt'.

Dr N B Firoozye

Invited lecture, ICMS Inaugural conference, Royal Society of Edinburgh, 11 October 1991, 'Elastic energies and microstructures in materials'.

Dr N B Firoozye

Seminar, University of Bonn, 22 October 1991, 'Optimal translations and explicit relaxations of some variational problems with applications to phase transitions in elastic solids'.  
Talk at conference on "Partial Differential Equations", Nice, 14-17 November 1991, 'BMO and stability of stationary states for simple variational problems'.  
Seminar, University of Bath, 23 November 1991, 'Optimal use of the translation method and relaxation of variational problems'.

Seminar, Heriot-Watt University, 29 November 1991, 'Positive second variation and local minimizers in BMO-Sobolev spaces'.

Seminar, Collège de France, 6 December 1991, 'Optimal use of the translation method, homogenization, and relaxation of variational problems'.

Invited lecture at Joint AMS/LMS meeting, Cambridge 29 June - 1 July 1992, special session on "Microstructure and Magnetostriction", 'An investigation into small-parameter limits of convolutions on lattices and applications to continuum limits in magnetostatics'.

Invited lecture at ICMS conference "Continuum Models for the Microstructure of Crystals", Heriot-Watt, 8-12 June 1992, 'Convolutions on lattices: homogenization for magnetostatics'.

Dr N D Gilbert

Seminar, University of St Andrews, 23 January 1992, 'Cockcroft group presentations'.  
Seminar, University of Aberdeen, 18 February 1992, 'Cockcroft group presentations'.  
Seminar, Edinburgh and Heriot-Watt Algebra Seminar, 21 February 1992, 'Longer and longer exact sequences in group homology'.

Dr J Howie

Seminar, Manchester University, 15 October 1991, 'Some generalizations of the Freiheitssatz'.  
Seminar, Heriot-Watt University, March 1992, 'Some generalizations of the Freiheitssatz'.  
Invited lecture, Conference "Topological methods in group theory", Oberwolfach, 30 March - 3 April 1992, 'Some generalizations of the Freiheitssatz'.

Professor R J Knops

Invited lecture, Oberwolfach, January 1992, 'Asymptotic behaviour on the half-strip for the solution to the equation of the surface of constant mean curvature'.

Dr A A Lacey

Seminar, Glasgow University, 20 February 1992, 'Blow-up with oscillatory boundary conditions'.  
Lecture, Edinburgh Mathematical Society, Dundee Institute of Technology, 13 March 1992, 'Blow-up for reaction-diffusion equations'.  
Lectures, Universidad de La Laguna, Tenerife, 8, 9, and 10 September 1992, 'Rigorous methods of asymptotic expansions'; 'Asymptotics of special functions'; 'Asymptotic behaviour for some nonlinear partial differential equations'.

Research and other grants reported from 1 October 1991

£54,555	From the Science and Engineering Research Council and From Unilever, for the period 1 January 1993 - 31 December 1994, for research entitled "Kinetics of Mixed Micelle Formation and Ionic Crystal Nucleation", under the direction of Professors O Penrose and J Carr (Heriot-Watt) and Dr D G Hall (Unilever).
£12,000	
£21,748	From the Science and Engineering Research Council, for the period January - June 1993, to fund ICMS workshop on Geometric and Combinatorial Methods in Group Theory, under the direction of Dr A J Duncan, Dr N D Gilbert and Dr J Howie.
£19,000	From the European Community, link with the Universities of Nice, Stuttgart, Paris and Utrecht for the period 1 October 1991 - 30 September 1994, under the direction of Professor J M Ball.
£6915	From the Royal Society of London, for the purchase of computing equipment, awarded to Dr D A Johnston.
£5604	From the Royal Society of London, for the purchase of computing equipment, awarded to Dr B P Rynne.
£4350	From the British Council, for investigation in nonlinear equations modelling phase transitions and diffusion problems with Professor M A Herrero, Complutense, Madrid, awarded to Dr A A Lacey.
£3,700	From the Science and Engineering Research Council Support for two months to 31 May 1992, to support a Visiting Fellowship for Professor M N Dyer, Oregon, for investigation into aspherical two-complexes and homology of groups, awarded to Dr J Howie.
£1974	From NATO for collaborative work on random surfaces with Dr C Baillie (Boulder) for the period July 1992 - July 94, under the direction of Dr D A Johnston.
£1400	From the British Council for collaborative work with Dr Domenec Espin, University of Barcelona on random surfaces for the period March 1992 - March 1993, under the direction of Dr D A Johnston.
£1000	From The British Council for investigation into amplification and transmission of graded voltage signals in neurons (Joint research programme with INSERM, Bordeaux) for the period November 1991 - December 1992, under the direction of Professor J C Ellbeck.
£1000	From The British Council for collaborative work on random surfaces with Dr H Janke, Mainz, for the period July 1992 - July 1994, under the direction of Dr D A Johnston.
£1000	From Ferranti Defence Systems Ltd, support for Computer Assisted Learning in Mathematics Project 1 October 1991 - 30 September 1992, under the direction of Dr C E Beavers and Dr G R McGuire.
£900	From London Mathematical Society, support for Scottish Algebra Day, 20 March 1992, awarded to Professor K A Brown, Dr J Howie and Dr T H Lenagan.

£874

From The British Council and Swiss National Science Foundation, for the period April 1991 - March 1992 for stochastic analysis, under the direction of Dr M van den Berg and Professor E Bolthausen, awarded to Dr M van den Berg.

£840

From the Royal Society for support for travel to ICOMAT '92, Monterey, California, July 1992, awarded to Professor J M Ball.

£400

From the Carnegie Trust for support for visit to Quebec to speak at ICME Conference August 1992, awarded to Dr C E Beavers.

£400

From the Royal Society for support for visit to University of Rome to attend workshop on String Theory, September 1992, awarded to Dr D A Johnston.

DM1000

From University Erlangen-Neurenberg for support for visit from 8 - 12 February 1992, awarded to Dr M van den Berg.

£322

From the Royal Society for support for visit to Hungary, May 1992, awarded to Professor O Penrose.

£250

From Edinburgh Mathematical Society for support for expenses of speakers at one-day meeting on Computational Mathematics, Strathclyde University, 14 September 1992, awarded to Dr D B Duncan.

£215

From Edinburgh Mathematical Society for support for visit by Dr G J Ellis in May 1992, awarded to Dr A J Duncan and Dr N D Gilbert.

£200

From the Royal Society of Edinburgh for support for participation in First European Solid Mechanics Conference, Munich, 9 - 13 September 1991, awarded to Professor R J Knops.

£200

From CIICMS for support for visit to Quebec to speak at ICME Conference August 1992, awarded to Dr C E Beavers.

£150

From the Royal Society for support for travel to attend Conference in Oberwolfach, 30 March - 3 April 1992, awarded to Dr J Howie.

THESES SUCCESSFULLY PRESENTED FOR HIGHER DEGREES

C H Walshaw (PhD), 'Parallel algorithms for large, sparse systems of differential equations.'

M G McGuigan (PhD), 'Some problems in blow-up.'

PUBLICATIONS - OCTOBER 1991 - SEPTEMBER 1992

S S Antman and R S Marlow  
'Material constraints, Lagrange multipliers, and compatibility. Applications to rod and shell theories.' *ARMA*, 1991, 116, 257-299.  
'Transcritical buckling of columns.' *ZAMP*, 1992, 43, 7-27.

J M Ball

'Dynamic energy minimization and phase transformations in solids.' Proceedings of 'ICIAM 91', Washington DC, July 8 - 12 1991, *SIAM*.

J M Ball and R D James

'Proposed experimental tests of a theory of fine microstructure and the two-well problem.' *Phil. Trans. R. Soc. London A*, 1992, 338, 389-450.

J M Ball and F Murat

'Remarks on rank-one convexity and quasiconvexity.' pp 25-37, In 'Ordinary and Partial Differential Equations', Eds. B D Sleeman and R J Jarvis, Pitman, 1991.

C F Baillie and D A Johnston

'Weak self avoidance and crumpling in random surfaces with extrinsic curvature.' *Physics Letters*, 1991, B273, 380-388.  
'Strong self-avoidance and crumpling in random surfaces with extrinsic curvature.' *Phys. Letts. B*, 1992, 283, 55-60.  
'Weak self avoidance and crumpling in random surfaces with extrinsic curvature.' *Phys. Letts. B*, 1992, 273, 380-386.  
'A modified Steiner functional string action.' *Phys. Rev.* 1992, D45, 3326-3329.  
'A numerical test of KPZ scaling: Potts models coupled to two dimensional quantum gravity.' *Modern Physics Letters*, A7, 1992, 1519-1524.  
'Multiple Potts models coupled to two dimensional quantum gravity.' *Phys. Letts. B*, 1992, 286, 44-50.  
'The XY model coupled to two dimensional quantum gravity.' *Phys. Letts. B*, 1992, 291, 233-241

J Bebernes and S Bricher

'Final time blowup profiles for semilinear parabolic equations via center manifold theory.' *Siam J. Math. Anal.*, 1992, 23, 852-869.

J Bebernes and A A Lacey

'Finite time blowup for semilinear reactive-diffusion equations.' *Jl. Diff. Eqns.*, 1992, 95, 105-129.

C E Beavers, M G Foster and G R McGuire  
'Computer Aided Learning in Mathematics: CALM Progress.' *CTISS File*, 1991, 12, 19.

C E Beavers, M G Foster, G R McGuire and J H Renshaw

'Some problems of mathematical CAL.' *J. Computers Educ.*, 1992, 18, 119-125.

M van den Berg

'On the trace of the difference of Schrödinger heat semigroups.' *Proc. Royal Soc. Edinburgh*, 1991, 119A, 169-175.  
'Dirichlet Neumann bracketing for horn-shaped regions.' *J. Functional Anal.*, 1992, 104, 110-120.  
'On the spectral counting function for the Dirichlet Laplacian.' *J. Functional Anal.*, 1992, 107, 352-361.  
'On the ratio of odd and even spectral counting functions.' pp 321-328. In 'Operator Calculus and Spectral Theory', Eds M Demuth, B Gramsch and B-W Schulze, Operator Theory: Advances and Applications Vol 57, Birkhäuser, Basel, 1992, 359pp.  
'A gaussian lower bound for the Dirichlet heat kernel.' *Bull. Lond. Math. Soc.*, 1992, 24, 475-477.

K J Brown and J Furter

'A singularity theory approach to a semilinear boundary value problem.' *J. Math. Anal. Applic.*, 1992, 166, 485-506.

R Brown, N D Gilbert, H J Hoehnke and J Shrimpton

'Non-abelian tensor products of groups; groupoids; quadratic forms and higher order symmetry.' In 'Mathematical Heritage of C F Gauss', Ed. G M Rassias, World Scientific Press, 1991.

B Cardinaud, J A Coles, J C Ellbeck and A M Vailet

'A voltage-gated Na<sup>+</sup> channel whose function is to amplify small signals.' *Biophysical Journal*, 1992, 61, A271 (published conference abstract).

J Carr

'Primary Masterclasses.'  
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