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Catalogue of the papers and correspondence of

John David Lawson FRS

(1923-2008)

By Timothy E. Powell and Peter Harper

NCUACS catalogue no. 173/4/09

Title: Catalogue of the papers and correspondence of John David Lawson FRS
(1923-2008), physicist

Compiled by: Timothy E. Powell and Peter Harper

Date of material: 1945-2009

Extent of material: ca 200 items

Deposited in: Churchill College, Cambridge

Reference: GB 0014 LWSN

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NCUACS catalogue no. 173/4/09

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GENERAL INTRODUCTION

PROVENANCE

The papers were received from Lawson in 2007.

OUTLINE OF THE CAREER OF JOHN DAVID LAWSON

John David Lawson was born on 4 April 1923. He was educated at Wolverhampton Grammar School before going on to St John's College, Cambridge to study for the short (two year) Mechanical Sciences degree, including a special wartime radio course. He graduated BA in 1943 and then joined the Telecommunications Research Establishment, Malvern, where he was assigned to work on microwave antenna design under D.W. Fry, as part of the ongoing work on development of radar. At the end of the war Lawson continued to work at Malvern, although in 1947 he was made a member of the staff of the Atomic Energy Research Establishment (AERE). He undertook experimental work with the new 30 MeV synchrotron.

In 1951 Fry's group was transferred to the General Physics Division of the AERE at Harwell. Lawson was assigned to working on the klystron, a device for producing high-power microwaves, in a group led by Peter Thonemann. Thonemann was also in charge of the ZETA (Zero Energy Toroidal Assembly) fusion work, and it was through Lawson's association with Thonemann that he became interested in the topic of nuclear fusion. Lawson also worked with the 180 MeV cyclotron and on early accelerator proposals. He remained on the staff of the AERE to 1961, spending 1959-1960 as Research Associate at the W.W. Hansen Laboratories at Stanford where his work included the study of the properties of caesium plasma.

In 1961 Lawson transferred to the newly established National Institute for Research in Nuclear Science, based very close to Harwell, an institution shortly to become the Rutherford Laboratory and then the Rutherford Appleton Laboratory. He continued his work on accelerators and led the project to build the Variable Energy Cyclotron (for AERE Harwell). He had responsibility for building up the superconducting magnet programme and retained an interest in new accelerator concepts. In the 1970s he moved onto the study of very high current beams and in 1977 his book *The Physics of Charged Particle Beams* was published (second edition 1989), which became a classic textbook on particle accelerators. In 1975-1976 Lawson returned to fusion research with a two year sabbatical at the Culham Laboratory, working on a design study of a conceptual fusion power reactor based on the reversed field pinch principle.

He returned to the Rutherford Appleton Laboratory in 1977 where he continued working on free electron lasers and accelerator design, and also played a leading international role in promoting and critically examining ideas for future accelerators. In the early 1980s he recognized the potential that high-power lasers could have for particle acceleration, and set up a small research group in laser plasma accelerators. He retired in 1987.

Lawson was awarded the University of Cambridge Sc.D. in Physics in 1959 and made a Fellow of the Institute of Physics in 1970. In 1983 he was elected a Fellow of Royal Society 'for his contributions to the field of applied electromagnetism, in particular the physics of charged particle beams and high temperature plasmas'. He is particularly remembered for the Lawson Criterion, a general measure of a system that defines the conditions needed for a fusion reactor to achieve net power. Formulated in 1955, it was first published in 1957, in 'Some criteria for a power producing thermonuclear reactor', (*Proc. Phys. Soc.* vol. 70, pt. 1, no. 445, B, 6-10).

Lawson died on 15 January 2008.

DESCRIPTION OF THE COLLECTION

This is a small collection covering aspects of Lawson's professional career as a physicist in government laboratories from immediately after the Second World War to his death.

Section A, Biographical, includes autobiographical and biographical accounts, including material assembled for an interview by C.A. Muldoon in the course of her Ph.D. research on visualisation, analogy, insight and communication in physics. There is also a little material relating to Lawson's career, including the inauguration of the Variable Energy Cyclotron in 1966.

Section B, Papers and publications, is the largest in the collection. It is chiefly memoranda and reports prepared by Lawson from his time at the Telecommunications Research Establishment, Atomic Energy Research Establishment and the Rutherford Appleton Laboratory, as well as reports produced during his periods in the USA and Japan. There is also a set of offprints and photocopies of published papers, including many conference papers. The section concludes with a few book reviews, short articles for the *New Scientist* and reviews relating to *The Physics of Charged Particle Beams*.

Section C, Lectures, is principally the contents of Lawson's two folders labelled 'Informal lectures notes' and 'Copies of lecture note transparencies' (many later lecture notes are in the form of photocopies of Lawson's overhead projector transparencies). However, the distinction between material presented in this section and the 'as published' lectures in section B is not absolute. A

number of the papers there were given as lectures and conference papers. This section also includes some illustrative material - photographs and transparencies, and notices and abstracts of lectures and talks given by Lawson.

Section D, Visits and conferences, presents Lawson's material (chiefly reports) on visits made over the period 1957-1989. It is the contents of two folders labelled 'Conferences' and 'More interesting visits made', though as the material contained therein overlapped in terms of both content and date, they are presented in a single sequence. Not all Lawson's travel and conference attendance is represented in this section; evidence of other travel is represented by drafts of lectures in both sections B and C.

Section E, Correspondence, consists of the contents of Lawson's two folders of correspondence. It is a very partial record, for although both incoming and (copies of) outgoing correspondence are included, many of the letters record only one half of an exchange or are individual pieces from a clearly more extended sequence of correspondence. Correspondents represented include Ch'en Chia-erh, Martin Reiser, A.M. Sessler and D.H. Wilkinson.

There is also an index of correspondents.

T.E. Powell
Bath, 2009

SECTION A BIOGRAPHICAL, A.1-A.24 1948/1949-2009

A.1-A.13 AUTOBIOGRAPHICAL AND BIOGRAPHICAL

A.14-A.22 CAREER AND HONOURS

A.23, A.24 MISCELLANEOUS

A.1-A.13 AUTOBIOGRAPHICAL AND BIOGRAPHICAL 1980s-2009

A.1 Obituaries, Fusion Power Report, 1 March 2008; CERN Courier, May 2008 2008

A.2 Print-out of text from the 'John Lawson: Life in Science' website 2009

The website was established on the website of 'ISIS', the major user facility (a pulsed neutron and muon source) at the Rutherford Appleton Laboratory.

<http://www.isis.rl.ac.uk/johnlawson/index.htm>

A.3 Lawson's 'Biographical Notes' 1980s

Chiefly a summary of Lawson's 'Places of work, and work done'.

A.4 Summary of scientific career 1998, 2002

'Draft dated Feb 6 1998. Copy deposited with Royal Society (Some modifications, 2002)'.

A.5-A.10 Interviews with C.A. Muldoon 2003-2004

Papers found in Lawson's envelope divided into six for ease of reference: correspondence, background information on Lawson's life, research and publications, interview questions and answers.

Muldoon interviewed Lawson in the course of her Ph.D. research ('Shall I Compare Thee To A Pressure Wave?')

Biographical, A.1-A.24

Visualisation, Analogy, Insight, and Communication in Physics'). She was based at the Science Studies Centre, Department of Psychology, University of Bath.

- | | | |
|------------------|---|-----------------------|
| A.11 | Interview for Joint European Torus website to mark the 50th anniversary of the 'Lawson Criterion' | 2005, 2006 |
| | Original version; adapted version for Danish website. | |
| A.12 | 2pp manuscript account by Lawson of some of his work | |
| A.13 | References to work and achievements of Lawson | |
| A.14-A.22 | CAREER AND HONOURS | 1948/1949-1987 |
| A.14 | Group photograph of 'Team that worked in Malvern on early synchrotron' | 1948/1949 |
| | Inscribed on verso. With key (tracing paper) identifying some of those featured. | |
| | 'Occasion of photo was successful operation of the first purpose built synchrotron, which accelerated electrons to 30 MeV'. | |
| A.15 | Correspondence <i>re</i> appointments | 1953-1962 |
| | Appoints within Ministry of Supply, UK Atomic Energy Authority and National Institute for Research in Nuclear Science. | |
| A.16-A.20 | Inauguration of the Variable Energy Cyclotron, Atomic Energy Research Establishment, Harwell, 8 November 1966 | 1966 |
| | T.G. Pickavance put Lawson in charge of the project to construct the Variable Energy Cyclotron. | |

SECTION B PAPERS AND PUBLICATIONS, B.1-B.99 1945-1995

- B.1-B.94 MEMORANDA, REPORTS AND OTHER PAPERS
- B.95 OFFPRINTS OF PUBLISHED PAPERS
- B.96-B.99 MINOR PUBLICATIONS

B.1-B.94 MEMORANDA, REPORTS AND OTHER PAPERS 1945-1995

This material includes papers that were also given as lectures by Lawson.

- B.1-B.9 'Various early papers and notes. Aerials accelerators general physics'
- B.10-B.54 'Study group papers. Informal notes'
- B.55-B.59 Atomic Energy Research Establishment reports
- B.60, B.61 Microwave Laboratory internal memoranda
- B.62-B.77 Rutherford and Rutherford Appleton Laboratory reports
- B.78, B.79 United Kingdom Atomic Energy Authority Research Group studies
- B.80, B.81 Institute for Nuclear Study, Tanashi, University of Tokyo, Japan papers
- B.82-B.94 Other papers

B.1-B.9 'Various early papers and notes. Aerials accelerators general physics' 1945-1947

Folder of reports so labelled by Lawson. Presented in chronological order. They were compiled by Lawson while he was working at the Telecommunications Research Establishment.

Papers and publications, B.1-B.99

- | | | |
|-----|--|---------------------|
| B.1 | 'Experiments on Reradiation from Aerials' by Lawson and MJL

1p duplicated typescript.

Reference G10/M151/JDL. File 2163. | 21 March
1945 |
| B.2 | 'Low angle cosecant patterns obtained from paraboloid and prisms' by Lawson

Bound TRE Report. 4pp duplicated typescript + figures.

Reference G10/R153/JDL. T.1856 | 18 May 1945 |
| B.3 | 'A wing aerial for G.A.P.' by Lawson.

2pp duplicated typescript + figures.

References GP/WORK/5/A35, S4/M161/JDL, D3728/JDL. | 1 December
1945 |
| B.4 | 'Radiation from small rectangular apertures' by Lawson

1p duplicated typescript + figures.

Reference S4/M163/JDL. | 19 December
1945 |
| B.5 | 'A new front feed for paraboloids' by Lawson

1p duplicated typescript + figures.

Reference S4/M164/JDL. | 20 December
1945 |
| B.6 | 'An adjustable plate that will pass unchanged, circularise or rotate through a right angle, the polarisation of an incident plane wave' by Lawson and F.K. Goward

Bound TRE Report. 3pp duplicated typescript + figures.

Reference T.1989. | 5 January
1946 |
| B.7 | 'Surface guides treated by means of the impedance concept' by Lawson | 14 March
1946 |

Papers and publications, B.1-B.99

3pp duplicated typescript + figures.

Reference S4/M172/JDL.

- | | | |
|------------------|--|---------------------|
| B.8 | 'The possibilities and limitations of suppressed microwave aerials' by Lawson | 6 February
1947 |
| | 2pp duplicated typescript + 5pp duplicated typescript appendix and figures. | |
| | Reference R4/M56/JDL. | |
| B.9 | 'Mutual impedance in linear aerials' by Lawson | 18 June 1947 |
| | 8pp duplicated typescript + figures. | |
| | Reference R4/M10/JDL. | |
| B.10-B.54 | 'Study group papers. Informal notes' | 1946-1995 |
| | Folder of reports, memoranda and notes so inscribed by Lawson. Presented in chronological order. | |
| | Items B.10-B.12 are notes compiled by Lawson while working at the Telecommunications Research Establishment. Those at B.13-B.19 are from his period at the Atomic Energy Research Establishment. | |
| B.10 | 'Some practical hints on designing simple waveguide fed paraboloid aerials' by Lawson | 11 March
1946 |
| | 2pp duplicated typescript. | |
| | Reference S4/M171/JDL. | |
| B.11 | 'A new type of omni-directional aerial with a shaped pattern in the vertical plane' | 31 December
1946 |
| | 2pp carbon copy typescript + 1p appendix and figures. | |
| | Reference R4/M4/JDL. | |

Papers and publications, B.1-B.99

- | | | |
|------|---|---------------------|
| B.12 | 'A scheme for obtaining elliptical split with three lenses' by Lawson

2pp typescript.

Reference S4/M177/JDL | [1946] |
| B.13 | 'A survey of experiments which may be performed with 20 MeV electrons from the synchrotron' by Lawson and W.B. Lasich

7pp duplicated typescript.

AERE Memo. G/M 73. | November
1950 |
| B.14 | 'The relation between electron current and forward target radiation intensity in high energy electron accelerators'

Bound AERE Report, 7pp duplicated typescript. | 9 October
1951 |
| B.15 | 'Some experiments on a strip electron beam confined by a magnetic field' by Lawson

2pp duplicated typescript + figures.

Reference AERE G/M 124. | 28 February
1952 |
| B.16 | 'On the possibility of a reactor using fast fission of U238 by T-D neutrons'

1p photocopy typescript + figure.

Reference P17/P1. | 1955 |
| B.17 | 'Energy balance' by Lawson.

4pp typescript.

Annotated 'From AERE GP/R 2073'. The paper is a talk given by Lawson. | November
1956 |
| B.18 | 'Design parameters for 200 Mc/s klystron' by Lawson | March 1957 |

Papers and publications, B.1-B.99

2pp duplicated typescript.

Reference HAG/Kly/1.

- B.19 'On the possibility of using proton or deuteron accelerators for neutron production' by Lawson and J.M. Dickson 1962

3pp duplicated typescript.

'Paper to be presented at the E.N.E.A. Symposium 'Scientific User Requirements for High Flux Reactors, A.E.R.E Harwell July 1962'.

- B.20 'Oscillation amplitudes induced by orbit coil leads' by Lawson 18 May 1963

6pp duplicated manuscript.

Rutherford Laboratory, Harwell, Cyclotron Group Design Note. Reference CDN 500/14/49.

- B.21 'Measurements of alternating magnetic fields from trim coils in the 1/3 scale magnet' by Lawson and P.H. Beckett 12 June 1963

4pp duplicated manuscript.

Rutherford Laboratory, Harwell, Cyclotron Group Design Note. Reference 500-14-052.

- B.22 'The effect of trapped ions on the Q-values at injection' 2 February 1968

Photocopy typescript. Paginated 298-300.

Reference WC/ERA-4. These notes appear to have been compiled in a US context.

- B.23 'What is the axial extent of the ring, and the field available to accelerate the ions?' by Lawson 7 February 1968

Photocopy with manuscript corrections. Paginated 376-378.

Reference WC/ERA-12. These notes appear to have been compiled in a US context.

Papers and publications, B.1-B.99

- B.24 'Notes on relativistic kinematics' 7 February 1968
Photocopy with manuscript corrections. Paginated 224-227.
Reference WC/ERA-13. These notes appear to have been compiled in a US context.
- B.25 'Some useful parameters' 7 February 1968
Typescript. Paginated 184-185.
Reference WC/ERA-14. Annotated 'From UCRL-18103'. These notes appear to have been compiled in a US context.
- B.26 'Criterion for electrons to pull away from ions when crossing the gap' by Lawson. 8 February 1968
Photocopy with manuscript corrections. Paginated 379-382.
Reference WC/ERA-16. These notes appear to have been compiled in a US context.
- B.27 'Build up of electron oscillation amplitude in ring if the $Q^R=1$ resonance is crossed' by Lawson 9 February 1968
Photocopy with manuscript corrections. Paginated 301-303.
Reference WC/ERA-20. These notes appear to have been compiled in a US context.
- B.28 'High current and beam-beam effects in EPIC' by Lawson April 1973
6pp typescript.
Reference RL-73-021 Nimrod Division EPIC/MC/17 Storage Rings.
- B.29 'Deuterons in EPIC?' by Lawson July 1973
4pp photocopy typescript.

Papers and publications, B.1-B.99

- Reference RL-73-057 Nimrod Division EPIC/MC/24
Storage Rings.
- B.30 'Reflections on Erice' by Lawson July 1973
5pp typescript.
Reference RL-73-075 Nimrod Division EPIC/MC/27
Storage Rings.
The note summarises the Erice Summer School on High
Intensity Relativistic Particle Beams, Italy, June 1973.
- B.31 'Q-shifts and Q-spreads associated with the head on 1973
collision of bunches of unequal size' by Lawson
5pp typescript.
Reference RL-73-079 Nimrod Division EPIC/MC/29
Storage Rings.
- B.32 'Multi-mode excitation of Lossy line by a pulsed beam' by 1973
Lawson
6pp typescript.
Reference RL-73-117 Nimrod Division EPIC/MC/35
Storage Rings.
- B.33 'Particle scattering in EPIC - some preliminary comments' 1973
by Lawson
5pp typescript.
Reference RL-73-156 Nimrod Division EPIC/MC/40
Storage Rings.
- B.34 'Note on the cut-off angle for Coulomb intra-beam 1973
scattering' by Lawson
2pp typescript.
Annotated 'Hamburg 1973'.

Papers and publications, B.1-B.99

- B.35 'The significance of transition energy in intra-beam scattering - an example' by Lawson 1973
- 2pp typescript.
- Annotated 'Hamburg 1973'.
- B.36 'Heating in RFPR' by Lawson January 1976
and January
1977
- 5pp typescript + 1p addendum of 1977.
- Reference RFPRS(76)9.
- B.37 'Stabilizing windings for a reversed field pinch reactor' by Lawson 1976
- 7pp typescript.
- Reference FTSG(76)87
- B.38 'Energy dissipated in RFP plasma during start up and run down. Some preliminary thoughts' by Lawson 15 March
1977
- 9pp typescript.
- Reference RFPRS(77)27.
- B.39 'Free electron laser. Summary of present understanding' by Lawson 1978
- 4pp typescript.
- Reference FEL Note 78/6.
- B.40 'First thoughts on a 40-1000 μ FEL' by Lawson 1978
- 7pp typescript + appendix by G. Saxon, with manuscript correction and annotation.
- Reference FEL Note 78/9.

Papers and publications, B.1-B.99

- | | | |
|------|--|--------------------|
| B.41 | 'Optical constraints arising from FEL magnet' by Lawson
2pp typescript.
Reference FEL Note 78/10. | 1978 |
| B.42 | 'Note on 'Echo techniques' for removing velocity spread in the output beam of the F.E.L.'
4pp typescript.
Reference FEL Note 78/14. | 1 December
1978 |
| B.43 | 'Power build-up in the FEL'
1p typescript.
Reference FEL Note 78/15. | 1978 |
| B.44 | 'Basic theory of the F.E.L.'
7pp typescript + list of symbols.
'Informal note for internal use'. | June 1978 |
| B.45 | 'Parameters for 40 FEL μ ' by Lawson
4pp typescript 'Final corrected version'.
Reference FEL Note 79/17. | 20 April 1979 |
| B.46 | 'Electron beam experiments at Maryland University' by Lawson et al
6pp typescript + figures.
Annotated 'HIF Workshop 1979 LBL10301'. | 1979 |
| B.47 | 'The SRC and fusion research' by Lawson
7pp typescript.
'Discussion paper for Energy Round Table May 1980' | 29 April 1980 |

Papers and publications, B.1-B.99

- B.48 'Free electron laser with photon wiggler' by Lawson 12 February
1980
2pp typescript.
Reference FEL Note 80/.
- B.49 'How far is Felix from the 'collective' scattering regime?' by Lawson 3 March 1980
2pp typescript.
Reference FEL Note 80/23.
- B.50 'Proposal for experimental programme on the formation of electron beams with variable emittance' by Lawson March 1981
Draft of statement for grant application to the Science Research Council.
- B.51 'New ideas for accelerators: what should be done?' by Lawson 7 May 1985
8pp typescript.
Reference LEP/DI/JDL-1/mpt.
- B.52 'Note on the disruption parameter' by Lawson 28 January
1986
2pp typescript.
Reference CLIC Note No. (no number given).
- B.53 'Some comments on the fusitron concept' 9 January
1990
6pp typescript.
Annotated 'Proposal by Ansaldo'.
- B.54 'The status of research into inertial confinement fusion driven by heavy ions' by Lawson 4 September
1995

Papers and publications, B.1-B.99

10pp typescript with manuscript annotation and including appendix by R. Hancox.

Reference F/PL/H-WP/HION/0010. Annotated
'Assessment for Culham 1995'.

B.55-B.59 Atomic Energy Research Establishment reports 1955-1957

B.55 'A survey of some suggested methods of realising fusion reactors' 1955

AERE GP/M 185.

B.56 'Some criteria for a useful thermonuclear reactor' 1955

AERE GP/R 1807.

B.57 'On the possibility of producing relativistic self-constructed ring currents' 1957

AERE GP/M 196.

B.58 'On the adiabatic self-construction of an accelerated electron stream' 1957

AERE GP/M 197.

B.59 'The relaxation time for the contraction of a relativistic self-constricted electron beam' 1957

AERE GP/M 200.

B.60, B.61 Microwave Laboratory internal memoranda 1960, 1961

These were produced by Lawson under the auspices of the W.W. Hansen Laboratories of Physics, Stanford University, California, USA.

Papers and publications, B.1-B.99

August-September 1969.

- | | | |
|------|--|-------------------|
| B.65 | 'How can we calculate the radiation loss in the electron ring accelerator?' | 1969 |
| | RPP/A 70. This paper was submitted to the 7th International Accelerator Conference, Yerevan, USSR, August-September 1969. | |
| B.66 | 'Studies at the Rutherford Laboratory on the problems of superconducting synchrotrons' | 1969 |
| | RPP/A 71. This paper was submitted to the 7th International Accelerator Conference, Yerevan, USSR, August-September 1969. | |
| B.67 | 'Radiation from relativistic electron rings passing through cavities' | September
1969 |
| | Bound copy; 4pp typescript 'Updated version'. | |
| | The bound copy is RPP/A 72. This was Lawson's rapporteur's talk at the 7th International Accelerator Conference, Yerevan, USSR, August-September 1969. | |
| B.68 | 'A comparison of different models of the Bennett pinch' | August 1971 |
| | RHEL/MA/3. | |
| B.69 | 'Design and status of EPIC' | May 1974 |
| | RL-74-083. This report, compiled by the EPIC Machine Design Study Group, of which Lawson was a member, was presented by G.H. Rees at the International Conference on High Energy Accelerators, Stanford Linear Accelerator Center, May 1974. | |
| B.70 | 'Problem areas in heavy ion fusion' | 1978 |
| | RL-79-003. Lawson's paper forms part of 'Notes of a Symposium on Heavy Ion Fusion, held at The Cosener's House, Abingdon on 16 June 1978' ed. D.E. Gray. | |

Papers and publications, B.1-B.99

- B.71 'The technology of heavy-ion fusion' September 1980
RL-80-064. This was a paper Lawson gave at the 11th Symposium on Fusion Technology, Oxford, 15-19 September 1980.
- B.72 'A survey of some ideas for accelerators using laser light' October 1980
RL-81-030. This was a paper Lawson gave at the Chinese National Accelerator Conference, Shanghai, October 1980.
- B.73 'Ideas for accelerators for the 21st century' September 1983
RL-83-082. This was based on a paper Lawson gave at the International Europhysics Conference on High Energy Physics, Brighton, July 1983.
- B.74 'Heavy ion inertial fusion - an overview' September 1983
RL-83-083. This was a paper Lawson gave at the Colloquium 'Interaction Faisceaux de Particules Chargeés-Matière', Grenoble, France, September 1983.
- B.75 'Collider constraints in the choices for wavelength and gradient scaling' June 1986
RAL 86-069. This was a paper Lawson gave at the Stanford Linear Accelerator Conference, USA, June 1986.
- B.76 'Mechanisms for particle acceleration: possibilities and constraints' March 1987
RAL-87-016. This was a paper Lawson gave at the Particle Accelerator Conference, Washington DC, USA, March 1987.
- B.77 'Lasers, microwave tubes, and accelerators: a unified point of view' November 1988
RAL-88-085. This was a paper Lawson gave at the Conference on Trends in Quantum Electronics, Bucharest, Romania, August-September 1988. It was subsequently published.

Papers and publications, B.1-B.99

B.78, B.79	United Kingdom Atomic Energy Authority Research Group studies	1977
	Bound papers.	
B.78	'Reversed field pinch reactor study I. Physical principles' by Lawson et al	1977
	Reference CLM - R 171.	
B.79	'A 600 MW(e) reversed field pinch reactor study' by Lawson et al	1977
	Reference CLM - P 501.	
B.80, B.81	Institute for Nuclear Study, Tanashi, University of Tokyo, Japan papers	1988
	Bound papers.	
	Lawson visited Japan March-April 1988 (see D.19).	
B.80	'The physics of high current beams'	May 1988
B.81	'The physics of particle acceleration and the search for new ideas'	June 1988
B.82-B.94	Other papers	1957-1993
B.82	'Universal beam chart'	28 March 1957
	2pp duplicated typescript + figure.	
B.83	'Classical hyper-electrodynamics and the K_2^0 meson' by Lawson	11 December 1964
	7pp duplicated manuscript.	

Papers and publications, B.1-B.99

3pp typescript.

From 'Frascati Workshop on The Generation of High Fields for Particle Acceleration, September 1984'.

- | | | |
|-------------|---|------------------|
| B.91 | Papers on high current beam transport | 1984 |
| | 'High current beam transport' by Lawson, 5pp typescript + figures, May; 'The high-current electron beam transport experiment at University of Maryland' by Lawson et al, typescript, paginated 309-311. | |
| | Both are reference G.S.I. Report GSI-84-11, 1984. The first is also headed 'Invited paper presented at the 1984 Linear Accelerator Conference, Seeheim/Darmstadt, May 7-11 1984'. | |
| B.92 | 'Some thoughts on future work' | January 1988 |
| | 2pp typescript. | |
| | The note begins, 'The purpose of this note is to discuss some future options now that I am retired'. | |
| B.93 | 'Note on 'Accelerator Physics' ' by Lawson | December
1989 |
| | 3pp typescript. | |
| B.94 | Untitled 'Revised draft' by Lawson | 19 May 1993 |
| | 3pp typescript. | |
| | The paper considers the history and prospects of research into nuclear fusion. | |
| B.95 | OFFPRINTS OF PUBLISHED PAPERS | 1946-1991 |
| | Lawson's collected offprints (and some photocopies) of journal articles and published conferences proceedings. | |
| | 1 bundle. | |

Papers and publications, B.1-B.99

B.96-B.99	MINOR PUBLICATIONS ETC	1958-1994
B.96	'Reviews etc (Books, Conferences)' Contents of Lawson's folder so inscribed: copies and drafts of book reviews and obituaries by Lawson. Also includes review of <i>Fusion Research in the UK 1945-1960</i> by Lawson and J. Hendry (1994).	1958-1994
B.97	'Contributions to books & encyclopedias' Contents of Lawson's folder so inscribed.	1960s, 1981
B.98	'Popular articles (New Scientist)' Contents of Lawson's folder so labelled. Articles on 'The new cyclotrons' (1966), 'Heavy ions beam in on fusion' (1982) and 'Particle accelerators: the next big step' (1982).	1966, 1982
B.99	Flyers for and book reviews of <i>The Physics of Charged-Particle Beams</i> by Lawson (1st edition 1977, 2nd edition 1989)	1977, 1989

SECTION C **LECTURES, C.1-C.42** **1950-1997,
n.d.**

C.1-C.33 LECTURE DRAFTS AND SCRIPTS

C.34-C.39 ILLUSTRATIVE MATERIAL

C.40-C.42 NOTICES

C.1-C.33 **LECTURE DRAFTS AND SCRIPTS** **1950-1989,
n.d.**

The bulk of the material here was found within Lawson's folders labelled 'Informal lectures notes' and 'Copies of lecture note transparencies'. Many of the later lecture notes are in the form of photocopies of Lawson's overhead projector transparencies. However, the distinction between material presented here and the 'as published' lectures in section B (both B.1-B.94 and the published offprints at B.95), is not absolute. A number of the papers there were given as lectures and conference papers.

C.1 'Lectures on the interaction of high energy photons and electrons with matter' October-
November
1950

Duplicated typescript notes and figures for series of four lectures.

C.2 'Wave guides and wave mechanics. Some similarities and differences' January 1951

4pp duplicated typescript + figure.

'Based on a lecture given on 15th December, 1950 by J.D. Lawson'.

C.3 'Nuclear fusion as a possible source of power' September
1957

5pp photocopy typescript + figures.

'Paper to be read by J.D. Lawson at the meeting of the British Association in Dublin'.

Lectures, C.1-C.42

- | | | |
|------|---|----------------|
| C.4 | 'Charged particle streams' | June 1958 |
| | Duplicated manuscript notes and figures for series of six lectures. | |
| | 'Notes on a series of lectures given in May-June 1958'. | |
| C.5 | 'Optics, radiation and accelerators' | June 1962 |
| | Duplicated manuscript and typescript notes for a series of two lectures. | |
| C.6 | 'Fundamentals of Accelerators Lecture 8 The Strong Focusing Synchrotron' | November 1962 |
| | Duplicated manuscript notes. | |
| C.7 | 'Oscillations and waves Some basic ideas' | September 1963 |
| | Duplicated manuscript notes. | |
| C.8 | 'Physics for Engineers Fundamentals of Electromagnetism' | March 1964 |
| | Duplicated manuscript with duplicated typescript introduction. | |
| C.9 | 'A microwave engineer looks at fundamental particles' | March 1964 |
| | Duplicated manuscript and typescript notes. | |
| | 'Notes for a lecture by J.D. Lawson, Rutherford Laboratory'. Note at bottom of front page, 'These notes have as yet been only roughly checked'. | |
| C.10 | 'An electrical engineer looks at photons' | June 1964 |
| | 10pp duplicated typescript. | |
| | 'Thursday Lecture, N.I.R.N.S. [National Institute for Research in Nuclear Science] 25th June 1964'. | |

Lectures, C.1-C.42

- | | | |
|------|--|----------------------------|
| C.11 | 'Space charge effects at the centre of the Cyclotron'

2pp duplicated manuscript.

'Presented at Eindhoven Colloquium, April '65'. Also given reference CDN/50/097. | April 1965 |
| C.12 | 'Space charge limited current in the Cyclotron'

10pp duplicated manuscript.

'Very preliminary notes for CERN lecture - algebra and arithmetic not checked'. | October 1967 |
| C.13 | 'Diversity and unity in sources and beams'

7pp typescript.

'Paper to be presented at the Symposium on Ion Sources and Formation of Ion Beams, Brookhaven National Laboratory, October 19-21, 1971'. | August 1971 |
| C.14 | 'Laser accelerators?'

19pp photocopy manuscript + supporting material.

'Given at the Rutherford Lab. March 10 1975 (Corrections and additional references, Sept 75) (and at various times thereafter)'. Reference RL-75-043. | post-
September
1975 |
| C.15 | 'Different ways of thinking about beams'

Typescript paginated 199-217.

Lecture delivered at International Conference on Electron Beam Research and Technology, 3-5 November 1975. | November
1975 |
| C.16 | 'Particle beams and plasmas'

Bound volume of lectures.

The lectures were originally given in the Academic Training Programme of CERN 1973-1974 | 1976 |

Lectures, C.1-C.42

- | | | |
|------|--|------------------|
| C.23 | <p>'Review of laser based accelerators'</p> <p>Photocopy of manuscript transparencies with typescript front matter.</p> <p>'INFN-Laboratori Nazionali di Frascati. CAS-ECFA-INFN Workshop, Frascati 25 September - 1 October 1984'.</p> | 1984 |
| C.24 | <p>'Future accelerators for high energy physics. What are the problems?'</p> <p>Photocopy of manuscript transparencies; 3pp typescript summary.</p> <p>The summary explains the paper was 'presented at the International Europhysics Conference on High Energy Physics, Bari, July 1985'.</p> | July 1985 |
| C.25 | <p>'Accelerators for the Future. Problems and challenges'</p> <p>Photocopy of manuscript transparencies.</p> <p>'CAS Colloquium, CERN, Aug 21 1985'</p> | August 1985 |
| C.26 | <p>'The physics of particle acceleration'</p> <p>Photocopy of manuscript transparencies for series of five lectures.</p> <p>Lecture series delivered to CERN in their 1985-1986 Academic Training Programme.</p> | June 1986 |
| C.27 | <p>'Accelerators, microwave tubes and lasers'</p> <p>Photocopy of manuscript and typescript transparencies.</p> | February
1987 |
| C.28 | <p>'The need and use of plasmas as focusing devices for particle beams'</p> <p>Photocopy of manuscript transparencies with typescript front matter.</p> <p>Given at CERN Workshop on Plasma Focusing, Capri, 1-3 October 1987.</p> | October 1987 |

Lectures, C.1-C.42

C.29	'First thoughts on Naples beat-wave experiment' Photocopy of manuscript transparencies. 'Prepared for meeting at RAL [Rutherford Appleton Laboratory], April 13-14 1989'.	April 1989
C.30	'Particle-photon interactions' Photocopy of manuscript transparencies. 'CAS/DL course Synch. Rad. FELS Chester April 1989'.	April 1989
C.31	'An approach to some quantum mechanical concepts' Duplicated manuscript notes for series of two lectures.	N.d.
C.32	'Electromagnetism' Duplicated manuscript notes for series of six lectures.	N.d.
C.33	'Beams - some fundamental constraints' Photocopy of manuscript transparencies with typescript front matter.	N.d.
C.34-C.39	ILLUSTRATIVE MATERIAL	N.d.
C.34-C.36	Photographs	N.d.
C.34	'Plot of X-Y space' and similar Found in Lawson's envelope. 10 photographs.	N.d.

Lectures, C.1-C.42

C.35	Equipment in the Rutherford Appleton Laboratory Found in Lawson's envelope. 5 photographs.	N.d.
C.36	Mounted photographs Apparently used for creating overhead projector transparencies. 5 sheets.	N.d.
C.37	Transparencies	N.d.
C.38	Poster on investigating 'limitations to high current beam transport systems' Manuscript.	N.d.
C.39	Manuscript figures	N.d.
C.40-C.42	NOTICES Contents of Lawson's folder: notices and abstracts of lectures and talks to be given by Lawson. 3 folders.	1957-1997

SECTION D **VISITS AND CONFERENCES, D.1-D.21** **?1956-1989**

This section presents Lawson's material (chiefly reports) on visits made over the period 1957-1989. It is the contents of two folders labelled 'Conferences' and 'More interesting visits made', though as the material contained therein overlapped in terms of both content and date, they are presented here in a single sequence. The material does not include papers given at meetings.

Not all Lawson's travel and conference attendance is represented here, evidence of other travel is represented by drafts of lectures in sections B and C.

D.1 Visit to the USSR, 16-25 September 1957 ?1956, 1957

Notes on the visit by Lawson and W. Walkinshaw, 5pp duplicated typescript; photocopy of autographed item ?from visit to USSR 1956.

The notes on the visit are AERE reference HAG/GEN/3. The autographed item bears the signature of Lawson, along with colleagues T.G. Pickavance, M. Snowden and others (including Russians).

D.2 Los Angeles Conference on Sector Focused Cyclotrons, April 1962 1962

Report on conference by Lawson, 6pp typescript + tables.

D.3 Visit to Canada and the USA, February-March 1967 1967

Report by Lawson, 14pp duplicated typescript.

Lawson principally visited North America to attend the US National Accelerator Conference, Washington DC. Here he spoke on 'Beam measurements in the Harwell Variable Energy Cyclotron'.

D.4 International Seminar on Perspectives in High Energy Physics, Tbilisi, Georgia, USSR, 5-7 September 1969 1969

Report, 5pp typescript, with letter from Science Research Council covering 'introductory paragraph' to the report by Sir Brian Flowers.

Visits and conferences, D.1-D.21

- D.5 Fifth International Cyclotron Conference, St Catherine's College Oxford, 17-20 September 1969 1969
Photocopy of Lawson's concluding remarks.
- D.6 Visit to the USSR, 24 May-6 June 1970 1970
Itinerary, correspondence.
Lawson visited colleagues at various research centres in the USSR.
- D.7 Opening of the Swiss Institute of Nuclear Research, Villigen, Switzerland, 4 October 1974 1974
Programme, annotated by Lawson, 'I was on advisory group to choose injector cyclotron - a very controversial matter!'
- D.8 Visit to Israel, 9-23 May 1976 1976
Notes on visit, 2pp photocopy typescript.
Lawson principally visited Israel to attend the 9th International Conference on Electromagnetic Ion Separators and Related Sources.
- D.9 Christophilos International Summer School and Conference on Plasma Physics, Spetses, Greece, 20-30 July 1977 1977
Report on first part of the Summer School and Conference by Lawson, 3pp typescript.
- D.10 Visit to Hungary, 21 May-2 June 1979 1979
Itinerary, report by Lawson, 12pp typescript + appendices.
Lawson visited Hungary under the auspices of the Anglo-Hungarian Cultural Exchange Scheme. He visited colleagues at various research centres and lectured.

Visits and conferences, D.1-D.21

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|-----------|---|------|
| D.11-D.13 | Visit to China, 28 September-31 October 1980 | 1980 |
| | Lawson was invited to visit China at the initiative of Professor Ch'en Chia-erh of Beijing University. Ch'en had been one of the first Chinese research students to study in the UK in the early 1960s and had worked in Lawson's group at the Rutherford Laboratory. Lawson visited colleagues and lectured in Beijing and Shanghai. | |
| D.11 | Correspondence including invitations | |
| D.12 | Exercise book inscribed on front 'Visit to China' | |
| | Used for notes on the visit, with visiting cards, photographs and other memorabilia taped or glued to pages. | |
| D.13 | Report by Lawson, 13pp typescript. | |
| D.14 | Visit to France and Germany, 11-18 February 1983 | 1983 |
| | Report by Lawson, 6pp typescript. | |
| | Lawson visited France and Germany to discuss work towards nuclear fusion. | |
| D.15 | Workshop on Laser and Plasma Collective Accelerators, International Centre for Theoretical Physics, Trieste, Italy, 31 May-1 June 1983 | 1983 |
| | Report by Lawson, 7pp typescript. | |
| | See also C.21. | |
| D.16 | Visit to France, September 1983 | 1983 |
| | Report, 2pp typescript + photocopies of meeting material. | |
| | Lawson lectured at the University of Clermont-Ferrand and attended a meeting of the French Physical Society at Grenoble (see B.74). | |

Visits and conferences, D.1-D.21

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|------|--|------|
| D.17 | <p>Visit to USA, 3 October-2 November 1983</p> <p>Report by Lawson, 4pp typescript.</p> <p>Lawson visited colleagues at a number of research centres in the USA.</p> | 1983 |
| D.18 | <p>Meeting to review the program of United Sciences Inc, New York, USA, 26-27 January 1985</p> <p>Report of meeting.</p> <p>Lawson was a member of the Blewett/Litton Committee appointed to review the proposed 'MIGMA cell'.</p> | 1985 |
| D.19 | <p>Visit to Japan, 13 March-29 April 1988</p> <p>Report by Lawson, 4pp typescript.</p> <p>Lawson visited Japan at the invitation of colleagues at the Institute of Nuclear Study, Tanashi. For scientific papers from the visit see B.80, B.81.</p> | 1988 |
| D.20 | <p>Visit to Romania, 28 August-11 September 1988</p> <p>Report by Lawson, 9pp typescript + appendices.</p> <p>Lawson visited Romania under the auspices of the British Council at the formal invitation of Professor Ioan Ursu, National Council for Science and Technology.</p> | 1988 |
| D.21 | <p>Visit to CERN, Switzerland, 26-27 January 1989</p> <p>Report by Lawson, 2pp typescript.</p> | 1989 |

SECTION E SCIENTIFIC CORRESPONDENCE, E.1-E.33 1947-2005

This material is the contents of Lawson's two folders of correspondence. It is a very partial record, for although both incoming and (copies of) outgoing correspondence are included, many of the letters record only one half of an exchange or are individual pieces from a clearly more extended sequence of correspondence.

E.1-E.14 'CORRESPONDENCE UP TO 1980'

E.15-E.33 'CORRESPONDENCE AFTER 1980'

E.1-E.14 'CORRESPONDENCE UP TO 1980' 1947-1979

Contents of Lawson's folder so labelled. Presented in original, chronological, order.

E.1 1947, 1949

1947 correspondence with D.G. Reid *re* 'Yagi' Array (with calculations attached). 1949 correspondence chiefly *re* Lawson's possible transfer to Armament Research Establishment, to undertake unspecified research.

E.2 1950-1952

Chiefly with H.C Pollock, General Electrical Company Research Laboratory, Schenectady, New York, on radiation from electron beams from synchrotrons.

E.3 1953-1954

Includes Lawson's announcement 'You may be interested to know that we ran up the x-band C.W. klystron for the first time yesterday and this morning obtained an output of over 900 watts', with notes of congratulation.

E.4 1957-1959

Includes note and calculation on colliding electron beams

Scientific correspondence, E.1-E.33

by Lawson and supplementary note arising by J.S Bell; Lawson's note on Soviet 10 GeV synchrotron; correspondence with J.B. Adams, CERN, *re* instabilities.

- E.5 1960-1964
- Includes copy correspondence between F.A. Vick and G. Vendryès (refers to role of Lawson in design of cyclotron at AERE Harwell).
- E.6 1965-1966
- Chiefly congratulations to Lawson on successful operation of the Variable Energy Cyclotron at the Rutherford High Energy Laboratory, December 1965-January 1966, and successful extraction of the first beam, July 1966.
- For commemorative material from the inauguration of the cyclotron, see A.16-A.20.
- E.7 1967
- Includes notes (by Lawson) on visit by members of the British Oxygen Company to the Rutherford Laboratory, 4 January.
- E.8 1968
- Includes comments by Lawson on the Diplomatic Wireless Service proposal for the industrial application of electron beams; correspondence from B.W. Montague on collective ion acceleration referring to Lawson's reports RHEL/M 144 and RHEL/M 152 (see B.62, B.63).
- Lawson believed the proposal made by the Diplomatic Wireless Service was interesting but required further work and was reluctant to become further involved in the project.
- E.9 1969-1970
- E.10 1971-1973
- Includes letter from S.D. Putnam *re* ion acceleration and

Scientific correspondence, E.1-E.33

Lawson's summary of the localised pinch model, 2 August 1971; letter from P. Gratreau arising from Lawson's paper 'Self-consistent Vlasov description of relativistic electron ring equilibria', *Particle Accelerators* vol 4 1972), 14 March 1973.

E.11 1974-1975

Includes correspondence responding to Lawson's lecture on laser accelerators April and May 1975

E.12 1977

Includes exchange with B. Schnitzer *re* research problem, 4 May, and letter to A.G. Hereward setting out Lawson's research plans, 17 November.

E.13 1978

Includes correspondence with M. Reiser, chiefly on heavy ion fusion, and letter to F.T. Cole with Lawson's 'Notes on emittance', 26 July.

E.14 1979

Includes correspondence *re* article on the free electron laser in the *New Scientist*, for which Lawson had provided information and with the quality of which he was disappointed.

E.15-E.33

'CORRESPONDENCE AFTER 1980'

1980-2005

Contents of Lawson's folder so labelled. Presented in original, chronological, order.

E.15 1980

Scientific correspondence, E.1-E.33

- E.16 1981
- Includes letter to M. Reiser, on forthcoming visit to University of Maryland in October-November.
- E.17 1982
- Includes correspondence on 1950s experiments on early betatron work in the UK, and accelerator physics and workshops.
- E.18 1983
- Includes correspondence on beat wave accelerators, with D.F. Sutter; proposed study group of the European Committee for Future Accelerators; and particle accelerators with Lawson's note 'Some thoughts on collaboration in the field of particle accelerators', 2pp photocopy manuscript
- E.19 February-June 1984
- Includes exchange with D.P. Chernin *re* suppression of the negative mass instability and correspondence with R. Becker *re* comments on paper.
- E.20 August-December 1984
- Chiefly *re* submission to the Kendrew Committee. Also correspondence on distributions in long beams.
- The Kendrew Committee was established to consider UK policy for particle physics and in particular to review the future of British participation in CERN.
- E.21 1985
- Includes exchange with P. Lapostolle *re* research problem; response to invitation to join CERN Advisory Panel on New Techniques for Particle Acceleration, with comments on main tasks.

Scientific correspondence, E.1-E.33

- E.22 1986
- Includes letter to J. Nation *re* his paper 'A novel high field gradient accelerator'; letter from M. Sands *re* Lawson's 1968 Report RHEL/M144 (See B.62).
- E.23 June-August 1987
- Includes letters expressing good wishes to Lawson on his retirement.
- E.24 September-December 1987
- Includes letters expressing good wishes to Lawson on his retirement; correspondence with T. Jackson, Centre for Energy Studies, Southbank Polytechnic, *re* report to European Parliament on nuclear fusion; letter to J. Mulvey on synchrotron design.
- E.25 1988
- Includes Lawson's revised entry on 'Charged-Particle Optics' for the *Encyclopedia of Physics* (VCH Publishers); letter to A. Glover on Lawson's current work to 'classify in a clear and fundamental way the essential features of all these devices in which radiation interacts with ensembles of charges'.
- E.26 January-April 1989
- E.27 May-December 1989
- Includes letter to R.B. Palmer commenting on particle acceleration; invitation to act as consultant to Ansaldo Ricerche.
- E.28 January-August 1990
- Letter to A.M. Sessler with memories of J.S Bell; correspondence with S. Humphries commenting on Humphries's draft book on Charged Particle Beams.

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