

Astrophysics and Space Science Library

Proceedings

Light on Dark Matter

F. P. Israel
(Editor)

LIGHT ON DARK MATTER

PROCEEDINGS OF THE FIRST IRAS CONFERENCE,
HELD IN NOORDWIJK,
THE NETHERLANDS, 10-14 JUNE 1985

Edited by

F. P. ISRAEL

Sterrewacht, Leiden, The Netherlands

D. REIDEL PUBLISHING COMPANY

A MEMBER OF THE KLUWER ACADEMIC PUBLISHERS GROUP

DORDRECHT / BOSTON / LANCASTER / TOKYO

875038

Library of Congress Cataloging in Publication Data

CIP

IRAS Conference (1st : 1985 : Noordwijk, Netherlands)

Light on dark matter.

(Astrophysics and space science library: v. 124)

Includes indexes.

1. Infrared astronomy--Observations--Congresses. 2. Infrared sources
--Observations--Congresses. 3. Infrared Astronomical Satellite--Congresses.
4. Astrometry--Congresses. 5. Cosmic dust--Observations--Congresses. 6.
Galaxies--Observations--Congresses. I. Israel, F. P. II. Title. III.
Series.

QB470.A1173 1986 522'.68 86-6554

ISBN 90-277-2254-4

Published by D. Reidel Publishing Company,
P.O. Box 17, 3300 AA Dordrecht, Holland.

Sold and distributed in the U.S.A. and Canada
by Kluwer Academic Publishers,
101 Philip Drive, Assinippi Park, Norwell, MA 02061, U.S.A.

In all other countries, sold and distributed
by Kluwer Academic Publishers Group,
P.O. Box 322, 3300 AH Dordrecht, Holland.

All Rights Reserved

© 1986 by D. Reidel Publishing Company, Dordrecht, Holland

No part of the material protected by this copyright notice may be reproduced or
utilized in any form or by any means, electronic or mechanical
including photocopying, recording or by any information storage and
retrieval system, without written permission from the copyright owner

Printed in The Netherlands

EDITOR'S PREFACE

'Light on Dark Matter', held from 10-14 June 1985 in the Dutch seaside resort of Noordwijk, was the first international conference devoted to the results of the all-sky survey by the US-Dutch-UK Infra-Red Astronomical Satellite (IRAS). As such, it was a homage to the scientists, engineers and technicians who conceived, built and operated this extremely successful satellite. That this was generally felt to be the case, was proven by the large number of participants (over 200 from seventeen different nations), the lively discussions, and the great variety of topics presented during the meeting. All this notwithstanding a typical Dutch summer: gale-force winds, heavy cloud cover, and meter-high surf crashing onto a beach on which only the hardy ventured. Most participants contented themselves by watching the lonely seagulls patrolling the North Sea coastline through the panoramic windows of the conference center.

Parallel to the IRAS Conference, a Workshop on Infrared Properties of Interstellar Grains was organized by J.M. Greenberg of the Leiden Laboratory Astrophysics Group: a busy shuttling of participants between the Workshop room and the Main Conference Hall showed that many found it hard to choose.

A large number of people were involved in making the Conference a success: in the first place the scientific organizers with their valuable advice and the conference speakers, among which I would like to mention Dr. J.H. Van der Waals, who opened the Conference on behalf of the Royal Dutch Academy of Sciences (KNAW), and Dr. F.J. Low who delivered a magnificent Grand Conference Lecture on the history of astronomical infrared research open to the public.

Then there were the many participants putting up and explaining their posters, the members of the local organizing committee (especially Wanda van Grieken (Leiden) en Theo Jurriëns (Groningen) who did a magnificent job of handling respectively the voluminous administration and the complex finances) and the members of the local assistance committee, many of the latter being students who did not hesitate to sacrifice their spare time in order to run an almost continuous minibus service between Noordwijk and Leiden. Thanks are also due to the hotel Huis ten Duin personnel, who for the first time since the renewal of their resort hosted an international conference and to the staff of the Restaurant Allemansgeest who came up with a superb conference diner. The conference poster was generously supplied by Fokker Aerospace Industries, and I would like to thank in particular Drs. R. van Duinen and B. Baud for their help and advice.

Editing a conference proceedings is not easy! It always takes up more time than even a pessimist would think. I would like to thank

all authors for their contributions, especially the few who actually sent in their papers on time. At the conference, IRAS data were liberally interpreted. Unfortunately, several authors also liberally interpreted the guidelines for camera-ready copy. For this reason my special thanks go to Anke van Vuuren and Marcel Bey for efficiently dealing with a massive (re)typing job. Thanks also go to the Leiden Astronomy Department and the Groningen Laboratory for Space Research for supplying the necessary manpower and support.

Finally, the Organizing Committee gratefully acknowledges financial support by the Royal Dutch Academy of Sciences (KNAW), the Leiden Kerkhoven-Bosscha Fund (LKBF), the Netherlands Agency for Aerospace Programs (NIVR) and the Dutch Foundation for Space Research (SRON).

They can be assured that the money spent has been paid back with considerable scientific interest.

Frank P. Israël
Leiden, December 1985

WORKSHOP PREFACE

The frequent "standing room only" attendant of the Interstellar Dust Workshop was our measure of its success. We owe a debt of gratitude to the speakers who inspired very lively discussions by presenting clear and provocative lectures. Even though the topics covered were quite varied, they maintained a clear connection with many of the important aspects of the IRAS symposium. I should like particularly to express my thanks to Liesbeth van der Poel for her invaluable assistance in the organization of the meeting and to my wife Naomi who added a tone of pleasant informality at our house by arranging and giving a dinner for many of the symposium and workshop participants.

J.M. Greenberg
Leiden, December 1985

ORGANIZATION

Conference Scientific Organizing Committee

H.J. Habing, Sterrewacht Leiden (chairman)
P. Clegg, Queen Mary College London
F.G. Gillett, KPNO Tucson
J.M. Greenberg, Astrophysics Lab. Leiden
J. Gunn, IAS Princeton
F.P. Israel, Sterrewacht Leiden
T. de Jong, Sterrenkundig Instituut Anton Pannekoek Amsterdam
J. Lequeux, Observatoire de Marseille
M.S. Longair, Royal Observatory Edinburgh
F.J. Low, Steward Observatory Tucson
G. Neugebauer, Caltech Pasadena

Local Organizing Committee

F.P. Israel, Sterrewacht Leiden (chairman)
W. van Grieken-Rückert, Sterrewacht Leiden (secretary)
M.H.K. de Grijp, Sterrewacht Leiden
P. Wesselius, Space Research Laboratory Groningen (treasurer)
P. te Lintel Hekkert, Sterrewacht Leiden
Th. Jurriens, Space Research Laboratory Groningen

Local Assistance Committee

E. Engelsman
H. Greidanus
H.J. van Langevelde
H.J. Latour
B. Liem
Nicole de Nies
R. Peletier
F. Steeman
W. Steemers
W.E.C.J. van der Veen

Workshop Organizers

J.M. Greenberg, Laboratory Astrophysics Leiden
E.H.J. van der Poel, Laboratory Astrophysics Leiden (secretary)

LIST OF PARTICIPANTS

J. Abolins, Ruth. Appleton Labs., Chilton, UK
S. Aiello, Universita di Firenze, Firenze, Italy
D.K. Aitken, Melbourne University, Victoria, Australia
J.S. Albinson, University of Keele, Keele, UK
D.A. Allen, Anglo-Australian observatory, Epping, Australia
J.T. Armstrong, NRAO, Charlottesville, USA
F. Baas, Lab. Astrophysics, Leiden, The Netherlands
J-P. Baluteau, Observatoire de Meudon, Meudon, France
B. Baud, Fokker, Schiphol-Oost, The Netherlands
E.E. Becklin, University of Hawaii, Honolulu, U.S.A.
P. Bedijn, Inst. für Theoretische Astroph. der Univ. Heidelberg, F.R.G.
C.A. Beichman, IPAC, Pasadena, U.S.A.
D.A. Beintema, Department of Space Research, Groningen, The Netherlands
J.A.M. Bleeker, Department of Space Research, Utrecht, The Netherlands
L. Blitz, University of Maryland, U.S.A.
J.B.G.M. Bloemen, Sterrewacht Leiden, The Netherlands
W. Boland, ASTRON, Den Haag, The Netherlands
A. Bonetti, Universita di Firenze, Firenze, Italy
P.B. Bosma, Vrije Universiteit, Amsterdam, The Netherlands
F. Boulanger, Goddard Institute for Space Studies, New York, U.S.A.
J. Brand, Sterrewacht Leiden, The Netherlands
R. Braun, Sterrewacht Leiden, The Netherlands
R. Breukers, Sterrewacht Leiden, The Netherlands
K. Brink, Universiteit van Amsterdam, The Netherlands
L. Brown, School of Physics and Astronomy, Preston, UK
G. Burbidge, University of California San Diego, La Jolla, U.S.A.
W.B. Burton, Sterrewacht Leiden, The Netherlands
R. Buser, University of Basel, Binningen, Switzerland
H.M. Butner, Sterrewacht Leiden, The Netherlands
C. Callus, University of Keele, UK
R. Cameron, Mt. Stromlo Observatory, Australia
Casoli, Observatoire de Meudon, France
Castets, Groupe d'Astrophysique, St. Martin d'Herès, France
E. Caux, Centre d'étude Spatiale, Toulouse, France
C. Cesarsky, Serv. d'Astroph. C.E.N. Saclay, Gif sur Yvette Cedex, France
A. Chalabaev, ESO, Santiago, Chile
J. Chapman, Jodrell Bank, Cheshire, UK
R. Chini, Max-Planck Institut für Radioastronomie, Bonn, F.R.G.
G.P. Chlewicki, Lab. Astrophysics, Leiden, The Netherlands
J. Clavel, ESA Satellite Tracking Station, Madrid, Spain
R.S. Cohen, Institute for Space Studies, New York, U.S.A.
J. Coté, Space Research Lab., Utrecht, The Netherlands

P. Cox, Max Planck Inst. für Radioastronomie, Bonn, F.R.G.
J. Crawford, Queen Mary College, London, UK
L. Deharveng, Observatoire de Marseille, France
M. Dennefeld, Institut d'Astrophysique, Paris, France
F.X. Désert, Lab. de Physique de l'École Nor. Sup., Paris, France
E. Deul, Sterrewacht Leiden, The Netherlands
H.L. Dinerstein, University of Texas at Austin, U.S.A.
S. Drapatz, Max-Planck Inst. für Extraterr. Phys., Garching bei München,
F.R.G.
R. Dumont, Observatoire, Floriac, France
G.M.R. Duvert, Sterrewacht Leiden, The Netherlands
B. Elmegreen, IBM Thomas J. Watson Research Center, Yorktown Heights, U.S.A.
E. Engelsman, Sterrewacht Leiden, The Netherlands
N. Epchtein, Observatoire de Meudon, France
R. Ewald, Physikalisches Institut der Universität zu Köln, Köln, F.R.G.
J. Fairclough, Rutherford/Appleton Lab., Chilton, UK
M. Feast, South African Astron. Observatory, Cape Town, South Africa
J.V. Feitzinger, Ruhr Universität Bochum, F.R.G.
M. Fischer, Lab. Astrophysics, Leiden, The Netherlands
P. Fontanelli, Observatoire de Meudon, France
A. Francheschini, Inst. de Astronomia, Padua, Italy
K.J. Fricke, Universitäts-Sternwarte, Göttingen, F.R.G.
U. Frisk, ESTEC, Noordwijk, The Netherlands
J. Frogel, Kitt Peak National Observatory, Tucson, U.S.A.
T.N. Gautier, IPAC, Pasadena, U.S.A.
D. Gezari, NASA Goddard Space Flight Center, Greenbelt, U.S.A.
F.C. Gillett, Kitt Peak National Observatory, Tucson, U.S.A.
I.S. Glass, South African Astron. Observatory, Cape Town, South Africa
W.M. Goss, Kapteyn Laboratorium, Groningen, The Netherlands
Th. de Graauw, Space Research Laboratory, Groningen, The Netherlands
J.M. Greenberg, Lab. Astrophysics, Leiden, The Netherlands
H. Greidanus, Sterrewacht Leiden, The Netherlands
M.H.K. de Grijp, Sterrewacht Leiden, The Netherlands
R. Grim, Lab. Astrophysics, Leiden, The Netherlands
M.S. de Groot, Lab. Astrophysics, Leiden, The Netherlands
B. Gustaffson, Stockholm Observatory, Saltsjobaden, Sweden
H.J. Habing, Sterrewacht Leiden, The Netherlands
L. Haikala, University of Helsinki, Finland
A. Harris, ESA Satellite Tracking Station, Madrid, Spain
D. Hartmann, Sterrewacht Leiden, The Netherlands
T.G. Hawarden, Royal Observatory, Edinburgh, UK
C. Heiles, University of California, Berkeley, U.S.A.
G. Helou, J.P.L. Caltech, Pasadena, U.S.A.
L.B. d'Hendecourt, Université de Paris, France
J. Herman, ESTEC, Noordwijk, The Netherlands
W. Hermsen, Space Research Laboratory, Leiden, The Netherlands
R. Hofmann, M.P.I. für Phys. und Astroph., Garching bei München, F.R.G.
J.R. Houck, Cornell University, Ithaca, U.S.A.
K.A. van der Hucht, Space Research Laboratory, Utrecht, The Netherlands
H.C. van de Hulst, Sterrewacht Leiden, Leiden, The Netherlands
R.M. Humphreys, University of Minnesota, Minneapolis, U.S.A.

L. K. Hunt, Osservatorio Astrofisico de Arcetri, Firenze, Italy
F.P. Israel, Sterrewacht Leiden, The Netherlands
R.E. Jennings, University College London, London, UK
P. Jenniskens, Sterrewacht Leiden, The Netherlands
A.P. Jones
A. de Jong, Space Research Laboratory, Groningen, The Netherlands
T. de Jong, Universiteit van Amsterdam, The Netherlands
A.A.W. Jongeneelen, Sterrewacht Leiden, The Netherlands
R.D. Joseph, Imperial College, London, UK
T. Jurriens, Space Research Laboratory, Groningen, The Netherlands
T. Kamperman, Space Research Laboratory, Utrecht, The Netherlands
M.F. Kessler, ESTEC, Noordwijk, The Netherlands
U. Klaas, Max-Planck Institut für Astronomie, Heidelberg, F.R.G.
B. Kneissel, Ruhr-Universität Bochum, F.R.G.
J. Knude, University Observatory, Copenhagen, Denmark
W. Kollatschny, Universitäts-Sternwarte, Göttingen, F.R.G.
J. Koornneef, ESA/Space Tel. Science Institute, Baltimore, U.S.A.
A. Krabbe, Max-Planck Institut für Astronomie, Heidelberg, F.R.G.
W. Krätschmer, Max-Planck Institut für Kernphysik, Heidelberg, F.R.G.
J. Krelowski, Institute of Astronomy, Torun, Poland
C.K. Kumar, Howard University, Washington, U.S.A.
S. Kwok, University of Calgary, Canada
H. van der Laan, Sterrewacht Leiden, The Netherlands
J.P.J. Lafon, Observatoire de Meudon, France
P-O. Lagage, Service d'Astrophysique C.E.N. Saclay, Gif sur Yvette, France
Ph. Lamy, Lab. d'Astronomie Spatiale, Marseille, France
H.J. Langevelde, Sterrewacht Leiden, The Netherlands
H.P. Larson, Max-Planck Institut für Physik, Garching bei München, F.R.G.
R.J. Laureijs, Kapteyn Laboratorium, Groningen, The Netherlands
T.J. Lee, Royal Observatory, Edinburgh, UK
A. Leene, Kapteyn Laboratorium, Groningen, The Netherlands
A. Leger, Université de Paris, Paris, France
S.K. Leggett, Royal Observatory, Edinburgh, UK
P.J. Lena, Observatoire de Meudon, France
P. Lenzini, Osservatorio di Arcetri, Firenze, Italy
B. Liem, Sterrewacht Leiden, Leiden, The Netherlands
Th.J. van der Linden, Universiteit van Amsterdam, The Netherlands
P. te Lintel, Sterrewacht Leiden, The Netherlands
M.S. Longair, Royal Observatory, Edinburgh, UK
D. Lorenzetti, C.N.R., Frascati, Italy
F. Low, Univ. of Arizona, Tucson, U.S.A.
J. Lub, Sterrewacht Leiden, The Netherlands
L. Magnani, University of Maryland, College Park, U.S.A.
G. Magni, Istituto Astrofisica Spaziale, Roma, Italy
P.L. Marsden, University of Leeds, UK
P. Martin, University of Toronto, Canada
J.S. Mathis, University of Wisconsin, Madison, U.S.A.
K. Matilla, University of Helsinki, Finland
P.G. Mezger, Max-Planck Institut für Radioastronomie, Bonn, F.R.G.
A. Monetti, Osservatorio Astrofisico Arcetri, Firenze, Italy
J. Monin, University of Grenoble, St. Martin d'Heres, France

A. Moorwood, ESO, Garching bei München, F.R.G.
M. Mountain, Royal Observatory, Edinburgh, UK
M. de Muizon, Sterrewacht Leiden, The Netherlands
P.C. Myers, Center for Astrophysics, Cambridge, U.S.A.
Nan Sheng Shao, Lab. Astrophysics, Leiden, The Netherlands
S. Odenwald, Naval Res. Lab., Washington, U.S.A.
F.M. Olnon, Radiosterrenwacht Dwingeloo, The Netherlands
G. Olofsson, Stockholm Observatory, Saltsjobaden, Sweden
O. Omont, Astrophysique CERMO, Saint-Martin d'Herès Cedex, France
J.H. Oort, Sterrewacht Leiden, The Netherlands
R. Papoular, Serv. d'Astroph. C.E.N. Saclay, Gif sur Yvette Cedex, France
R. Peletier, Sterrewacht Leiden, The Netherlands
Peppel, Max-Planck Inst. für Extraterr. Phys., Garching bei München, F.R.G.
M. Perault, Observatoire de Meudon, France
R.S. Le Poole, Sterrewacht Leiden, The Netherlands
S. Pottasch, Kapteyn Laboratorium, Groningen, The Netherlands
A. Preite-Martinez, Instituto Astrofisica Spaziale, Frascati, Italy
J.-L. Puget, Observatoire de Meudon, France
M. Raharto, Sterrewacht Leiden, The Netherlands
E. Raimond, Radiosterrenwacht Dwingeloo, The Netherlands
W.M. Reich, Max Planck Institut für Radioastronomie, Bonn, F.R.G.
B. Reipurth, University Observatory, Copenhagen, Denmark
P. Richards, Rutherford/Appleton Lab. Chilton, UK
S.T. Ridgway, Kitt Peak National Observatory, Tucson, U.S.A.
J.K. Ridley, UK
P.F. Roche, Anglo-Australian Observatory, Epping, Australia
C. Rogers, University of Toronto, Canada
H. Röttgering, Sterrewacht Leiden, The Netherlands
M. Rowan-Robinson, Queen Mary College, London, UK
M. Salvati, Instituto di Astrofisica Spaziale, Frascati, Italy
G. Sandell, University of Helsinki, Finland
L. Sanz Fernandez de Cordoba, ESA Satellite Tracking Stations, Madrid, Spain
A. Savage, Royal Observatory, Edinburgh, U.K.
J. Schmid-Burgk, Max-Planck Institut für Radioastronomie, Bonn, F.R.G.
W. Schutte, Lab. Astrophysics, Leiden, The Netherlands
P.R. Schwartz, Naval Research Laboratory, Washington, U.S.A.
P. Schwing, Sterrewacht Leiden, The Netherlands
K. Sellgren, University of Hawaii, Honolulu, U.S.A.
G. Serra, C.E.S.R., Toulouse, France
W.W. Shane, Sterrenkundig Instituut, Nijmegen, The Netherlands
F. Sloff, Sterrewacht Leiden, The Netherlands
R. Shubert, California State University, Fullerton, U.S.A.
C. Smith, Melbourne University, Victoria, Australia
M.D. Smith, University of Leicester, England
C. Snyder, J.P.L., Pasadena, U.S.A.
H. van de Stadt, Sterrewacht "Sonneborgh", Utrecht, The Netherlands
F. Steeman, Sterrewacht Leiden, The Netherlands
W. Steemers, Sterrewacht Leiden, The Netherlands
J.R. Stephens, Los Alamos National Laboratory, Los Alamos, U.S.A.
G. Strazzulla, Osservatorio Astrofisico di Cantania, Cantania, Italy
W.M. Tobin, University of Oxford, UK

- S.W. Unger, Jodrell Bank, Cheshire, UK
V. Ungerer, Space Research Laboratory, Groningen, The Netherlands
M.S. Vardya, Tata Inst. of Fundamental Research, Bombay, India
I. Vauglin, Observatoire de Lyon, St. Genis Laval, France
W.E.C.J. van der Veen, Sterrewacht Leiden, The Netherlands
K. Vedi, Queen Mary College, London, U.K.
R.P. Verma, Tata Inst. of Fundamental Research, Bombay, India
F. Viallefond, Observatoire de Meudon, Meudon, France
J. de Vries, ESTEC, Noordwijk, The Netherlands
C.P. de Vries, Sterrewacht Leiden, The Netherlands
J.M. Waalwijk, Philips Persdienst, Eindhoven, The Netherlands
H.J. Walker, Sterrewacht Leiden, The Netherlands
R.A.M. Walterbos, Sterrewacht Leiden, The Netherlands
L.B.F.M. Waters, Space Research Laboratory, Utrecht, The Netherlands
N. van Weeren, Sterrewacht Leiden, The Netherlands
P. Weissman, JPL, Pasadena, U.S.A.
P. van der Werf, Kapteyn Laboratorium, Groningen, The Netherlands
P. Wesselius, Space Research Laboratory, Groningen, The Netherlands
P.A. Whitelock, South African Astron. Observatory, Cape Town, South Africa
D.C.B. Whittet, Preston Polytechnic, Preston, U.K.
F. Willems, Universiteit van Amsterdam, The Netherlands
S.P. Willner, Center for Astrophysics, Cambridge, U.S.A.
A. Winnberg, Onsala Space Observatory, Onsala, Sweden
H. van Woerden, Kapteyn Laboratorium, Groningen, The Netherlands
R.D. Wolstencroft, Royal Observatory, Edinburgh, U.K.
J. Wouterloot, Max-Planck Institut für Radioastronomie, Bonn, F.R.G.
G. Wynn-Williams, University of Hawaii, Honolulu, U.S.A.
H. Zinnecker, Royal Observatory, Edinburgh, U.K.
B.M. Zuckerman, University of California, Los Angeles, U.S.A.
G. van de Zwet, Lab. Astrophysics, Leiden, The Netherlands

TABLE OF CONTENTS

(IR=Invited Review; W=Workshop Paper)

Editor's Preface and Workshop Preface		xv
Organization		xvii
List of Participants		xix
 SECTION 1. THE IRAS SURVEY		
A Statistical Analysis and Overview of the IRAS Point Source Catalog (IR)	T. Chester	3
Semi-Automated Identification of IRAS Point Sources Using UKST Plates and the Cosmos Measuring Machine	A. Savage R.G. Clowes M. Kalafi S.K. Leggett H.T. MacGillivray R.D. Wolstencroft	23
Submm Continuum Observations of Sources from the IRAS Point-Source Catalogue	R. Chini E. Kreysa E. Krügel P.G. Mezger H.-P. Gemünd	29
A Statistical Analysis of the LRS Catalog (IR)	F.M. Olnon	31
The Zodiacal Background in the IRAS Data (IR)	M.G. Hauser J.R. Houck	39
Heliocentric Dependences of Zodiacal Emission, Temperature and Albedo	R. Dumont A.C. Levasseur-Regourd	45
Spectral Decomposition of IRAS Maps	R. Braun R.G. Strom H. v.d. Laan H. Greidanus	47

Observations of Infrared Cirrus (IR)	T.N. Gautier	49
Dust at the North Galactic Pole	J. Knude	55
SECTION 2. STARS AND STELLAR PHENOMENA		
IRAS Observations of Cool Excess around Main Sequence Stars (IR)	F.C. Gillett	61
The Flux Distribution of Vega for $10 \mu\text{m} < \lambda < 100 \mu\text{m}$, and the Calibration of IRAS at $12 \mu\text{m}$ and $25 \mu\text{m}$	S.K. Leggett	71
A Search for Infrared Excesses in G-Type Stars	S.F. Odenwald	75
IRAS Intrinsic Colours of Hot Stars	J. Coté L.B.F.M. Waters	77
The Infrared Excess from Stellar Winds	H.J.G.L.M. Lamers	79
The Disc Structure and Mass Loss Rates of Be Stars	L.B.F.M. Waters	83
IRAS Observations of Wolf-Rayet Stars	K.A. van der Hucht T.A. Jurriens F.M. Olnon P.S. Thé P.R. Wesselius P.M. Williams	87
Dust Formation in Wolf-Rayet Stellar Winds (W)	K.A. van der Hucht P.M. Williams P.S. Thé	90
Observations of Young (Orion-Type) Stars with IRAS	H.J. Walker P.L. Marsden	91
Mass Loss by Cool Stars (IR)	B. Zuckerman	93
Models of IRAS Observations of Circumstellar Shells	M. Rowan-Robinson A. Lock D.W. Walker S. Harris	101
Luminosities of OH/IR Stars	J.H. Burger J. Herman	103

OH/IR Catalogue and Correlation with the IRAS Data Base	R. Breukers W. van der Veen P. te Lintel M. Wiertz H. Habing	105
AGB Stars with High Mass Loss Rates in the Bulge of Our Galaxy	W.E.C.J. van der Veen	107
The Circumstellar Envelope of VX Sagittarii	J.M. Chapman R.J. Cohen	109
The Internal Radius of CS Shells around Cool, Oxygen-rich Stars (W)	R. Papoular B. Pegourie	111
IRAS Observations of Carbon Stars	F.J. Willems	113
From Miras to Planetary Nebulae: a Model of Mass Loss (IR)	P.J. Bedijn	119
Ground-based and IRAS Observations of Proto-planetary Nebulae	S. Kwok B.J. Hrivnak E.F. Milone R.T. Boreiko	127
Spectra of Some IRAS Sources	J.W. Menzies P.A. Whitelock I.M. Coulson	129
IRAS Measurements of Planetary Nebulae (IR)	S.R. Pottasch	131
IR Observations of An Extended Planetary Nebula: NGC 7293 - the Helix Nebula	A. Leene S.R. Pottasch	143
Novae Detected in the IRAS Point Source Catalog	H.L. Dinerstein E.L. Robinson	145
IRAS Observations of Classical Novae	C.M. Callus J.S. Albinson A. Evans M.F. Bode	149
Collisional Heating of Dust in the 1985 Outburst of RS Ophiuchi	J.S. Albinson C.M. Callus A. Evans	151
Infrared Observations of Tycho Using IRAS	P.L. Marsden	153

Shock-heated Dust in Young Supernova Remnants	R. Braun R.G. Strom H. v.d. Laan H. Greidanus	155
--	--	-----

SECTION 3. DUST GRAINS AND THEIR PROPERTIES

Grains, What Do We Know? (IR)	H.C. van de Hulst	161
IRAS Cirrus Observations and the Nature of Dust (IR)	J.S. Mathis	171
Dust in Diffuse Clouds: One Stage in a Cycle	J.M. Greenberg	177
Infrared Extinction in Molecular Clouds: the Form of the Curve in Orion	R. Hofmann D.S. Davis H.P. Larson	189
UV Extinction as a Key to Grain Optical Properties in the IR and UV	G. Chlewicki J.M. Greenberg	191
The Wavelength of Maximum Polarization in the Chamaeleon Dark Cloud (W)	D.C.B. Whittet J.H. Hough J.A. Bailey M.F. Rouse T.M. Kirrane	197
Three Principal Heating Sources of Dust in the Galactic Disk	P. Cox E. Krügel P.G. Mezger	201
Mid-IR Emission of the Interstellar Medium (W)	F. Boulanger M. Pérault J.L. Puget	203
Optical Luminescence from Reflection Nebulae? (W)	G. Olofsson	209
Infrared Spectra and Dust Temperature Fluctuations (W)	F.X. Désert	213
Non-equilibrium Emission from Small Particles (W)	K. Sellgren	217
Evidence for a 12 Micron Water-ice Absorption Band in the IRAS LRS Spectra of Protostars and Late Type Stars	M. de Muizon L.B. d'Hendecourt C. Perrier	221

S ₂ Formation in Interstellar Dust; a Diagnostic of the Maximum Aggregation Temperature for a Comet (W)	R.J.A. Grim J.M. Greenberg L.J. van IJzendoorn	225
Formation of Organic Molecules on Interstellar Dust Particles (W)	W. Schutte J.M. Greenberg	229
Polycyclic Aromatic Hydrocarbons and the Diffuse Interstellar Bands (W)	G.P. van der Zwet L.J. Allamandola	233
Identification of Polycyclic Aromatic Hydrocarbons (W)	A. Léger L. d'Hendecourt	237
Silicate Absorption Strength; Polarized Emission and Absorption by Aligned Grains (W)	D.K. Aitken	241
Optical Properties of Simulated Astrophysical Grains and Their Dynamics in the Near-earth Environment	J.R. Stephens T.D. Kunkle I.B. Strong	245
Ultraviolet Photoprocessing and Infrared Spectroscopy of Laboratory Simulated Grain Mantles (W)	L.B. d'Hendecourt	247
Radiation Effects on Grain Materials (W)	G. Strazulla	253
Reflection Nebulae, Non-equilibrium Thermal Emission, and IRAS	K. Sellgren L.J. Allamandola J.D. Bregman M.W. Werner D.H. Wooden	261
SECTION 4. INTERSTELLAR MEDIUM AND STAR FORMATION		
Theories of Star Formation Confronted by IRAS Data (IR)	B.G. Elmegreen	265
IMF in Starburst Regions	H. Zinnecker	277
Point Sources in the Orion Complex (IR)	C.A. Beichman	279
The IR Emission of the Orion-Monoceros Molecular Clouds	F. Boulanger R.J. Maddalena P. Thaddeus	293

Young Stars and High Density Condensations in the Horsehead Region	G. Sandell B. Reipurth C. Menten M. Walmsley H. Ungerechts	295
Mapping of the Coronae Austrinae Star Forming Region	A. Evans J.S. Albinson M.F. Bode D.C.B. Whittet	297
Analysis of Point Sources in the Ophiuchus and Perseus Clouds and CPC Observations of NGC 1333	R.E. Jennings W. Cudlip C.J. Hirst D.H.M. Cameron	299
Star Forming Loops in the IRAS Sky Images	P.R. Schwartz	301
Models for IRAS Observations of Galactic HII Regions	J. Crawford M. Rowan-Robinson	303
Far-infrared (100-200 μm) Photometry of HII Regions with a 1m Balloon Borne Telescope	R.R. Daniel S.K. Ghosh K.V.K. Iyengar T.N. Rengarajan S.N. Tandon R.P. Verma	305
Young Stars and Dense Cores in Nearby Dark Clouds (IR)	P.C. Myers	307
Water Masers Coincident with IRAS Sources	J.G.A. Wouterloot C.M. Walmsley	313
IR CCD Imaging of L1551-IRS 5: Direct Observations of Its Circumstellar Shell	A. Moneti J.L. Pipher W.J. Forrest C.E. Woodward	315
A Model for Bipolar Sources in Molecular Clouds	M.D. Smith	319
Comparison of CO and IR Emission of IRAS Unidentified Sources	F. Boulanger F. Casoli F. Combes Ch. Dupraz M. Gerin	321
IRAS Observations of Symbiotic Objects	P.A. Whitelock	323