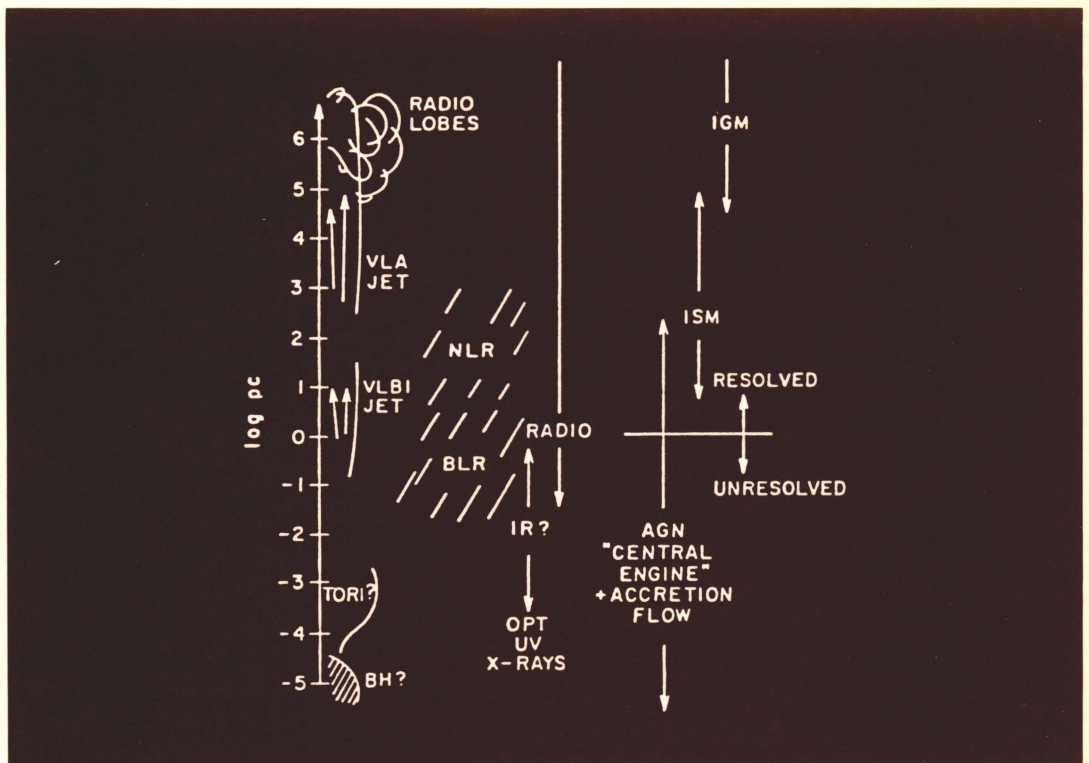


ACTIVE GALACTIC NUCLEI

Edited by DONALD E. OSTERBROCK and JOSEPH S. MILLER



INTERNATIONAL ASTRONOMICAL UNION

KLUWER ACADEMIC PUBLISHERS

ACTIVE GALACTIC NUCLEI

INTERNATIONAL ASTRONOMICAL UNION
UNION ASTRONOMIQUE INTERNATIONALE

ACTIVE GALACTIC NUCLEI

PROCEEDINGS OF THE 134TH SYMPOSIUM OF THE
INTERNATIONAL ASTRONOMICAL UNION,
HELD IN SANTA CRUZ, CALIFORNIA,
AUGUST 15-19, 1988

EDITED BY

DONALD E. OSTERBROCK

and

JOSEPH S. MILLER

*Lick Observatory, University of California,
Santa Cruz, U.S.A.*



KLUWER ACADEMIC PUBLISHERS

DORDRECHT / BOSTON / LONDON



Library of Congress Cataloging in Publication Data

International Astronomical Union. Symposium (134th : 1988 : Santa Cruz, Calif.)

Active galactic nuclei : proceedings of the 134th Symposium of the International Astronomical Union, held in Santa Cruz, California, August 15-19, 1988 / edited by Donald E. Osterbrock and Joseph S. Miller.

p. cm.

Includes index.

ISBN 0-7923-0256-7 (U.S.)

1. Galactic nuclei--Congresses. 2. Active galaxies--Congresses. 3. Radio astronomy--Congresses. I. Osterbrock, Donald E. II. Miller, Joseph S. III. Title.

QB856.I58 1988

523.1'12--dc20

89-32130

ISBN 0-7923-0256-7 (HB)

ISBN 0-7923-0257-5 (PB)

*Published on behalf of
the International Astronomical Union
by*

Kluwer Academic Publishers, P.O. Box 17, 3300 AA Dordrecht, The Netherlands.

*Kluwer Academic Publishers incorporates
the publishing programmes of
D. Reidel, Martinus Nijhoff, Dr W. Junk and MTP Press.*

*Sold and distributed in the U.S.A. and Canada
by Kluwer Academic Publishers,
101 Philip Drive, 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, The Netherlands.*

printed on acid free paper

*All Rights Reserved
© 1989 by the International Astronomical Union*

*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 photo-
copying, recording or by any information storage and retrieval system, without
written permission from the publisher.*

Printed in The Netherlands

PREFACE

IAU Symposium No. 134 on Active Galactic Nuclei was hosted by the Lick Observatory, as part of the celebration of its centennial, for the Observatory went into operation as part of the University of California on June 1, 1888. Twenty years later, in 1908, Lick Observatory graduate student Edward A. Fath recognized the unusual emission-line character of the spectrum of the nucleus of the spiral “nebula” NGC 1068, an object now well-known as one of the nearest and brightest Seyfert galaxies and active galactic nuclei. Ten years after that, and seventy years before this Symposium, Lick Observatory faculty member Heber D. Curtis published his description of the “curious straight ray” in M 87, “apparently connected with the nucleus by a thin line of matter,” which we now recognize as an example of one of the jets which are the subject of so much current AGN research.

The symposium was held at Kresge College on the campus of the University of California, Santa Cruz, only a short walk through the redwood groves to the Lick Observatory offices. A total of 232 astronomers and astrophysicists from 24 countries attended and took part in the Symposium. About 200 more had applied to come, but could not be accepted in order to keep the meeting at a reasonable size. Most of the participants lived in the Kresge College apartments immediately adjacent to the Kresge Town Hall in which the oral sessions took place. The poster sessions were in another large classroom a few steps away, and coffee, tea and soft drinks were available near both buildings at the long morning and afternoon breaks. Many of the participants had their meals together at the Porter College Dining Hall and at the Kresge College Northwoods Cafe. Scientific discussions flourished in this atmosphere.

This volume contains, in written form, most but not all of the papers that were presented orally or as posters at the Symposium. For publication they have been grouped into sections in a somewhat different order from that in which they were presented at the Symposium. There are seven published long invited review papers, each of which is at the beginning of a section. In addition, 56 contributed papers were presented orally, and 115 more as poster papers. Twelve particularly significant contributed papers, originally contributed, were redesignated invited papers and the authors were requested to expand them to six to eight printed pages. These papers appear either immediately after the long invited review papers in some sections, or as the first papers in other sections. All the rest of the contributed papers, whether presented orally or in poster form, were limited in published form, under the IAU guidelines, to two pages, or in a very few cases, three or four pages. Some of the discussion following the oral papers, as recalled

in written form after the session by the participants and edited by us, is printed immediately after each paper to which it refers. On the final afternoon, D. W. Weedman and G. A. Shields gave summaries of the Symposium, aimed especially at suggesting profitable subjects for future research on active galactic nuclei, and their two papers are published in the last section of this volume.

We are particularly grateful to Sue Robinson, of the Lick Observatory staff, who coordinated and organized the entire Symposium from the moment of arranging for the facilities on the UCSC campus until the last participant left for home. Without her skill, knowledge, experience, dedication, zeal and diplomatic skills, it would have been impossible to hold this Symposium. The fact that it was a great success, according to the expressed opinions of the participants, was due in no small measure to her untiring efforts.

We also are very grateful to Pat Shand, of the Lick Observatory Publication Office, who prepared this book for publication. She assembled all of the papers, entered all the discussions into the word processor, prepared the figures, the index, and all the front-of-the-book material, and took care of all the details of preparing a fine volume for the press.

We also wish to thank Alicia Thompson and Peggy Merrell, of the Lick Observatory and Board of Studies for Astronomy and Astrophysics staffs, for their help at the Symposium and in the offices while the sessions were going on. Together with Sue Robinson and Pat Shand, this team made all the participants feel welcome and well looked after during the Symposium. This opinion was expressed to us by many of the participants orally or in writing, after the Symposium ended.

Richard A. Shaw organized the poster sessions for the symposium, and Richard W. Pogge organized the visual and audio systems for the oral sessions. We are grateful to them, and to all the Board of Studies for Astronomy and Astrophysics graduate students who assisted at the oral and poster sessions.

Finally, we are grateful to all of the sponsoring organizations listed on another page for their support, and especially to Robert P. Kraft, Director of Lick Observatory, Frank D. Drake, Dean of Natural Sciences, and Robert Stevens, Chancellor of the University of California, Santa Cruz, for their unfailing support of the Symposium.

Donald E. Osterbrock
Joseph S. Miller

TABLE OF CONTENTS

PART 1

SURVEYS, LUMINOSITY FUNCTIONS, AND EVOLUTION

M. G. SMITH QSO Luminosity Functions and Evolution	1
C. B. FOLTZ, F. H. CHAFFEE, P. C. HEWETT, B. FRYE, R. J. WEYMANN, S. F. ANDERSON, S. L. MORRIS, G. M. MacALPINE, and D. A. TURNSHEK The APM QSO Survey: Description and Status Report	25
J. A. STEPANIAN, L. K. ERASTOVE, V. A. LIPOVETSKY, and A. I. SHAPOVALOVA The Second Byurakan Spectral Sky Survey, Quasistellar Objects and Seyfert Galaxies	31
J. MAZA and M. T. RUIZ Seyfert 1 Galaxies in Calan-Tololo Survey	35
A. P. FAIRALL The Spatial Distribution of Seyfert Galaxies	37
A. SAVAGE, D. L. JAUNCEY, G. L. WHITE, B. A. PETERSON, W. L. PETERS, S. GULKIS and J. J. CONDON A Complete Sample of Flat-Spectrum Radio Sources from the Parkes 2.7 GHz Survey	39
S. CRISTIANI, C. BARBIERI, A. IOVINO, F. LA FRANCA, and A. NOTA Quasars in the Field of SA94 — A Colour Survey	41
A. R. PETROSIAN and M. SH. KARAPETIAN Multivariate Statistical Analysis of the Sample of AGN	43
D. TREVESE, D. C. KOO, and R. G. KRON Properties of a QSO Sample Selected Through Variability	47
C. BONOLI, F. BONOLI, L. DANESE, F. DELPINO, G. DE ZOTTI, G. GRANATO, and V. ZITELLI Multicolor CCD Photometry of a Homogeneous Sample of Seyfert 1 Galaxies	49
Y. CHU and X. ZHU The Destruction of Quasars Clustering at $z > 2$	51
P. KJAERGAARD, P. MÖLLER, M. JENSEN, and I. JÖRGENSEN A Search for Companions to High Redshift ($z \geq 3.0$) Quasars	53
L. SPINOGLIO and M. A. MALKAN A $12 \mu\text{m}$ Flux Limited Sample of Galaxies: Preliminary Results on the IR Luminosity Function	55

S. G. NEFF, J. B. HUTCHINGS, AND A. C. GOWER How Do Radio Quasars (for $z < 2$) Evolve?	57
V. PETROSIAN and D. CADITZ Quasar and AGN Evolution	59
A. WANDEL The Masses of Quasars and AGN: Correlating the Accretion-Disk and the Emission-Line Methods	62
N. SCOVILLE and C. NORMAN The Evolution of Starburst Galaxies to Active Galactic Nuclei	65
 PART 2 BLR AND VARIABILITY	
H. NETZER Structure and Nature of AGNs	69
M. V. PENSTON, E. PÉREZ, and M. MOLES Rapid Line Variations in High Luminosity AGN and Anisotropic Emission of the Optical/UV Continuum	85
I. I. PRONIK The NGC 1275 Galaxy Nucleus Emission Spectrum Variability at Various Stages of Activity	88
I. C. BUSKO and J. E. STEINER On the Broad H α Component of IC 5063, IC 5135 and NGC 2992	90
C. M. GASKELL, A. P. KORATKAR, and L. S. SPARKE Investigations of Broad Line Region Structure and Kinematics Using Variability	93
R. A. EDELSON and J. H. KROLIK The Discrete Correlation Function: A New Method for Analyzing Unevenly Sampled Variability Data	96
B. M. PETERSON Emission-Line Variability and the Nature of the Broad-Line Region	97
D. MAOZ Emission-Line Variability in AGN	100
R. W. GOODRICH Spectropolarimetry and Variability of Seyfert 1.8 and 1.9 Galaxies	103
J. H. BEALL, W. A. SNYDER, and K. S. WOOD Short Time Scale Variability of Active Galactic Nuclei: Einstein IPC Observations of PKS 2155-304 – A Report of Rapid Variations of Instrumental Origin	106

F. Z. CHENG, J. F. LU, G. Z. XIE, K. H. LI, Z. L. LI, and L. F. WANG Optical Short-Term Variability in the X-Ray-Selected BL Lac Object IE 0317+186 and the Radio-Selected BL Lac Objects ON231	108
E. I. ROBSON, T. J.-L. COURVOISIER, and P. BOUCHET Rapid Infrared and Optical Variability in 3C 273	110
T. J.-L. COURVOISIER, E.I. ROBSON, A. BLECHA, and P. BOUCHET 4 Years of Radio to X-ray Observations of 3C 273	112
E. I. ROSENBLATT and M. A. MALKAN Broad Line Variations in NGC 5548	114
H. R. MILLER and M. T. CARINI The Character of the Optical Variability for the BL Lacertae Objects OJ 287	116
M. A. STRAUSS, K. W. WACHTER, and A. V. FILIPPENKO Soft X-ray Variability and the Covering Fraction of Active Galactic Nuclei	118
M.-H. ULRICH The Complex Structure of the C IV Emission Line in the Seyfert 1 Galaxy NGC 4151 at Minimum States	120
V. JUNKKARINEN QSO Emission Line Redshift Differences	122
R. GREEN, P. OSMER, and A. PORTER Quasar Emission-Line Strengths	124
R. D. COHEN, R. J. RUDY, G. S. ROSSANO, R. C. PUETTER, and S. D. CHAPMAN Helium I λ 10830 Observations of Seyfert 2 Galaxies	126
M. JOLY Ca II - Fe II Correlation in Active Galactic Nuclei	128
T. R. KALLMAN, J. H. KROLIK, and B. J. WILKES Quasar Emission Line Profile Modelling	131
K. L. THOMPSON Observations of Quasar Broad-Line Profiles in the Optical and Infrared	133
S. L. MORRIS and M. J. WARD Optically Thin Gas in the BLR of Seyfert Galaxies	135
R. C. PUETTER Star Clusters in Quasars: Bloated Stars as Broad Emission Line Clouds	137

P. M. GONDHALEKAR Is There a Scaling Law for the Size of the BELR in AGNs?	139
--	-----

PART 3

X-RAYS AND THE CENTRAL SOURCE

M. C. BEGELMAN Physics of the Central Engine	141
K. A. POUNDS and T. J. TURNER The EXOSAT Spectral Survey of Emission Line AGN	155
C. R. CANIZARES and J. L. WHITE The X-ray Spectra of High Redshift Quasars	161
K. KOYAMA Iron Line Emission from NGC 1068	167
C. M. URRY, J. S. KRUPER, and C. R. CANIZARES Soft X-ray Spectra of Seyfert Galaxies	173
D. A. SCHWARTZ, Y. QIAN, and W. H. TUCKER The Shape of Soft X-ray Spectra of Quasars	175
G. BRANDUARDI-RAYMONT EXOSAT Observations of Flux and Spectral Variability in the Seyfert Galaxy NGC 5548	177
J. P. D. MITTAZ and G. BRANDUARDI-RAYMONT The Flux and Spectral Variability of NGC 6814 as Observed with EXOSAT	179
R. S. WARWICK, T. YAQOOB, and K. A. POUNDS Variable X-ray Absorption in NGC 4151	182
M. ELVIS, J. McDOWELL, and B. J. WILKES The Infrared and X-ray Continua of Quasars: Is there a Connection?	184
B. J. WILKES, M. ELVIS, and J. McDOWELL Is There a Relation Between Optical Emission Line Strengths and Continuum Shapes?	187
S. TSURUTA Composite Spectra of Some Active Galactic Nuclei	189
P. BARR, P. GIOMMI, A. POLLOCK, G. TAGLIAFERRI, D. MACCAGNI, and B. GARILLI An X-ray Spectral Survey of BL Lac Objects	191
C. DONE and A. C. FABIAN Pair Production in AGN	194

D. M. WORRALL and B. J. WILKES A Comparison of the X-ray Spectra of Quasars and BL Lac Objects	197
R. J. V. BRISSSENDEN, I. R. TUOHY, G. V. BICKNELL, R. A. REMILLARD, and D. A. SCHWARTZ A Multi-Wavelength Study of X-ray Selected AGN	199
W. A. STEIN Spectral Index Versus Frequency and Models for the Continua of AGN and QSOs	201
I. M. GIOAI, T. MACCACARO, S. L. MORRIS, R. SCHILD, J. T. STOCKE, and A. WOLTER X-ray Selected AGN from the Extended Medium Sensitivity Survey	203
E. BOLDT X-ray Background Constraints on the Log N-Log S Relation for AGN	205
A. A. ZDZIARSKI Cosmic X-ray Background from Early Active Galactic Nuclei	207
A. KEMHAVI, S. WAGH, and D. NARASHIMA Relativistic Beaming of X-rays from Quasars	209
J. G. KIRK Power-Law Spectra from Fermi Acceleration at Relativistic Shocks	211
P. L. BIERMANN Photon and Neutrino-Emission From Shockwaves in Active Galactic Nuclei	213
M. SIKORA, B. RUDAK, and M. BEGELMAN Relativistic Neutrons in Active Galactic Nuclei	215

PART 4
BLACK HOLES, ACCRETION DISKS AND
GRAVITATIONAL LENSES

A. DRESSLER Observational Evidence for Supermassive Black Holes	217
R. D. BLANDFORD Quasar Evolution and the Growth of Black Holes in the Nuclei of Active Galaxies	233
N. ROOS Bright Quasars as Rapid Precessors	241
J. P. HALPERN and K. CHEN New Evidence for Accretion Disks in AGNs	245

A. LAOR The Spectrum of Massive Thin Accretion Disks: Theory and Observations	251
D. L. BAND and M. A. MALKAN Combined Accretion Disk and Nonthermal Source Model for AGN	253
S. COLLIN-SOUFFRIN and A. M. DUMONT Line Emission from Accretion Disks in Active Galactic Nuclei	255
H. A. SCOTT and S. L. O'DELL Spectra of AGN Accretion Disks – Preliminary Results	257
D. ALLOIN, T. BARIBAUD, C. BOISSON, and D. PELAT Revisiting the Geometry of the BLR in AKN 120: Preliminary Results from UV Data and Line Profile Analysis	259
W-H SUN and M. A. MALKAN Is the Lyman Absorption Edge a Good Observational Test for AGN Accretion Disks?	262
G. SWARUP, R. SUBRAHAMANYAN, D. NARASHIMA, and A. P. RAO Is the Flat Spectrum Double 1830-211 a Result of Gravitational Lensing?	265
S. REFSDAL and R. KAYSER Some Remarks on Gravitational Micro-Lensing	267
S. DJORGOVSKI and G. MEYLAN An Optical Imaging Search for Gravitational Lenses	269
G. MEYLAN and S. DJORGOVSKI Discovery of a Probable Gravitational Lens	271

PART 5

STRUCTURE OF THE CENTRAL OBJECT AND NLR

J. S. MILLER Observational Studies of the Structure of Active Galactic Nuclei and QSOs	273
J. KROLIK Theory of the Intermediate Zone	285
S. E. PERSSON and G. J. FERLAND Calcium Infrared Triplet Emission in AGN	293
V. I. PRONIK Narrow Line Region in NGC 4151 Nucleus	296
D. E. OSTERBROCK, R. A. SHAW, and S. VEILLEUX Near-Infrared Emission-Line Spectra of the Orion Nebula, NGC 4151, and Other Seyfert Galaxies	298

M. NISHIDA and K. KAWARA Near-Infrared Spectroscopy of Seyfert and Starburst Galaxies	301
W. G. MATHEWS and S. VEILLEUX Stability of Emission-Line Clouds in Seyfert Galaxies	303
S. RAWLINGS and R. SAUNDERS Using Narrow Emission Lines to Test Physical Models Unifying AGNs	305
M. WARD Anisotropic Continuum Emission in Seyferts	308
D. KAZANAS Red Giant Winds as Emission Line Clouds (Broad or Narrow) in Active Galactic Nuclei	310
S. VEILLEUX Substructures in the Narrow-Line Region of AGN	312
J. PALOUS Cloud Disruption and Formation	314
S. M. VIEGAS-ALDROVANDI and M. CONTINI Composite Models: A Tool for Interpreting the Emission-Line Spectra of Active Galactic Nuclei	316
M. CONTINI and S. M. VIEGAS-ALDROVANDI Theoretical Narrow Emission-Line Profiles of Active Galactic Nuclei	318
K. T. KORISTA and G. J. FERLAND The Origin of the Coronal Lines in Seyfert Galaxies	320
U. C. JOSHI, R. JAIN, and M. R. DESHPANDE Photopolarimetry of Seyfert Galaxies – NGC 2992, NGC 3081, NGC 3227, and IC 4329 A	321
D. WILLS, B. J. WILLS, R. J. ANTONUCCI, R. BARVAINIS, M. BREGER, J. A. BAILEY, J. M. HOUGH, and K. BALLARD High Optical Polarization in Flat-Spectrum Radio Sources	323
B. J. WILLS, D. WILLS, N. J. EVANS, A. NATTA, K. L. THOMPSON, M. BREGER, M. L. SITKO, D. T. LESTER, D. R. GARNETT, and S. R. SAWYER Polarization of IRAS Quasars and the Inner Structure of Active Galactic Nuclei	325
W. ZHENG How High a Density is for Photoionization in AGN?	327

- I. M. YANCOULOVA and Z. I. TSVETANOV
 Reddening in the Narrow-Line Region of Active Galactic Nuclei 329

PART 6

VELOCITY FIELDS, KINEMATICS, NL PROFILES

- S. W. UNGER, K. TAYLOR, A. PEDLAR, H. GHATAURE, M. V. PENSTON,
 and D. J. AXON
 TAURUS Observations of Active Galaxies: NGC 1275 and NGC 4151 331
- R. B. TULLY, J. BLAND, and G. CECIL
 First Results with HIFI - Studies of Extended Anomalous Emission
 Regions with an Imaging Fabry-Perot 337
- J. BLAND and G. N. CECIL
 The Large-Scale Activity in NGC 1068 343
- G. CECIL and J. BLAND
 Imaging Spectrophotometry of the Narrow-Line Region of NGC 1068 345
- R. A. SHAW and M. M. DE ROBERTIS
 Emission-Line Asymmetries and the Kinematics of the Narrow-Line
 Region in AGNs 347
- M. WHITTLE
 Gravitational Acceleration and Forbidden Line Widths in Seyfert Galaxies 349
- H. SCHULZ and B. BOER
 A Separation of Systematic and Turbulent Motions in the Narrow-Line
 Region of NGC 4151 352
- B. R. ESPEY, R. F. CARSWELL, J. A. BAILEY, M. G. SMITH,
 and M. J. WARD
 H α Emission Lines in High Redshift Quasars 355
- N. KANEKO and T. SATOH
 The Velocity Field of NGC 1068 357

PART 7

DUST, MOLECULES, INFRARED AND MM RADIATION

- T. M. HECKMAN
 CO in Seyfert Galaxies 359
- A. F. M. MOORWOOD and E. OLIVA
 Infrared [Fe II] and H $_2$ Line Emission in Active Galactic Nuclei 365
- E. KRÜGEL
 Millimeter Observations of Markarian Galaxies 373

D. H. HUGHES and E. I. ROBSON Optical and Near Infrared Imaging of NGC 1275	376
R. P. NORRIS Are ELF's Little Monsters?	379
I. S. GLASS Delayed Infrared Emission from Luminous Seyfert 1 Galaxies	382
T. J. BALONEK, P. A. HECKERT, R. ELSTON, P. S. SMITH, and M. L. SITKO Optical-Infrared Continuum Spectra and Polarization of Quasars: An Outburst in 3C 279 During 1987-88	385
J. CLAVEL, W. WAMSTEKER, and I. GLASS Hot Dust on the Outskirts of the BLR in Fairall 9	387
G. NEUGEBAUER, D. B. SANDERS, B. T. SOIFER, S. PHINNEY, and R. F. GREEN Spectral Energy Distributions of PG Quasars	390
A. LAWRENCE New Millimetre Measurements and the Radio to X-ray Continua of Active Galactic Nuclei	393
J. KEENE, G. NEUGEBAUER, D. CARICO, D. SANDERS, and B. T. SOIFER Millimeter Observations of Optically Selected Quasars	396
M. A. MALKAN, W. K. P. GEAR, R. A. EDELSON, and E. I. ROBSON Submillimeter Observations of NGC 4151: Evidence for Thermal Dust Emission	398
G. M. MacALPINE and J. J. SALZER Optical and Far-Infrared Properties of UM Survey Emission-Line Galaxies	400
W. A. BAAN Megamasers in Young Active Galactic Nuclei	402
C. D. IMPEY, C. G. WYNN-WILLIAMS, and E. E. BECKLIN Infrared Emission from Radio Galaxies	404
J. P. VADER, J. A. FROGEL, F. C. GILLET, and M. H. K. DE GRIJP Dust-Embedded AGN in Unusually Warm IRAS Galaxies	406
C. A. HEISLER and J. P. VADER Morphological Properties of Unusually Warm IRAS Galaxies	408
R. ANTONUCCI, R. BARVAINIS, D. ALLOIN, and P. COLEMAN Testing the Emission Mechanism of the Quasar Infrared Component	410
V. ZITELLI, R. WADE, L. DANESE, G. DE ZOTTI, G. GRANATO, and N. MANDOLESI Infrared Imaging and Photometry of a Sample of Seyfert Galaxies	412

L. ARMUS, T. M. HECKMAN, and G. K. MILEY Longslit Optical Spectroscopy of Powerful Far-Infrared Galaxies	414
C. J. LONSDALE Faint IRAS Number Counts and Galaxy Evolution	416
A. C. VAN DEN BROEK IRAS Galaxies: Near-Infrared Colours and Starformation	418
P. J. GREEN, M. WARD, S. F. ANDERSON, B. MARGON, M. H. K. DEGRIJP, and G. K. MILEY Infrared-Selected "Warm" Galaxies Observed in X-rays	420
D. DULTZIN-HACYAN, M. MOLES, and J. MASEGOSA The Origin of the 25 μm Emission in Seyfert 2 Galaxies	422

PART 8

RELATIONSHIPS OF NUCLEUS, GALAXY AND ENVIRONMENT

K. J. FRICKE and W. KOLLATSCHNY Relationships of the Active Nucleus, Galaxy, and Environment	425
A. R. PETROSIAN, K. A. SAHAKIAN, and E. YE. KHACHIKIAN The New Double Nuclei Markarian Galaxies	445
W. KOLLATSCHNY and K. J. FRICKE Activity of Interacting Galaxies Mkn 673: A Close-By "E+A" Galaxy	449
J. B. HUTCHINGS, S. G. NEFF, and J. H. VAN GORKOM The Twin-Nucleus Merging Galaxy MKN 266	452
R. W. POGGE Circumnuclear Emission in Nearby, Non-Interacting Seyfert Galaxies	454
H. K. C. YEE and M. M. DE ROBERTIS Optical Nuclear Activity in Radio Galaxies in Clusters	457
W. ROMANISHIN Color Maps of A 1795 and A 2597—Cooling Flow Cluster Central Galaxies with Active Nuclei	460
I. SHLOSMAN, J. FRANK, and M. C. BEGELMAN Bar Instabilities and Nuclear Activity in Disk Galaxies	462
N. A. DEVEREUX Nuclear Starbursts in Barred Spirals	465
P. J. WIITA and A. ROSEN Interactions of Jets with Interstellar and Intergalactic Media	467

GOPAL-KRISHNA and P. J. WIITA Interaction of the Beams of Active Galactic Nuclei with Their Environment at High Redshifts	469
A. SOUBEYRAN, G. WLÉRIK, G. LELIÉVRE, B. SERVAN, L. RENARD, D. HORVILLE, A. BIJAOU, and P. BOUCHET 3C 120. Properties of 4 Condensations Neighbouring the Nucleus and Emitting in the Continuum	472
H. A. DOTTORI NGC 613: Nuclear Region Narrow Band Imagery	474
F. DURRET The Extended Ionized Nebulosities Surrounding the Active Galaxies NGC 6215, A 0945-30 and MCG-2-58-22	476
P. RAFANELLI Physical Properties of the Extranuclear Emitting Regions in Irregular and Interacting AGNs	478
J. C. SHIELDS and A. V. FILIPPENKO Long-Slit Spectroscopy of IC 5135 and NGC 4388	480
T. E. CARONE Long Slit CCD Observations of Active and Normal Galaxies	482
S. M. SIMKIN and E. M. SADLER Gas Disks in Radio Galaxies	484
M. G. PASTORIZA, E. MEDIAVILLA, and E. BATTANER Morphology and Luminosity Distribution of Seyfert Galaxies	486
P. PISMIS and E. MORENO Formation of Bi-Polar Spiral Features in Galactic Nuclei	488
J. M. MAZZARELLA and G. D. BOTHUN Far-Infrared Properties of Markarian Galaxies with Multiple Nuclei	490
G. DE ZOTTI, M. PERSIC, A. FRANCESCHINI, L. DANESE, G. G. C. PALUMBO, E. A. BOLDT, and F. E. MARSHALL X-ray Constraints on AGN Clustering	492
 PART 9 INTRINSICALLY WEAK AGNs	
A. V. FILIPPENKO Low-Luminosity Active Galactic Nuclei	495
W. C. KEEL High-Resolution Observations of the M81 Nucleus	513

T. STORCHI-BERGMANN and M. G. PASTORIZA Low Activity Nuclei with Strong [N II] Lines	515
G. FABBIANO Low-Activity Nuclei in Spiral Galaxies	517
D. C. KOO, R. G. KRON, and R. A. WINDHORST Optical Spectra of Low Flux Radio Sources	518
R. D. DAVIES, A. PEDLAR, D. J. AXON, B. VILA, E. HUMMEL, R. D. WOLSTENCROFT, and J. M. VAN DER HULST Activity in the Nuclei of Normal Sbc Galaxies – A Multiwavelength Study	520
J. M. WROBEL Low-Power Radio Sources in the Nuclei of Nearby E/S0 Galaxies: Evidence for Active Nuclei and for Current Star Formation	522
 PART 10 RADIO GALAXIES, COMPONENTS AND STRUCTURE	
T. J. PEARSON and A. C. S. READHEAD The Milliarcsecond Structure of Active Galactic Nuclei Observed with VLBI	525
A. E. WEHRLE Superluminal Motion in CTA 102	529
V. K. KAPAHI, C. R. SUBRAHMANYA, and S. D'SILVA VLA Observations of an Optically Deep Sample of Molonglo Quasars: Aspect Dependence of the Optical Continuum	531
D. TAYLOR, J. E. DYSON, A. PEDLAR, D. J. AXON, and S. W. UNGER Compact Radio Components in Seyfert Nuclei	533
V. S. ARTYUKH Physical Conditions in Active Galactic Nuclei	535
C. AKUJOR Radio Observations of Moderately Compact Steep Spectrum Sources	537
W. B. McADAM Monitoring of Southern QSOs at 843 MHz	539
A. STOCKTON and S. J. LILLY Multicolor Images of a Complete $z \sim 1$ Sample of 3CR Galaxies	541
P. J. MCCARTHY, H. SPINRAD, and W. VAN BREUGEL Optical Properties of High Redshift Radio Galaxies	543

W. VAN BREUGEL and P. J. MCCARTHY Radio-Optical Correlations in Distant Radio Galaxies	546
---	-----

PART 11

MISCELLANEOUS

J. BECHTOLD and S. A. SHECTMAN Statistical Properties of the Lyman α Forest	549
A. L. KINNEY, R. R. J. ANTONUCCI, and H. C. FORD Lyman Edges in Quasar Spectra	555
H. E. SMITH, R. D. COHEN, J. E. BURNS, D. J. MOORE, and B. UCHIDA Lyman α Emission from Disk Absorption Systems in QSOs: Star Formation in Young Galaxy Disks	557
A. I. DIAZ, E. TERLEVICH, and R. TERLEVICH Calcium Features in the "Featureless" Continuum of Seyfert Nuclei: Evidence for a Young Stellar Population?	560
G. BURBIDGE and A. HEWITT The Ejection of QSOs from Galaxies	562
M. KALINKOV, I. KUNEVA, Z. TSVETANOV, and L. FILIPOV Photometric Properties of AGNs from the Absolute Spectrophotometry of De Bruyn and Sargent	565
J. E. FELTEN and R. ISAACMAN Run of the Scale Factor $R(t)$ in Some Universes with Zero and Nonzero Pressure	567

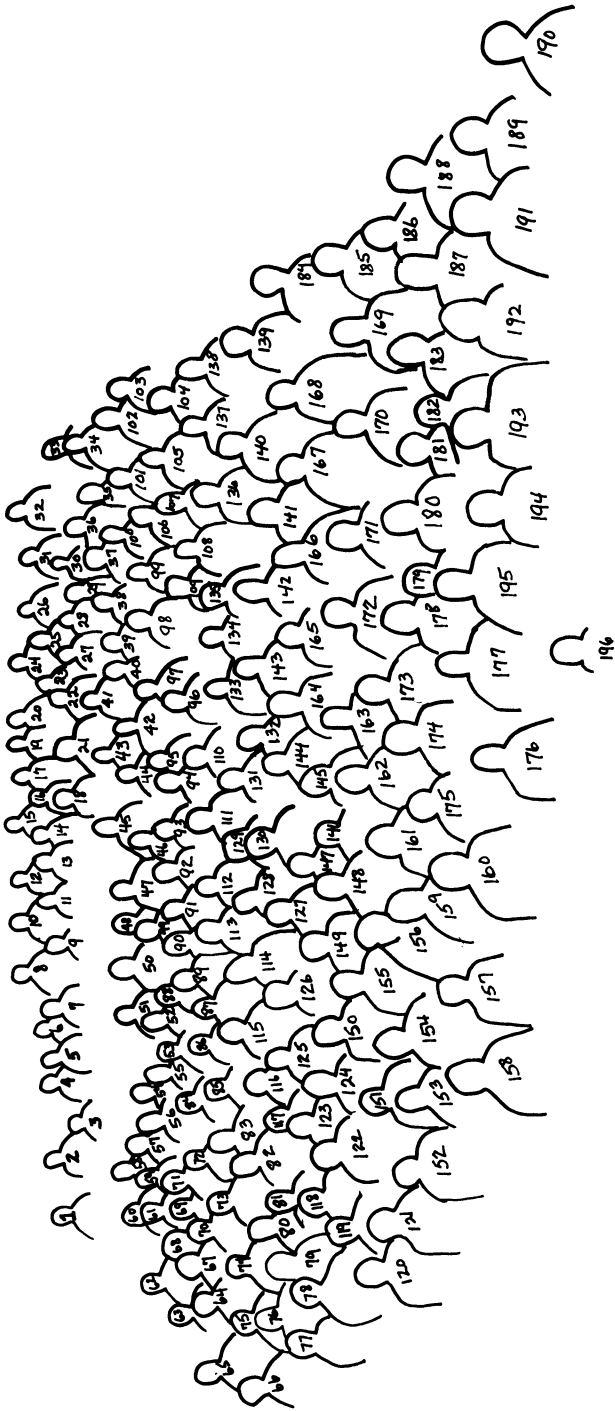
PART 12

FUTURE

D. W. WEEDMAN The Future of Observational Research on Active Galactic Nuclei	569
G. A. SHIELDS Future AGN Research II	577

INDEX	589
-------	-----





Identification Chart

- | | | |
|---------------------------|-----------------------------|--------------------------|
| 1. G. Cecil | 48. A. Savage | 95. K. Thompson |
| 2. A. Pedlar | 49. V. Junkkarinen | 96. T. Menon |
| 3. S. Neff | 50. W. Keel | 97. G. Wynn-Williams |
| 4. S. Unger | 51. W. Romanishin | 98. S. Cristiani |
| 5. J. Hutchings | 52. M. De Robertis | 99. C. -I. Bjornsson |
| 6. D. Band | 53. W. Stein | 100. J. Halpern |
| 7. K. Pounds | 54. A. Kinney | 101. L. Armus |
| 8. T. Kallman | 55. A. Laor | 102. J. Bland |
| 9. S. Tsuruta | 56. D. Maoz | 103. M. Penston |
| 10. I. Glass | 57. P. Kjaergaard Rasmussen | 104. B. van den Broek |
| 11. C. Lonsdale | 58. D. Weedman | 105. J. Weisheit |
| 12. V. Pronik | 59. J. Clavel | 106. S. Refsdal |
| 13. K. Fricke | 60. P. Vader | 107. W. Kollatschny |
| 14. N. Nishida | 61. J. Maza | 108. D. Wills |
| 15. T. Pearson | 62. G. Smith | 109. E. Krügel |
| 16. V. Zitelli | 63. T. Fairall | 110. J. Palous |
| 17. M. Contini | 64. D. Hughes | 111. T. Balonek |
| 18. J. Mittaz | 65. R. Pogge | 112. T. Storchi-Bergmann |
| 19. G. Branduardi-Raymont | 66. N. Kaneko | 113. A. Diaz |
| 20. G. Shields | 67. A. Filippenko | 114. J. Bechtold |
| 21. P. Rafanelli | 68. C. Bonoli | 115. W.-H. Sun |
| 22. G. Polumbo | 69. P. McCarthy | 116. S. Collin |
| 23. B. Peterson | 70. G. Meylan | 117. B. Wilkes |
| 24. K. Korista | 71. T. Heckman | 118. A. Kembhavi |
| 25. S. Morris | 72. P. Green | 119. U. Joshi |
| 26. M. Sikora | 73. M. Malkan | 120. C.-C. Wu |
| 27. G. De Zotti | 74. I. Robson | 121. S. Veilleux |
| 28. D. Dultzin-Hacyan | 75. A. Messina | 122. B. Mathews |
| 29. G. Setti | 76. J. Beall | 123. M. Joly |
| 30. F. Durret | 77. V. Kapahi | 124. D. Koo |
| 31. B. Tarter | 78. J. Steiner | 125. H. Netzer |
| 32. G. Blumenthal | 79. P. Barr | 126. D. Kazanas |
| 33. D. Alloin | 80. R. Green | 127. K. Koyama |
| 34. R. Shaw | 81. M. Strauss | 128. H. Yee |
| 35. C. Heisler | 82. J. Shields | 129. B. Wills |
| 36. A. Wehrle | 83. T. Courvoisier | 130. M. Whittle |
| 37. Y. Chu | 84. S. Odell | 131. I. Shlosman |
| 38. H. Arp | 85. B. Jones | 132. R. Antonucci |
| 39. J. Mazzarella | 86. D. Worrall | 133. P. Wiita |
| 40. S. Rawlings | 87. J. Doane | 134. W. Zheng |
| 41. V. Artyukh | 88. J. Keene | 135. R. Brissenden |
| 42. N. Devereux | 89. S.V.-Aldrovandi | 136. R. Puetter |
| 43. N. Roos | 90. M. Pastoriza | 137. T. Carone |
| 44. J. Felten | 91. H. Dottori | 138. H. Marshall |
| 45. E. van Groningen | 92. B. McAdam | 139. C. Canizares |
| 46. G. Wlérick | 93. G. Swarup | 140. R. Blandford |
| 47. A. Stockton | 94. R. Davies | 141. D. Hartmann |

142. R. Goodrich
143. G. Stringfellow
144. H. Schulz
145. I. Novikov
146. J. Stepanian
147. G. Krishna
148. E. Rosenblatt
149. J. Gonzalez
150. G. Illingworth
151. L. Kay
152. C. Done
153. N. Ellman
154. C. M. Gaskell
155. C. Fu-Zhen
156. G. Burbidge
157. P. Pismis
158. D. Trevese
159. R. Norris
160. P. Veron
161. J. Fischer
162. A. Wandel
163. A. Moorwood
164. B. Espey
165. W. Baan
166. P. Biermann
167. P. Gondhalekar
168. R. Edelson
169. A. Lawrence
170. B. Warwick
171. G. Djorgovski
172. L. Spinoglio
173. M. Smith
174. G. MacAlpine
175. M. Burbidge
176. S. Simkin
177. M.-H. Ulrich
178. J. Wrobel
179. J. Krolik
180. M. Schmidt
181. N. Veron
182. M. Elvis
183. H. Miller
184. J. Kirk
185. D. Schwartz
186. G. Fabbiano
187. M. Ward
188. L. Ling
189. A. Zdziarski
190. R. Cohen
191. R. Svensson
192. M. Urry
193. M. Peimbert
194. J. Miller
195. D. Osterbrock
196. D. Arp

SCIENTIFIC ORGANIZING COMMITTEE

E. Ye. Khachikian
M. Peimbert
M. Rees
M. Schmidt
M.-H. Ulrich
P. Veron
D. W. Weedman
D. E. Osterbrock (Chairman)

LOCAL ORGANIZING COMMITTEE

E. M. Burbidge
F. D. Drake
R. P. Kraft
W. G. Mathews
D. E. Osterbrock
V. Petrosian
W. L. W. Sargent
H. Spinrad
J. S. Miller (Chairman)

SPONSORING INSTITUTIONS

California Space Institute, University of California
Division of National Sciences, University of California, Santa Cruz,
California
International Astronomical Union
IAU Commission No. 28 (Galaxies)
Lick Observatory
National Science Foundation
University of California, Santa Cruz

LIST OF PARTICIPANTS

Mr Steve Allen	University of California, Santa Cruz
Dr Danielle Alloin	Observatoire de Paris-Meudon, FRANCE
Dr Robert Antonucci	Space Telescope Science Institute
Mr Lee Armus	University of Maryland
Dr Halton Arp	MPI fuer Astrophysik, WEST GERMANY
Dr V.S. Artyukh	Lebedev Physical Institute, USSR
Dr Willem A. Baan	Arecibo Observatory
Dr Thomas J. Balonek	Colgate University
Dr Paul Barr	ESA/EXOSAT Observatory, THE NETHERLANDS
Dr David L. Band	Lawrence Livermore National Lab
Dr Jim Beall	St.John's College/Naval Research Lab
Dr Jill Bechtold	Mount Wilson & Las Campanas Observatories
Dr Mitchell C. Begelman	JILA, University of Colorado
Dr Thaisa Storchi Bergmann	Universidade Federal do Rio Grande do Sul, BRAZIL
Dr Peter L. Biermann	MPI fuer Radioastronomie, WEST GERMANY
Dr Claes-Ingvar Bjornsson	Stockholms Observatorium, SWEDEN
Dr Jonathan Bland	Institute for Astronomy, Hawaii
Dr Roger Blandford	California Institute of Technology
Dr George Blumenthal	University of California, Santa Cruz
Dr Elihu Boldt	NASA-Goddard SFC/UC San Diego
Dr Carlotta Bonoli	Osservatorio Astronomico, ITALY
Dr Graziella Branduardi-Raymont	Mullard Space Science Lab, ENGLAND
Mr Roger Brissenden	Mt Stromlo Observatory, AUSTRALIA
Dr Jean Brodie	Lick Observatory
Dr Geoffrey Burbidge	University of California, San Diego
Dr E. Margaret Burbidge	University of California, San Diego
Dr Claude Canizares	Massachusetts Institute of Technology
Mr Timothy E. Carone	University of Arizona
Dr Alfonso G. Cavaliere	Il Universita di Roma, ITALY
Dr Gerald Cecil	Institute for Advanced Study
Dr Fu-Zhen Cheng	University of Science and Technology, PR CHINA
Dr Yaoquan Chu	University of Science and Technology, PR CHINA
Dr Jean Clavel	ESA, IUE Observatory, SPAIN
Dr Cathie Clarke	University of California, Santa Cruz
Dr Ross Cohen	University of California San Diego
Dr Suzy Collin-Souffrin	Institut d'Astrophysique, FRANCE
Dr Marcella Contini	Tel-Aviv University, ISRAEL
Mr Stephane Courteau	University of California, Santa Cruz

Dr Thierry Courvoisier	European Southern Observatory, WEST GERMANY
Dr Stefano Cristiani	Universita di Padova, ITALY
Dr Rodney Davies	Mullard RAL, ENGLAND
Dr Michael DeRobertis	York University, CANADA
Dr Nicholas Devereux	Five College RAO
Dr Gianfranco De Zotti	Osservatorio Astronomico, ITALY
Dr Angeles I. Diaz	Universidad Autonoma de Madrid, SPAIN
Dr S. George Djorgovski	California Institute of Technology
Mr Jay Doane	University of California, Santa Cruz
Ms Christine Done	Institute of Astronomy, ENGLAND
Dr Horacio A. Dottori	URFGS, BRAZIL/RGO, ENGLAND
Dr Frank D. Drake	University of California Santa Cruz
Dr Alan Dressler	Mount Wilson & Las Campanas Observatories
Dr Deborah Dultzin-Hacyan	Instituto de Astronomia, UNAM, MEXICO
Dr Florence Durret	Institut d'Astrophysique, FRANCE
Dr Rick Edelson	University of Colorado
Ms Nancy Ellman	University of California, Santa Cruz
Dr Martin Elvis	Harvard-Smithsonian Center for Astrophysics
Mr Brian Espey	Institute of Astronomy, ENGLAND
Dr Giuseppina Fabbiano	Harvard-Smithsonian Center for Astrophysics
Dr Anthony P. Fairall	University of Cape Town, SOUTH AFRICA
Dr James E. Felten	NASA-Goddard Space Flight Center
Dr Alexei V. Filippenko	University of California, Berkeley
Dr Jacqueline Fischer	Naval Research Lab
Dr Craig Foltz	Multiple Mirror Telescope Observatory
Dr Klaus J. Fricke	Universitäts-Sternwarte Göttingen, WEST GERMANY
Dr Jay A. Frogel	NOAO/Kitt Peak National Observatory
Dr Martin Gaskell	University of Michigan
Dr Isabella M. Gioia	Harvard-Smithsonian Center for Astrophysics
Dr Ian S. Glass	South African Astronomical Observatory, SOUTH AFRICA
Mr Bob Goodrich	University of California, Santa Cruz
Dr Prab Gondhalekar	Rutherford Appleton Laboratory, ENGLAND
Mr J. Jesus Gonzalez	University of California, Santa Cruz
Mr Paul J. Green	University of Washington
Dr Richard Green	Kitt Peak National Observatory
Dr Jules P. Halpern	Columbia University
Mr Dieter Hartmann	University of California, Santa Cruz
Dr Timothy Heckman	University of Maryland
Ms Charlene Anne Heisler	Yale University

Mr David H. Hughes	Lancashire Polytechnic, ENGLAND
Dr John B. Hutchings	Dominion Astrophysical Observatory, CANADA
Dr Garth Illingworth	Lick Observatory
Dr Monique Joly	Observatoire de Meudon, FRANCE
Dr Barbara Jones	University of California, San Diego
Dr Umesh Chandra Joshi	Physical Research Laboratory, INDIA
Dr Vesa Junkkarinen	University of California, San Diego
Dr Marin Kalinkov	Bulgarian Academy of Sciences, BULGARIA
Dr Timothy Kallman	NASA-Goddard Space Flight Center
Dr Noboru Kaneko	Hokkaido University, JAPAN
Dr Vijay Kapahi	TIFR, INDIA/National Radio Astronomy Observatory
Ms Laura Kay	University of California, Santa Cruz
Dr Demosthenes Kazanas	University of Maryland/NASA GSFC
Dr William C. Keel	University of Alabama
Dr Jocelyn Keene	California Institute of Technology
Dr Kenneth Kellermann	National Radio Astronomy Observatory
Dr Ajit K. Kembhavi	Tata Institute of Fundamental Research, INDIA
Dr E.Ye. Khachikian	Byurakan Astrophysical Observatory, USSR
Dr Anne L. Kinney	Space Telescope Science Institute
Dr John G. Kirk	MPI fuer Astrophysik, WEST GERMANY
Dr Wolfram Kollatschny	Universitäts-Sternwarte Göttingen, WEST GERMANY
Dr David C. Koo	Lick Observatory
Mr Kirk T. Korista	Ohio State University
Dr Katsuji Koyama	Nagoya University, JAPAN
Dr Gopal Krishna	Tata Institute of Fundamental Research, INDIA
Dr Julian Krolik	Johns Hopkins University
Dr Endrik Krügel	MPI fuer Radioastronomie, WEST GERMANY
Dr Sanjiv Kumar	International School for Advanced Studies ITALY
Mr Ari Laor	Tel-Aviv University, ISRAEL
Dr Andrew Lawrence	Queen Mary College, ENGLAND
Dr Douglas Lin	University of California, Santa Cruz
Dr Carol Lonsdale	California Institute of Technology
Dr Matthew Malkan	University of California, Los Angeles
Mr Dan Maoz	Tel-Aviv University, ISRAEL
Dr Herman L. Marshall	Space Sciences Laboratory, UC Berkeley
Dr William G. Mathews	University of California, Santa Cruz
Dr Jose Maza	Universidad de Chile, CHILE
Mr Joseph M. Mazzarella	University of Michigan
Dr Thuppalay K. Menon	University of British Columbia, CANADA

Dr Antonio Messina	Universita di Bologna, ITALY
Dr Georges Meylan	European Southern Observatory, WEST GERMANY
Dr H. Richard Miller	Georgia State University
Dr Joseph S. Miller	Lick Observatory
Mr Jonathan P.D. Mittaz	Mullard Space Science Laboratory, ENGLAND
Dr Alan F.M. Moorwood	European Southern Observatory, WEST GERMANY
Dr Simon L. Morris	Mount Wilson & Las Campanas Observatories
Dr Philip Morrison	Massachusetts Institute of Technology
Dr Bruce McAdam	University of Sydney, AUSTRALIA
Dr Gordon MacAlpine	University of Michigan
Mr Patrick J. McCarthy	University of California Berkeley
Dr Susan G. Neff	NASA-Goddard Space Flight Center
Dr Hagai Netzer	Tel-Aviv University, ISRAEL
Dr Minoru Nishida	Kyoto University, JAPAN
Mr Richard Nolthenius	University of California, Santa Cruz
Dr Ray P. Norris	CSIRO Divn of Radiophysics, AUSTRALIA
Dr I.D. Novikov	Space Research Institute, USSR
Dr Stephen L. O'Dell	NASA-Marshall Space Flight Center
Dr Donald E. Osterbrock	Lick Observatory
Dr Jan Palous	Czechoslovak Academy of Sciences, CZECHOSLOVAKIA
Dr Giorgio G.C. Palumbo	Universita di Bologna, ITALY
Dr Miriani G. Pastoriza	UFRGS, BRAZIL/RGO, ENGLAND
Dr Timothy J. Pearson	California Institute of Technology
Dr Alan Pedlar	Nuffield Radio Astronomy Laboratory, ENGLAND
Dr Manuel Peimbert	Instituto de Astronomia, UNAM, MEXICO
Dr Michael Penston	Royal Greenwich Observatory, ENGLAND
Dr Eric Persson	Mount Wilson & Las Campanas Observatories
Dr Bradley M. Peterson	Ohio State University
Dr Vahé Petrosian	Stanford University
Mr Philip Pinto	University of California, Santa Cruz
Dr Paris Pismis de Recillas	Instituto de Astronomia, UNAM, MEXICO
Dr Richard W. Pogge	University of California, Santa Cruz
Dr Kenneth A. Pounds	University of Leicester, ENGLAND
Dr Joel Primack	University of California, Santa Cruz
Dr V. Pronik	Crimean Astrophysical Observatory, USSR
Dr Richard Puetter	University of California San Diego
Dr Piero Rafanelli	University of Padova, ITALY
Dr Per Kjaergaard Rasmussen	University Observatory, DENMARK
Dr Steven Rawlings	Cavendish Laboratory, ENGLAND

Dr Sjur Refsdal	Hamburg Observatory, WEST GERMANY
Dr Lloyd B. Robinson	Lick Observatory
Dr Ian Robson	Lancashire Polytechnic, ENGLAND
Dr William Romanishin	Arizona State University
Dr Nico Roos	Sterrenkundig Instituut, THE NETHERLANDS
Mr Edward Rosenblatt	UCSC/University of California, Los Angeles
Dr David B. Sanders	California Institute of Technology
Dr Ann Savage	Royal Obs., UK/UK Schmidt T'scope Unit, AUSTRALIA
Dr Maarten Schmidt	California Institute of Technology
Dr Hartmut Schulz	Ruhr-Universität, WEST GERMANY
Dr Daniel A. Schwartz	Smithsonian Astrophysical Observatory
Dr Nick Scoville	California Institute of Technology
Dr Giancarlo Setti	European Southern Observatory, WEST GERMANY
Dr Richard A. Shaw	Lick Observatory
Dr Gregory A. Shields	University of Texas
Mr Joseph Shields	University of California, Berkeley
Dr Isaac Shlosman	California Institute of Technology
Dr Marek Sikora	N. Copernicus Astronomical Center, POLAND
Dr Susan M. Simkin	Michigan State University
Dr Harding E. Smith	University of California, San Diego
Dr Malcolm G. Smith	Joint Astronomy Centre, Hawaii
Dr Baruch T. Soifer	California Institute of Technology
Dr Luigi Spinoglio	UCLA/Istituto di Fisica dello Spazio, ITALY
Dr Wayne A. Stein	University of Minnesota
Dr Joao E. Steiner	Institute de Pesquisas Espaciais, BRAZIL
Dr Jivan Stepanian	Byurakan Astrophysical Observatory, USSR
Dr Alan Stockton	Institute for Astronomy, Hawaii
Mr Michael A. Strauss	University of California, Berkeley
Mr Guy Stringfellow	University of California, Santa Cruz
Dr Wei-Hsin Sun	NASA-Goddard Space Flight Center
Dr Roland Svensson	NORDITA, DENMARK
Dr Govind Swarup	Tata Institute of Fundamental Research, INDIA
Dr Bruce Tarter	Lawrence Livermore National Laboratory
Mr Keith Louis Thompson	University of Texas
Dr Dario Trevese	Universita di Roma "La Sapienza," ITALY
Dr Sachiko Tsuruta	Montana State University/ISAS, JAPAN
Dr Zlatan Tsvetanov	European Southern Observatory, WEST GERMANY
Dr R. Brent Tully	Institute for Astronomy, Hawaii
Dr Marie-Helene Ulrich	European Southern Observatory, WEST GERMANY

Dr Stephen Unger	Royal Greenwich Observatory, ENGLAND
Dr Meg Urry	Space Telescope Science Institute
Dr J. Patricia Vader	Yale University
Dr Wil van Breugel	University of California, Berkeley
Mr Albertus van den Broek	University of Amsterdam, THE NETHERLANDS
Dr Ernst van Groningen	Uppsala Observatory, SWEDEN
Dr Sylvain Veilleux	University of California, Santa Cruz
Dr Mira-P. Veron	Observatoire de Haute-Provence, FRANCE
Dr Philippe Veron	Observatoire de Haute-Provence, FRANCE
Dr Sueli M. Viegas-Aldrovandi	Ohio State University
Dr Amri Wandel	Stanford University
Dr Martin J. Ward	Institute of Astronomy, ENGLAND
Dr Robert Warwick	University of Leicester, ENGLAND
Dr Daniel W. Weedman	Pennsylvania State University
Dr Peter Wehinger	Arizona State University
Dr Ann E. Wehrle	California Institute of Technology
Dr Jon C. Weisheit	Rice University
Dr Ray J. Weymann	Mount Wilson & Las Campanas Observatories
Dr Albert Whitford	Lick Observatory
Dr D. Mark Whittle	University of Virginia
Dr Paul J. Wiita	Georgia State University
Dr Belinda Wilkes	Harvard-Smithsonian Center for Astrophysics
Dr Beverley J. Wills	University of Texas
Dr Gerard Wlérick	Observatoire de Paris, FRANCE
Dr Diana M. Worrall	Harvard-Smithsonian Center for Astrophysics
Dr Joan M. Wrobel	New Mexico Tech
Dr Chi-Chao Wu	Computer Sciences Corporation, STScI
Dr Gareth Wynn-Williams	Inst. of Astronomy, Hawaii/Cavendish Lab. UK
Dr Howard K.C. Yee	University of Montreal, CANADA
Dr Andrzej A. Zdziarski	Space Telescope Science Institute
Dr Wei Zheng	University College London, ENGLAND
Dr Valentina Zitelli	Bologna University, ITALY

HONORARY PARTICIPANTS

Dr Chin Akujor	University of Nigeria, NIGERIA
Dr V. A. Lipovetsky	Special Astrophysical Observatory, USSR
Dr A. R. Petrosian	Byurakan Astrophysical Observatory, USSR
Dr I. I. Pronik	Crimean Astrophysical Observatory, USSR