

# Angular Momentum Evolution of Young Stars

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# Angular Momentum Evolution of Young Stars

edited by

**S. Catalano**

Istituto di Astronomia,  
Università di Catania,  
Catania, Italy

and

**J. R. Stauffer**

Center for Astrophysics,  
Smithsonian Astrophysical Observatory,  
Cambridge, Massachusetts, U.S.A.



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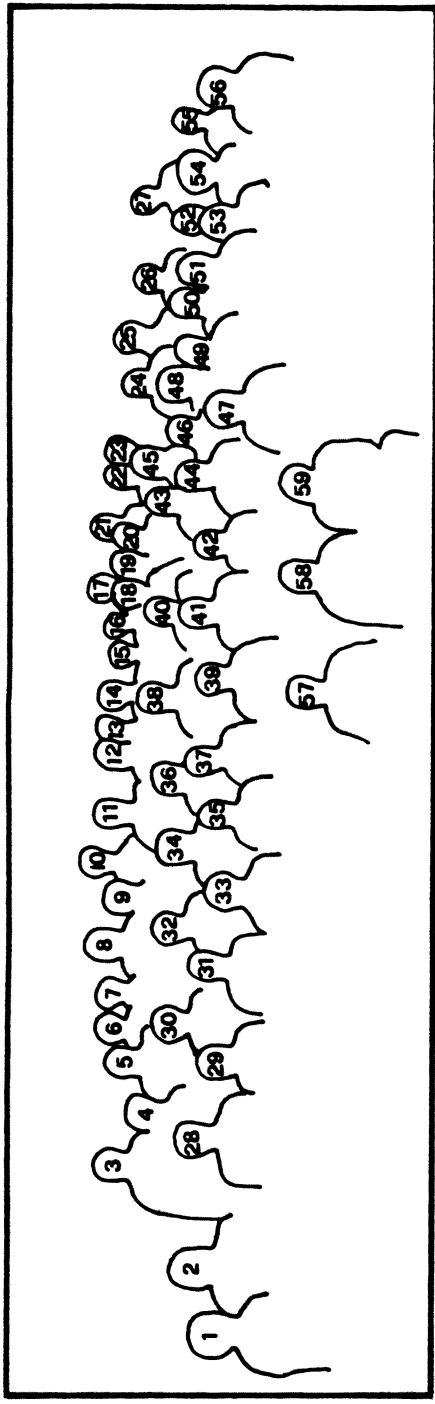
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## LIST OF PARTICIPANTS

- Anile, A.M. *Dipartimento di Matematica, Città Universitaria, Viale A. Doria 6 , 95125 Catania, ITALY*
- Antonuccio, V. *Osservatorio Astrofisico, Città Universitaria, Viale A. Doria 6, 95125 Catania, ITALY*
- Belvedere, G. *Istituto di Astronomia, Città Universitaria, Viale A. Doria 6, 95125 Catania, ITALY*
- Bertout, C. *Group d' Astrophysique Observatoire de Grenoble Université J. Fourier - CNRS, CERMO B.P. 53X, 38041 Grenoble Cedex, FRANCE*
- Blanco, C. *Istituto di Astronomia, Città' Universitaria, Viale A. Doria 6, 95125 Catania, ITALY*
- Bodenheimer, P. *Lick Observatory, University of California, Santa Cruz CA 95064, USA*
- Bouvier, J. *Canada-France-Hawaii Tel. Corp., P.O. Box 1597 Kamuela, HI 96743 USA*
- Catalano, S. *Istituto di Astronomia, Città Universitaria, Viale A. Doria 6, 95125 Catania, ITALY*
- Charbonnel, C. *Observatoire Midi-Pyrénées, Université Paul Sabatier, 14 Avenue E. Belin, 31400 Toulouse, FRANCE*
- Chugainov, P.F. *Crimean Astrophysical Observatory, P.O. Nauchny, 334413 Crimea, USSR*
- Collier-Cameron, A. *Astronomy Centre, University of Sussex, Falmer, Brighton BN1 9QH, U.K.*
- Cutispoto, G. *Osservatorio Astrofisico, Città Universitaria Viale A. Doria 6, 95125 Catania, ITALY*
- Damiani, F. *Osservatorio Astronomico di Palermo, Palazzo dei Normanni, 90134 Palermo, ITALY*
- de Medeiros, J.R. *Observatoire de Geneve, Chemin des Maillettes, 51 - 1290 - Sauverny, SUISSE*
- Duncan, D.K. *Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA*
- Dziembowski, W. *Polish Academy of Sciences, Nikolaus Copernicus Astronomy Center, U.L. Bartycka, 18, 00-716 Warsaw, POLAND*
- Errico, L. *Osservatorio Astronomico di Capodimonte, Via Moiarello, 16, 80131 Napoli, ITALY*
- Foderà-Serio, G. *Osservatorio Astronomico di Palermo, Palazzo dei Normanni, 90134 Palermo, ITALY*
- Galli, D. *Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, 50125 Firenze, ITALY*
- Geroyannis, V. *Department of Astronomy, University of Patras, GR-26110 Patras, GREECE*

- Gough, D.O. *Institute of Astronomy, Madingley Road, Cambridge CB3 0HA, U.K.*
- Gray, D.F. *Department of Astronomy, University of Western Ontario, London, Ontario, N6A 3K7, CANADA*
- Grillo, F. *Osservatorio Astronomico di Palermo, Palazzo dei Normanni, 90134 Palermo, ITALY*
- Hartmann, L.W. *Harvard-Smithsonian Center for Astrophys., 60 Garden Street, Cambridge MA 02138, USA*
- Kraft, R. *Lick Observatory, University of California, Santa Cruz CA 95064, USA*
- Lamzin, S. *Sternberg State Astronomical Institute, University Prospect 13, 119899 Moscow V-234, USSR*
- Lanza, A. *Istituto di Astronomia, Città Universitaria, Viale A. Doria 6, 95125 Catania, ITALY*
- Lanzafame, G. *Istituto di Astronomia, Città Universitaria, Viale A. Doria 6, 95125 Catania, ITALY*
- MacGregor, K.B. *High Altitude Observatory, N.C.A.R., P.O. Box 3000, Boulder, CO 80307, USA*
- Maceroni, C. *Osservatorio Astronomico di Roma, Viale del Parco Mellini 84, 00136 Roma, ITALY*
- Maggio, A. *Osservatorio Astronomico di Palermo, Palazzo dei Normanni, 90134 Palermo, ITALY*
- Marilli, E. *Osservatorio Astrofisico, Città Universitaria, Viale A. Doria 6, 95125 Catania, ITALY*
- Mayor, M. *Observatoire de Geneve, Chemin des Maillettes, 51 CH-1290 Sauverny, SUISSE*
- Mermilliod, J.C. *Institut d'Astronomie de l'Université de Lausanne, CH-1290 Chavannes des Bois, SUISSE*
- Micela, G. *Osservatorio Astronomico di Palermo, Palazzo dei Normanni, 90134 Palermo, ITALY*
- Muscato, O. *Dipartimento di Matematica, Città Universitaria, Viale A. Doria 6, 95125 Catania, ITALY*
- Palla, F. *Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, 50125 Firenze, ITALY*
- Paternó, L. *Istituto di Astronomia, Città Universitaria, Viale A. Doria 6, 95125 Catania, ITALY*
- Peres, G. *Osservatorio Astrofisico, Città Universitaria, Viale A. Doria 6, 95125 Catania, ITALY*
- Pinsonneault, M.H. *Center for Solar and Space Research, Dept. of Astronomy, Yale University, P.O. Box 6666, New Haven, CT 06511, USA*
- Randich, S. *Dipartimento di Astronomia e Scienza dello Spazio, Università di Firenze, Largo E. Fermi 5, 50125 Firenze, ITALY*
- Reglero, V. *Universitat de Valencia, Dept. de Matematica y Astronomia, Dr. Moliner 50, 46100 Burjasot - Valencia, SPAIN*

- Rodonó, M. *Istituto di Astronomia, Città Universitaria,  
Viale A. Doria 6, 95125 Catania, ITALY*
- Roxburgh, I. W. *Queen Mary and Westfield College,  
Mile End Road, London E1 4NS, U.K.*
- Scaltriti, F. *Osservatorio Astronomico di Torino,  
Via Osservatorio 20, 10025 Pino Torinese, ITALY*
- Schatzman, E. *DASGAL, Observatoire de Meudon,  
F-92195 Meudon Principal Cedex, FRANCE*
- Sciortino, S. *Osservatorio Astronomico di Palermo,  
Palazzo dei Normanni, 90134 Palermo, ITALY*
- Sserio, S. *Osservatorio Astronomico di Palermo,  
Palazzo dei Normanni, 90134 Palermo, ITALY*
- Severino, G. *Osservatorio Astronomico di Capodimonte,  
Via Moiarello 16, 80131 Napoli, ITALY*
- Soderblom, S. *Space Telescope Science Institute,  
3700 San Martin Drive, Baltimore MD 21218, USA*
- Sofia, S. *Center for Solar and Space Research, Dept. of Astronomy,  
Yale University, P.O. Box 6666, New Haven, CT 06511, USA*
- Spadaro, D. *Osservatorio Astrofisico, Città Universitaria,  
Viale A. Doria 6, 95125 Catania, ITALY*
- Stauffer, J. *Harvard-Smithsonian Center for Astrophys.,  
60 Garden Street, Cambridge MA 02138, USA*
- Strom, K.M. *Five College Astron. Dept., University of  
Massachusetts, Amherst, MA 01003, USA*
- Strom, S.E. *Five College Astron. Dept., University of  
Massachusetts, Amherst, MA 01003, USA*
- Tanzi, E.G. *Istituto di Fisica Cosmica, CNR,  
Via E. Bassini 15, Milano, ITALY*
- Trigilio, C. *Istituto di Radioastronomia, CNR,  
Stazione di Noto, 96017 Noto, ITALY*
- Umana, G. *Istituto di Radioastronomia, CNR,  
Stazione di Noto, 96017 Noto, ITALY*
- Vaiana, G. S. *Osservatorio Astronomico,  
Palazzo dei Normanni, 90134 Palermo, ITALY*
- Van't Veer, F. *Institut d'Astrophysique, CNRS,  
98bis Boulevard Arago, 75014 Paris, FRANCE*
- Vauclair, S. *Observatoire Midi - Pyrénées, Université Paul Sabatier,  
14 Avenue E. Belin, 31400 Toulouse, FRANCE*
- Ventura, R. *Osservatorio Astrofisico, Città Universitaria,  
Viale A. Doria 6, 95125 Catania, ITALY*
- Vittone, A. *Osservatorio Astronomico di Capodimonte,  
Via Moiarello 16, 80131 Napoli, ITALY*

## FOREWORD

This book reports the Proceedings of the NATO Advanced Research Workshop on "Angular Momentum Evolution of Young Stars" held from 17 to 21 September 1990 at Noto, Italy. The workshop had its immediate origin in a discussion about the availability of stellar rotation data, that took place in 1987 at Viana do Castelo Portugal during the NATO meeting, Formation and Evolution of Low Mass Stars. We recognized that nearly 20 years had passed since the last meeting on stellar rotation and that significant progress in the observation of rotation rates in low mass stars had been made.

During the last 20 years, new efficient instrumentation (CCD and photon counting detectors and echelle spectrographs) and new analysis techniques (profile Fourier analysis) have allowed us to measure rotational velocities as low as 1-2 km/s and to reach low mass stars in young clusters. Even with these advances, rotational velocities of low mass stars would have remained challenging to determine if all single, low mass stars later than G0 had rotational velocities of order or less than 10 km/sec. Evidence that this is not always the case was first provided by the photometric variability data obtained by van Leeuwen and Alphenaar for K dwarfs in the Pleiades and more recently by the *vsini* measurements of low mass stars in several young clusters. Given the availability of a considerable body of new data, we decided that it was appropriate to consider how these data might be used to elucidate basic problems of stellar formation, structure and evolution such as the initial angular momentum distribution, angular momentum evolution and transport, internal rotation, lithium depletion and diffusion, magnetic activity and rotation braking.

This NATO Advanced Research Workshop gathered together about 60 scientists, including both senior "pundits" and young active researchers, whose research interests were directly related to the topic of the meeting. Observers provided new fundamental data on the rotation of T Tauri stars, low mass stars in young clusters, and post-main sequence stars. Additional papers dealt with how new observational data on protostellar disks, lithium abundances in young stars and magnetic field measurements might provide useful constraints on models of rotational velocity evolution. These observational reports provided the basis for a number of theoretical papers which attempted to compare the predictions of angular momentum loss via stellar winds with the observations.

The meeting format left ample space for discussion and included two panel discussion on the key topics:

- Initial Angular Momentum
- Surface Braking and Internal Rotation

The text of the discussions during these panel sessions is provided here particularly to indicate the directions of current research interest.

The book is divided into 5 major sections: I. Initial Angular Momentum Distribution, II. Angular Momentum Evolution, III. Consequences of rotation, IV. Internal Rotation

and Theoretical Models, V. Observational Perspectives. The volume includes also the complete transcription of discussions following each presentation and the panel discussions as recorded on tapes. There are inevitable gaps due to loss of recording for various reasons. Generally the discussion was transcribed word-by-word, but to improve the language, repetitions, excessive use of colloquialisms, etc. were removed. We are confident that the speakers will recognise themselves and that no unacceptable changes were made.

*The Scientific Organizing Committee* of the NATO Advanced Research Workshop consisted of S. Catalano (Chair), C. Bertout, D. Gough, M. Rodonó, J. Stauffer.

*The local Organizing Committee* consisted of S. Catalano (Chair), J. Stauffer (Co-chair), A.M. Anile, E. Marilli, O. Muscato, M. Rodonó, D. Spadaro.

We are very grateful to acknowledge the vital financial support given by the NATO Scientific Affairs Division. We also wish to thank the following Institutions and Companies who supplied additional funds to make the meeting a most rewarding one: The Comune di Noto, the University of Catania, the Catania Astrophysical Observatory, the Ministero della Ricerca Scientifica e Tecnologica, The Consiglio Nazionale delle Ricerche, the Provincia regionale di Siracusa, the Azienda Autonoma Provinciale per l' Incremento Turistico di Siracusa, the Banca Nazionale del Lavoro, and the Convex Computer S.p.A.

The logistics of putting together the meeting, having things run smoothly at Noto, and completing the manuscript for this book were the result of the hard work and dedication of a number of people who we wish to specially thank: A. Cali', S. Del Popolo, P. Massimino, M. Miraglia, S. Novello D. Randazzo, L. Rapisarda, D. Recupero, S. Sardone, C. Spampinato, V. Stancanelli.

We are also indebted to Stepha Genelza, who take care of the vital but exhausting job of transcribing the discussions from the tapes.

Most of all, we are grateful to the Workshop participants for making this a lively and profitable meeting. In particular we would like to thank the moderators of the two panel discussions E. Schatzman and P. Bodenheimer who chaired the sessions masterfully by presenting lists of provocative questions which evoked thoughtful responses from the participants.