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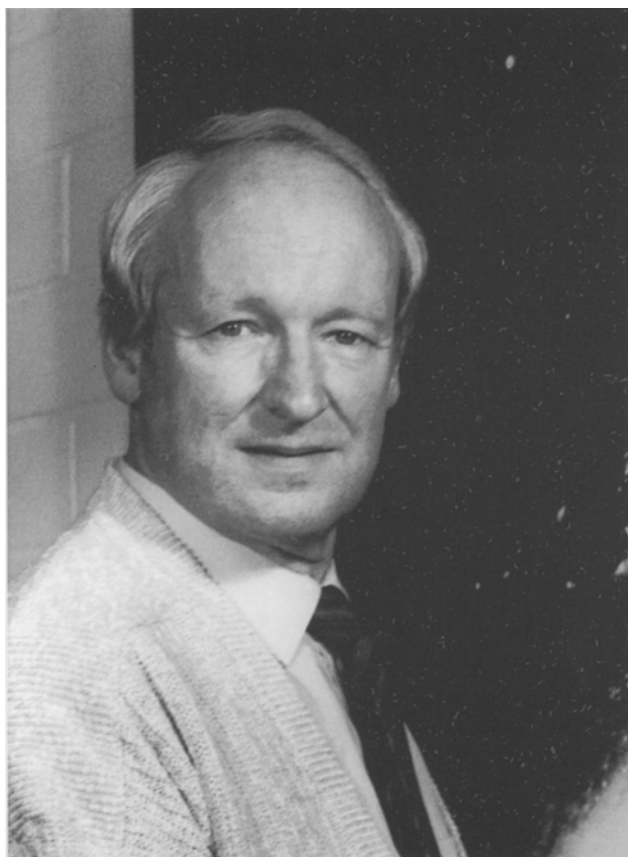
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Hans Elsässer

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# Disks and Outflows Around Young Stars

Proceedings of a Conference  
Honouring Hans Elsässer  
Held at Heidelberg, Germany,  
6–9 September 1994



Springer

## Editors

Steven Beckwith  
Jakob Staude  
Axel Quetz  
Max-Planck-Institut für Astronomie  
Königstuhl 17  
D-69117 Heidelberg, Germany

Antonella Natta  
Osservatorio di Arcetri  
Largo Enrico Fermi, 5  
I-50125 Firenze, Italy

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# Preface

After the upheavals in the first half of the 20th century, astronomical research in Europe, particularly in Germany, was almost destroyed and had to be rebuilt competely. Hans Elsässer was one of a handful of people with the vision, energy, and tenacity to recreate the scientific excellence that existed previously. He founded the Max-Planck-Institut für Astronomie and built the Calar Alto Observatory in southern Spain, an observatory that is the cornerstone for all optical/infrared research in Germany today. He created *Sterne und Weltraum*, a German-language magazine for popular astronomy, wrote several books, and greatly expanded the influence of astronomy within the Max-Planck-Society. He is without doubt one of the most important astronomers for Germany in the 20th century. It is to him and his achievements that this book is dedicated on the occasion of his 65th birthday.

The subjects of the book, the ubiquitous circumstellar disks around very young stars and the corresponding jets of outflowing matter, were the first addressed by Professor Elsässer when the new Max-Planck-Institut was started, and became the basis for much of the research he undertook in the following 25 years. This subject has recently become one of the hottest areas in astrophysics. The disks are thought to be precursors to planetary systems, and the outflows are thought to be a necessary phase in the formation of a young star, helping the star to get rid of angular momentum and energy as it makes its way onto the main sequence. The possible connections to planetary systems and stellar astrophysics make these topics especially broad, appealing to generalists and specialists alike.

The book is divided into five parts, each emphasizing one aspect of the conference. Parts I and II concern observations and the theory of disks, respectively. Part III concentrates on the young stars and their immediate environments apart from the disks. Parts IV and V discuss the observations and theory of outflows. With the exception of Part IV, each part starts with a general review of the subject followed by a number of topical papers. There were a large number of excellent contributions that could not be printed in the main book. These are included on the accompanying CD-ROM. The CD-ROM contains more than just the papers; it allows the authors to include a fair amount of original data, often displayed as color images. The reader is encouraged to use these data to stimulate new research in a way that was difficult before the advent of compact storage media.

As indicated by the reviews by Sargent and Adams, there is no viable alternative to disk theory to explain the wide range of phenomena seen around young stars. The papers in Part I even give examples of disks that can now be imaged directly with instruments such as HST (McCaughrean) and millimeter-wave interferometers (Dutrey et al., Ohashi and Hayashi). The association of young stars with disks is sufficiently secure in many cases for research to have moved into the next phases: the effect of binary stars (Herbst et al.; Artymowicz and Lubow; Whitworth et al.) and the non-stationary aspects of disk accretion (Bell).

Few stars are born in isolation. The presence of other stars – as in clusters – and the residue of gas and dust not in the form of a disk are important both for the understanding of the star formation process and as diagnostics to how it proceeds. Part III emphasizes the importance of stellar evolution theory and the presence of stellar companions to the understanding of observational phenomena related also to disks and outflows. Palla's article shows that our theory for early stellar evolution is converging, just as the theory for main sequence stars did half a century ago. We are reminded by Simon that most young stars are parts of multiple star systems and how this fact affects our thinking about disks (McDonald and Clarke). Several other contributions discuss special aspects of the stars and their environs, including a prediction of the stellar mass function (Nakano et al.).

Outflows were first observed as spectacular, highly collimated jets of hot gas extending large fractions of a pc from their origins. Part IV presents the many new tools used to analyse these jets: the transverse motion of small knots (Eislöffel); the bright molecular hydrogen emission (Zinnecker et al.); the exquisite spectra of the lines and continua providing cooling for the outflowing gas (Staute and Neckel; Hirth et al.; Corcoran and Ray); and high-resolution maps of lines in the millimeter-wave region using the new generation of interferometers (Hirano et al.).

One of the prevailing beliefs is that the outflows and disks are intimately connected, that, without the disks, the outflows would not occur, and it is possible that the disks need the outflows for their own evolution. Königl's review and the subsequent articles by Fendt and Camenzind, Sauty et al., and Bacciotti et al. all rely on the presence of a disk to provide the energy and material for the observed jets and outflows. Almost everyone believes magnetic fields are an integral part of the outflow physics, although the details are in some dispute.

This conference was possible only because of the hard work of many people connected with the MPIA working on behalf of the organizing committees. Reinhard Mundt supervised all the local arrangements aided by Rachel Blythe, Josef Fried, Andreas Glindemann, Christoph Leinert, Karl-Heinz Marien, AMQ, and JS. The members of the scientific organizing committee (Claude Bertout, Charles Lada, AN, Tom Ray, Steve Strom, and SB) put in much time and thought to attract the best speakers to Heidelberg. AMQ was responsible for the technical aspects of the production of these proceedings. We are indebted to the Deutsche Forschungs Gemeinschaft and the Max-Planck-Society for the monetary support needed to make the conference possible.

We are grateful most of all to Professor Hans Elsässer for the visionary work that made this celebration so attractive. It is but a small gesture of gratitude from a community to which he gave his career.

*Steven Beckwith, Jakob Staude,  
Axel M. Quetz, Antonella Natta*

Heidelberg,  
February 1996

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