

FIFTEEN YEARS OF "SONDERFORSCHUNGSBEREICH" IN HEIDELBERG:
RESEARCH ON CIRCUMSTELLAR MATTER

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At the end of this year, the Sonderforschungsbereich (Special Collaborative Programme) no. 132 on "Theoretical and Observational Stellar Astronomy" in Heidelberg will terminate after fifteen years. Although 15 years are only 2 1/2 per cent of the age of the University of Heidelberg, which is celebrating its 600 th anniversary this year, they are nevertheless a long and important time for astronomical research in Heidelberg. On the occasion of the termination of the Sonderforschungsbereich, we are now given the opportunity to present an essential part of its research, namely that on circumstellar matter, at an international conference, and we are grateful to the International Astronomical Union that this could be realized, and that we can welcome here so many participants to this Symposium. As the Speaker of our Sonderforschungsbereich I would like to briefly introduce to you the general concept of the institution of an SFB and give an overview over its structure and research activities.

The concept of support of research in the frame of a Sonderforschungsbereich (SFB) was proposed at the end of the 1960s by the Wissenschaftsrat, our National Science Council. In these new institutes the federal government and the state governments jointly give funds to the Deutsche Forschungsgemeinschaft (DFG), the West German Science Foundation, which in turn financially supports the SFBs in addition to its various other programs for funding research.

In 1968, there were 18 SFBs with a total funding of 5 million DM, this increased to 96 SFBs with 125 million DM in 1972, the year our SFB was first financed, and at present there are 163 SFBs supported by 317 million DM altogether.

An SFB is to be approved by the university and by the DFG, and is equivalent to other institutions of the university, e.g. institutes. The host university, in establishing an SFB, commits itself to making available a sufficient base of staff and financial resources ("Grundausstattung") and is applicant and recipient of the DFG support. The scientists of the SFB decide on the scientific course and the day-to-day affairs. An important aspect of an SFB is the support by the DFG for a longer period of time, subject to refereeing in three years' intervals. The maximum duration of support is 15 years.

Essential for an SFB is joint research by different groups of scientists. Within the SFB 132, four Heidelberg institutes collaborate on problems of theoretical and observational stellar astronomy, the Astronomisches Rechen-Institut, the Institut für Theoretische Astrophysik of the University, the Landessternwarte Königstuhl, and the Max-Planck-Institut für Astronomie.

The SFB is composed of two subprojects:

- A. "Objects with Extended Envelopes", and
- B. "Astrometry, Stellar Kinematics and Dynamics".

The research topic of project A is essentially equivalent to "Circumstellar Matter", and reaches from stellar atmospheres out into the interstellar medium, hereby excluding conventional (compact) atmospheres as well as the general interstellar medium, or - in other words - deals with the transition and the interaction between stars and the interstellar matter. The "objects with extended envelopes" are very different, in particular, are in different evolutionary states. The basic physical conditions, however, may be similar irrespective of the evolutionary phase so that common observational techniques as well as common theoretical methods are appropriate.

Influenced in part by the original interests of the Heidelberg institutes, the research first concentrated (a) on objects associated with star formation and early evolutionary phases such as molecular clouds, infrared sources, protostars, bipolar nebulae, maser, H II regions, T Tau and YY Ori stars, and Herbig Ae and Be stars, and (b) on objects in later evolutionary phases such as giants, supergiants, miras, planetary nebulae, novae, and again maser and H II regions. In the course of the 15 years, additional topics were added: chromospheres, coronae, bipolar structures and outflows (jets, Herbig Haro objects) and dust formation. These objects have been investigated by combined observational and theoretical approaches with varying degree of detail from surveys to very detailed studies of individual objects.

Regarding the observational side, development of instrumentation for the optical and infrared was carried out at the Landessternwarte and the Max-Planck-Institut. Within the period of the SFB, new instruments became available at the new observatory on the Calar Alto in Spain, in particular the 2.2 m-telescope in 1978, and the 3.5 m-telescope in 1984.

Essential for observing circumstellar matter was also the access to other spectral ranges which bear important information on the surrounding gas/dust envelope. Radio telescopes and satellites such as IUE (launch in 1978), Einstein (1978), and IRAS (1983) have also been used by the scientists of the SFB.

As for the theoretical interpretation, methods had to be developed which are "intermediate" between those for the classical compact, static atmospheres and those for the interstellar medium and equilibrium Strömgren spheres. In particular one has to deal with the occupation of atomic and molecular levels which are far from LTE, radiative transfer in spherical and extended systems, velocity fields comprising turbulence, winds, mass loss and accretion, jets, and mechanical heating (acoustic and magnetohydrodynamic waves), radiative pressure and dust formation.

This overview over a variety of research topics illustrates that the astronomical institutes in Heidelberg have been very fortunate to experience a substantial additional funding in the frame of the SFB for a period of 15 years only through which has research on such a scale been possible. Let me emphasize that we do not take this for granted and that we are deeply indebted for this support. On behalf of the Sonderforschungsbereich 132 I should like to take this opportunity to express our sincere gratitude to the Deutsche Forschungsgemeinschaft, to the State of Baden-Württemberg, and to the University of Heidelberg for their active and efficient support to our research.