PREFACE

Helio- and asteroseismology study the interior of the Sun and other stars, by means of observations of oscillations on their surfaces. The last 10 years has witnessed a very rapid evolution in the study of the solar interior, to a point where we can now contemplate investigating the physical state of matter, or the details of rotation and other large-scale motion, in the Sun. The stellar studies are in some respects at the point of the solar studies 10 years ago, but appear poised to take off. Thus the time was deemed ripe for IAU Symposium No 123, to assess the present status of this work, and plan for its future development.

Apart from the seismic data, few observations are available to provide information about stellar interiors. Detailed studies, by spectral analysis, can be made of stellar *surface* properties, including atmospheric temperature and chemical composition. However, the stellar radiative spectrum is almost entirely fixed by the mass, luminosity, radius and surface rotation of the star, and contains essentially no other information about the interior. An important test of stellar evolution theory is provided by observations of *stellar clusters*, whose members can reasonably be assumed to have the same age and chemical composition. The location of such stars in a HR diagram, where luminosity is plotted against the effective temperature, can roughly be understood in terms of stellar evolution calculations. Nevertheless this only provides a statistical test of the calculations, and obviously leaves room for considerable uncertainty in the details. An additional test is provided by the flux of neutrinos from the Sun; as is well known solar models fail this test.

Information about the structure of *pulsating stars* is contained in observations of their oscillations. Classical examples are the various mass determinations for single and double mode Cepheids, which have led to a number of, still not entirely resolved, mass problems. What distinguishes the present seismic investigations is the simultaneous excitation of many modes, and hence the availability of a large amount of information. In the case of the Sun many thousand frequencies have already been measured, with precisions in some cases exceeding 10^{-5}. Observations of oscillations in other stars are necessarily more limited, but may provide information about the properties of stars over a wide range of the parameters, such as mass or age, characterizing the stars. Indeed asteroseismology is possible in any star with a sufficiently rich spectrum of oscillations, and this is not restricted to solar-like stars. Thus the observation of oscillations in white dwarfs offers very exciting possibilities for studying their structure and evolution.

The principal data for helio- and asteroseismology are the observed frequencies. Due to the long coherence time of the oscillations, these can be measured with a precision far exceeding that of most astrophysical observations. Each frequency provides a measure of the properties of the stellar interior. Given a stellar model, it is straightforward to compute its oscillation frequencies; comparison with the observations then provides a test of

the model. With more extensive data, such as are now available for the Sun, one can combine the observations in ways that isolate particular properties. This leads on to *inverse analyses* of the observations, where *e.g.* the sound speed or the rotation rate are determined as functions of position within the Sun. - The other observable properties of the oscillations, *viz.* their amplitudes and phases, in principle also carry information about the stars, particularly the structure of the stellar atmosphere, and about the excitation mechanisms of the oscillations.

Observations of solar and stellar oscillations has up to now largely been carried out with equipment developed for other purposes. However, as was evident at the Symposium, dedicated observing facilities are now being developed; they should lead to a very substantial improvement in the data available for the Sun, and in definite detection and detailed analysis of oscillations in solar-like stars. Particularly exciting are the large-scale facilities, in the shape of ground-based networks or space-based instruments, that will become operational during the coming decade.

These proceedings document the wide range of topics that was covered during the Symposium. Unfortunately it was not possible to record the, often lively, discussion accompanying the presentations; we hope that a little of the spirit of the discussion comes through in the written contributions. As editors we apologize for the tardy publication of the proceedings, which was caused by delays not entirely within our control. We are truly grateful to the (very many) authors who submitted their contributions well within the deadline. Our hope, given the high quality of the papers, is that they will preserve their interest long after the publication.

The original suggestion for organizing an IAU Symposium on this subject in Denmark is the responsibility of R.W. Noyes. We are very grateful to him, as well as to N.H. Baker and A.N. Cox, as presidents of IAU Commissions 12, 27 and 35 which sponsored the meeting, for their support. We thank the members of the Scientific Organizing Committee for their help, and the lack of undue interference, in the organization of the scientific programme. Warm thanks are also due to the invited speakers for the uniformly high level of their presentations.

The organization of the meeting was only possible thanks to the great efforts of Lisa Sloth Carlsen, Inge S. Christensen and Kirsten Holm-Nielsen of the Convention Bureau of the City of Aarhus. We also thank Margit Mortensen and Helene Nielsen for assistance in the financial arrangements and in preparing the documents for the meeting and the proceedings, and Wagner Lund for help with the practical arrangements. We are very grateful for financial assistance from the International Astronomical Union, The Danish Natural Science Research Council, Aarhus Universitets Forskningsfond, and Lektor G.J. Gørges' Legat. Birte L. Christensen-Dalsgaard is thanked for assistance in the preparation of the cover figure for the proceedings.

Finally we thank all the participants for coming to Aarhus, and making sure that everybody had a good time.

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