Preface

Much of the material in this book originated with lectures given for the Summer School on Radiative Transfer and Radiation Hydrodynamics at the Institute of Theoretical Astrophysics of the University of Oslo during June 1–11, 1999. Those lectures focused on the specifics of the dynamic coupling of radiation and matter, and on the detailed processes of the interaction. The other lecturers were Rob Rutten of the University of Utrecht, Phil Judge of the High Altitude Observatory in Boulder, Colorado, and Mats Carlsson of the University of Oslo, the organizer of the Summer School and the Director of the Institute. Their lectures treated the introduction to radiative transfer, atomic processes and spectral line diagnostics with special reference to the sun, and numerical methods in radiative transfer and radiation hydrodynamics. For that reason the original content of these lectures was light in those areas, especially in numerical methods. In putting the lectures into the present form some effort was invested to expand the coverage of the neglected topics.

The background for the theory of radiation hydrodynamics as presented here came from work at JILA, the Joint Institute for Laboratory Astrophysics of the University of Colorado and the National Bureau of Standards, as they were called then, in the late 1960s and 1970s. It originated with the need to treat radiation–matter coupling correctly in stellar pulsations and other areas of astrophysical fluid dynamics. The theory of radiatively-driven stellar winds developed out of that work. At this same time the Boulder School of radiative transfer was flourishing through the efforts of L. Auer, D. Hummer, J. Jefferies, D. Mihalas, R. Thomas, and many others. Some of the knowledge absorbed from these people, and their colleagues E. Avrett, W. Kalkofen, and G. Rybicki at the Harvard-Smithsonian Center for Astrophysics, made it into this book. The years in JILA also provided an education in theoretical atomic physics, and the mentors in this area included D. G. Hummer again, and R. Garstang, D. Norcross, J. Cooper, M. Seaton (when he visited), and H. Nussbaumer. The leader of stellar pulsation theory was J. Cox,

and his influence was felt in several areas, as was that of his good friend A. Cox of Los Alamos National Laboratory. R. McCray provided an outstanding example of insightful analytic theory complementing computational astrophysics.

Later on the opportunity to work directly with A. Cox provided additional exposure to the methods current at that time in numerical hydrodynamics and radiation hydrodynamics. Since the beginning of the 1980s the Lawrence Livermore National Laboratory has provided many lessons in numerical techniques for radiation hydrodynamics, and A. Winslow, E. Garelis, and P. Crowley were notable teachers. Their friend G. Pomraning, when he was visiting, was a fount of knowledge as well. G. Zimmerman, then and now, is the master of this subject. R. Klein has been a valued colleague for many years, beginning with stellar winds in Boulder and continuing today in Livermore, where he is a recognized authority in precision hydrodynamic techniques. Two of today's leading experts in S_N methods for radiation transport, M. Zika and P. Nowak, have helped with ideas in that part of the book.

Every work on radiation hydrodynamics since the 1980s stands in the shadow of the monumental *Foundations of Radiation Hydrodynamics* by D. Mihalas and B. Mihalas. The present author owes a great debt of gratitude to D. Mihalas for his teaching, support, and encouragement over the years. The help and encouragement of D. Hummer, L. Auer, and R. Klein are also greatly appreciated. The colleagues D. Abbott, D. Band, D. Friend, G. Olson, S. Owocki, and D. Van Blerkom may find their fingerprints here too.

Finally, special gratitude is extended to Professor Mats Carlsson of the Institute of Theoretical Astrophysics in Oslo for the opportunity to present the original lectures.