# AAVSO

## Manual for Visual Observing of Variable Stars


Revised Edition
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The **A**merican **A**ssociation of **V**ariable **S**tar **O**bservers

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# FOREWORD TO 2001 EDITION

It is with great pleasure that we present this revised and improved edition of the *Manual for Visual Observing of Variable Stars*. This manual is intended to be a comprehensive guide to variable star observing. It incorporates a lot of the basic information in the *Manual for Observing Variable Stars*, published in 1970 by the former Director of the AAVSO, Margaret W. Mayall, as well as information from various AAVSO observing materials published since then. This manual provides up-to-date information for making variable star observations and reporting them to the AAVSO.

For new observers, this manual is an essential tool—the one place from which one can gather all the information needed in order to start a variable star observing program. Long-time and experienced observers, and those returning to variable star observing, on the other hand, may find it useful as a ready-reference, quick-resource, or refresher text to help explore new aspects of variable star observing.

This manual will familiarize you with the standardized processes and procedures of variable star observing—a very important part of making and submitting your observations to the AAVSO.

You will find here new information, presented in a useful format, with chapters arranged in order of difficulty and grouped by subject-matter. There are many pull-out pages for those who prefer to put essential information in their own observing notebooks or under a plastic sleeve.

Whether you are a novice or an experienced observer, or even if you are just an armchair observer who wishes to learn more about variable star observing, we hope this manual will help you to increase your knowledge of the fundamentals of variable star observing, improve your work at the telescope, and help you to get more enjoyment and satisfaction from making a real contribution to the science of variable star astronomy.

The information in this manual has been collected from various AAVSO publications and was edited by Sara J. Beck, AAVSO Technical Staff. I sincerely thank Sara for the excellent job she has done in preparing this work.

In addition, many AAVSO members and HQ staff contributed valuable comments and recommendations to this manual. Many thanks to Carl Feehrer, Peter Guilbault, Gene Hanson, Haldun Menali, Paul Norris, Ron Royer, Doug Welch, and Michael Saladyga. Our special thanks to Gene Hanson both for providing a chapter in this manual and for his generous contribution toward the cost of publication.

Janet A. Mattei
AAVSO Director 1973-2004

# FOREWORD TO 2005 EDITION

The 2001 Edition of the *Manual for Visual Observing of Variable Stars* has proved to be a useful and popular resource for visual variable star observers—an essential for the novice and a valuable reference for the experienced observer. AAVSO Technical Assistant Sara J. Beck, who edited the 2001 edition, has also edited this newest edition, updating the material and incorporating suggestions and other feedback from observers, HQ personnel, and AAVSO Committee Chairs. I thank Sara very much for her continuing excellent work on this project, and wish you much enjoyment with variable star observing.

Elizabeth O. Waagen
AAVSO Interim Director

*...it is a fact that only by the observation of variable stars can the amateur turn his modest equipment to practical use, and further to any great extent the pursuit of knowledge in its application to the noblest of the sciences.*

—William Tyler Olcott, 1911

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# INTRODUCTION

### *What are variable stars?*

Variable stars are stars that change in brightness. Stars often vary in brightness when they are very young or when they are very old. The cause of variability may be intrinsic to the star (expansion, contraction, eruption, etc.), or may be due to extrinsic factors such as eclipses of two or more stars. In the year 2000, over 30,000 variables were known and catalogued while another 14,000 stars were suspected of changing in brightness. Most stars—including the Sun and the North Star—vary in brightness if measured precisely.

### *Why study variable stars?*

Research on variable stars is important because it can provide fundamental information about the physical properties, nature, and evolution of stars. Distance, mass, radius, internal and external structure, composition, temperature, and luminosity can be determined using variable star data. Since professional astronomers have neither the time nor the resources needed to gather data on the brightness changes of thousands of variables, amateurs have been making a real and useful contribution to science by observing variable stars and submitting their observations to the AAVSO or similar organizations.

The importance of the contribution of the serious amateur observer was first recognized in the mid-1800's by Friedrich Wilhelm August Argelander (1799–1875), a German astronomer, famous for his *Bonner Durchmusterung* (BD) star atlas and catalogue. In 1844 when only 30 variable stars were known, Argelander wrote in an article: " …I lay these hitherto sorely neglected variables most pressingly on the heart of all lovers of the starry heavens. May you increase your enjoyment by combining the useful and the pleasant while you perform an important part toward the increase of human knowledge." Argelander's plea is just as appropriate today.

### *What is the AAVSO?*

The American Association of Variable Star Observers (AAVSO) is a worldwide, nonprofit, scientific and educational organization of amateur and professional astronomers who are interested in variable stars. Founded in 1911 by William Tyler Olcott, an amateur astronomer and lawyer by profession, and Edward C. Pickering, Director of the Harvard College Observatory, the AAVSO was part of the Harvard College Observatory until 1954 when it became an independent, private research organization. Its purpose was—and still is—to coordinate, collect, evaluate, analyze, publish, and archive variable star observations made largely by amateur astronomers, and to make these observations available to professional astronomers, educators, and students. In the year 2004, with over 1200 members in 46 countries, and headquartered in Cambridge, Massachusetts, USA, it is the world's largest association of variable star observers.

In 2004, the archives of the AAVSO contained nearly 12 million observations on over 7500 stars. Over 700 observers from around the world submit about 450,000 observations every year. At the end of each month, incoming observations are sorted by observer and checked for obvious errors. The observations are then digitized, processed, and added to the data files for each star in the AAVSO International Database. This database is a tribute to the skill, enthusiastic devotion, and dedication of AAVSO observers since 1911.

### *Services to the Astronomical Community*

AAVSO data, both published and unpublished, are distributed to astronomers around the world via the AAVSO website (http:\\www.aavso.org) or upon request to AAVSO Headquarters. AAVSO services are sought by astronomers for the following purposes:

a. Real-time, up-to-date information on unusual stellar activity;
b. Assistance in scheduling and executing of variable star observing programs using earth-based large telescopes and instruments aboard satellites;
c. Assistance in simultaneous optical observations of program stars and immediate

notification of their activity during earth-based or satellite observing programs;
d. Correlation of AAVSO optical data with spectroscopic, photometric, and polarimetric multi-wavelength data;
e. Collaborative statistical analysis of stellar behavior using long-term AAVSO data.

Collaboration between the AAVSO and professional astronomers for real-time information or simultaneous optical observations has enabled the successful execution of many observing programs, particularly those using satellites for their research. These collaborative projects include observations by Apollo-Soyuz, HEAO 1 and 2, IUE, EXOSAT, HIPPARCOS, HST, RXTE, EUVE, Chandra, XMM-Newton, Gravity Probe B, CGRO, HETE-2, Swift, and INTEGRAL. A significant number of rare events have been observed with these satellites as a result of timely notification by the AAVSO.

***Services to Observers and Educators***

The AAVSO enables variable star observers to contribute vitally to astronomy by accepting their observations, incorporating them into the AAVSO data files, publishing them, and making them available to the professional astronomer. Incorporating your observations into the AAVSO International Database means that future researchers will have access to those observations, giving you the opportunity to contribute to the science of the future as well as the present.

Upon request, the AAVSO will help set up an appropriate observing program for an individual, an astronomy club, an elementary school, high school, college, etc. In this way, observers, students, and faculty are able to make the best use of their resources and to do valuable science. The AAVSO can also assist in teaching observing techniques and in suggesting stars to be included in a program.