## Chapter 4

# Introduction to stellar photometry

#### Goal-of-the-Day

Understand the concept of stellar photometry and how it can be measured from astronomical observations.

## 4.1 Essential preparation

#### Exercise 4.1

(a) Have a look at www.astro.keele.ac.uk/astrolab/results/week03/week03.pdf.

#### 4.2 Fluxes and magnitudes

Photometry is a technique in astronomy concerned with measuring the brightness of an astronomical object's electromagnetic radiation. This brightness of a star is given by the flux F: the photon energy which passes through a unit of area within a unit of time. The flux density,  $F_{\nu}$  or  $F_{\lambda}$ , is the flux per unit of frequency or per unit of wavelength, respectively: these are related to each other by:

$$|F_{\nu}d\nu| = |F_{\lambda}d\lambda|$$
 (4.1)

Whilst the total light output from a star — the bolometric luminosity — is linked to the flux, measurements of a star's brightness are usually obtained within a limited frequency or wavelength range (the photometric band) and are therefore more directly linked to the flux density. Because the measured flux densities of stars are often weak, especially at infrared and radio wavelengths where the photons are not very energetic, the flux density is sometimes expressed in Jansky, where 1 Jy =  $10^{-26}$  W m<sup>-2</sup> Hz<sup>-1</sup>.

However, it is still very common to express the brightness of a star by the ancient classification of magnitude. Around 120 BC, the Greek astronomer Hipparcos ordered stars in six classes, depending on the moment at which these stars became first visible during evening twilight: the brightest stars were of the first class, and the faintest stars were of the sixth class. It was not before 1856 that Norman Pogson calibrated the magnitude classification in terms of flux (density). He realised that the magnitude scale reflects the logarithmic response of the receptors in the retina of the human eye (which is why the human eye can see at such a vast dynamical range), and that a difference of five of the

# **Poster Papers On Stellar Photometry**

**LL Leslie** 

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Poster Papers on Stellar Photometry International Astronomical Union, 1993 The Impact of Long-Term Monitoring on Variable Star Research C. Sterken, Mart de Groot, 2012-12-06 Long term monitoring is of fundamental significance in solving many important problems in astrophysics and furthermore has unequalled value in extending observational runs with small telescopes for the education of young astronomers in order to teach them how to secure high quality observational data over many years The Impact of Long Term Monitoring on Variable Star Research contains reports based on the analysis of data collected in the visible IR and radio measurement ranges as well as the design and history of well known photometric systems Though the reporting of novel results forms an important part of the book there are also reports of eight discussion sessions covering more general areas such as extinction monitoring the problems of archival storage of astronomical data service observation the role played by long term monitoring in graduate teaching and thesis supervision the interplay between the great observational effort and theory the contribution of LTM to new knowledge of fundamental data and the increasing decommissioning of telescopes of modest aperture New Developments in Array Technology and Applications A.G. Davis Philip, Kenneth A. Janes, Arthur R. Upgren, 2012-12-06 IAU Symposium No 167 brought together researchers who use CCDs and arrays designers and manufacturers of CCDs and Array Mosaics and those who write the software to control these devices and to reduce the large amounts of data contained in each frame At the meeting such topics as plans for applying the new technology to the new large telescopes that have been built recently and those planned in the near future new developments in infrared arrays advances and concerns with the use of CCDs in photometry and spectroscopy and the creation of large mosaics in photometry and spectroscopy and the creation of large mosaics of chips which allow larger areas of the sky to be covered in a single frame were discussed There were sessions devoted to the following topics New Developments in CCD Technology New Developments in IR Detector Arrays Direct Imaging with CCDs and Other Arrays Spectroscopy with CCDs and Other Arrays and Large Field Imaging with Array Mosaics Scientific results of studies made with this technology were covered in the poster sessions CCD and Array Detectors have become the detectors of choice at all the world's optical observatories Such instruments on small university and college telescopes have turned these telescopes into instruments that can now do observations which in the past were done only on the largest telescopes CCDs and Arrays are known as the people's detector because of their ability to turn small telescopes into true research instruments On large telescopes observations can be made of extremely faint and crowded objects that were impossible to observe before the advent of CCD and Array technology The proceedings of this meeting will be useful to all those who are interested in the design manufacture and use of CCDs and Arrays for astronomical observations The Future of Photometric, Spectrophotometric and Polarimetric Standardization Christiaan Sterken, 2007 These proceedings from the May 2006 conference focus on the present status and the future of standardization and calibration of these fields

including the production process for those standards and the construction and use of calibration apparatus Topics include the basic concepts of standardization the construction calibration and maintenance of photometric systems sky surveys in photometry standardization of spectrophotometry spectrophotometric and photometric absolute flux calibrations standardization for the infrared standardization of polarimetry synthetic data and models reduction techniques procedures and methods standardization of unusual objects such as supernovae and variable stars and recommendations for the future The editors have provided object subject and author indices and have dedicated this volume to Arlo U Landolt in commemoration of his life s work Mitteilungen der Astronomischen Gesellschaft Astronomische Gesellschaft Astronomical Bulletin Carter Observatory (Wellington, N.Z.),1994 (Germany), 2006 **Instrumentation and Research Programmes for Small Telescopes** J.B. Hearnshaw, P.L. Cottrell, 2012-12-06 This volume is the proceedings of IAU Symposium No 118 on Instrumentation and Research Programmes for Small Telescopes where small telescopes were defined as those ground based instruments with apertures less than 1 5m The scientific goal of the symposium was to emphasise research programmes which were more suited to smaller tele scopes on which frequent regular observations can be made A wide variety of topics on instrumentation photometry spectroscopy and polarimetry of objects in the solar system to extragalactic systems were discussed Each of the four scientific days of the symposium comprised a number of invited review papers contributed oral papers and discussion sessions devoted purely to the large number 4 of poster papers An introductory paper on the research potential of small telescopes sets the scene for the symposium. The proceedings have then been divided into three sections Section I Telescopes and instrumentation Section II Photometric research programmes Section III Spectroscopic research programmes The diversity of topics within each of these sections indicated the extent to which small telescopes have and can contribute greatly to astronomical research Dr J A Graham's summary of the symposium which illustrates the opportunities available with small telescopes concludes these proceedings As in all symposia the importance of the discussion following each paper was realised The discussion was recorded on tape and wherever possible on questions and answer sheets transcribed and then edited The Stellar Content of Local Group Galaxies International Astronomical Union. Symposium, 1999 The nonprofit Astronomical Society of the Pacific ASP publishes the Conference Series Proceedings as part of its century old mission to provide resources for astronomers and advance the science of astronomy Since 1988 the ASP has published the proceedings of astronomical workshops meetings colloquia and symposia to meet the community s demand for affordable high quality volumes on current topics in the rapidly expanding fields of astronomy and astrophysics Since 1998 the Society has also served as publisher for the International Astronomical Union IAU adding their Symposia Highlights and Transactions to our growing list of publications For most rapid delivery of each volume we encourage libraries and astronomy departments to place a Standing Order for the ASP Conference Series and or the IAU Publications Standing Orders are shipped directly from the printer and customers receive volumes at the

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Optical and IR Telescope Instrumentation and Detectors Society of Photo-optical Instrumentation Engineers, 2000 Convection in Astrophysics (IAU S239) International Astronomical Union. Symposium, 2007-06-07 Convection is ubiquitous throughout the Universe and during the last three decades it has become the largest factor of uncertainty in theoretical models of stars and in the interpretation of observations on the basis of such models Recently numerical simulations of convection have dramatically improved in their potential to take into account both the large scale properties of the flow itself and the microphysical properties of the fluid Observations have become accurate enough to provide stringent tests for both numerical simulations and models of convection IAU S239 was held to further understanding of convection bringing together leading researchers in solar and stellar physics the physics of planets and of accretion disks With reviews research contributions and detailed recordings of plenary discussions this book is a valuable resource for professional astronomers and graduate students interested in the interdisciplinary study of one of the key physical processes in astrophysics

The MK Process at 50 Years Christopher J. Corbally, Richard O. Gray, Robert F. Garrison, 1994

Symposium International Astronomical Union, 1996 Precision Photometry A. G. Davis Philip, Arthur R. Upgren, Kenneth Janes, 1991 Robotic Observatories M. F. Bode, 1995 Vatican Observatory Publications, 1970

Third Pacific Rim Conference on Recent Development on Binary Star Research Kam-Ching Leung, 1997 Publikace Astronomický ústav (Československá akademie věd), 1952

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