Astronomy for Developing Countries
IAU Special Session at the 24th General Assembly, 2001
Alan H. Batten, ed.

What Can be Done with Small Telescopes?

Boonraksar Soonthornthum
Sirindhorn Observatory, Department of Physics, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand. e-mail: boonraks@cmu.chiangmai.ac.th

Abstract. Modern astronomy has developed rapidly in the last few decades. Large telescopes, several metres in diameter, have been constructed and installed at many sites around the world, in order to carry out high-quality research work at the frontiers of astronomy. In many parts of the world, only small telescopes are available, because of budgetary limitations and the stage of development of science in the country. However, much effort has been put into using these small telescopes to the best of their capabilities. A small telescope with modern detectors can do good astronomical research. Sirindhorn Observatory, Chiang Mai University, is the only observatory in northern Thailand which plays an active role in astronomical research. The major instrument is the 40-cm Cassegrain reflecting telescope with standard wide-band and intermediate band photoelectric photometers, CCD photometers and a CCD spectrograph. Because of Thailand's hot and humid climate, the telescopes and detectors at Sirindhorn Observatory need regular maintenance. Major research at the Observatory emphasizes the study of physical propoerties and evolution of close binary systems, especially near-contact and contact binaries, by photometric techniques. Networks in this field of research have been established through national and international collaboration with some astronomical institutes in the region. A larger telescope is being developed for more efficiency in operation; it is expected to be able to serve the future development of astronomical research in Thailand.

1. The Situation in Thailand

Thailand is one of the countries with very little science tradition in the past. Astronomy and other branches of science, in their original local form, were on modest levels. Astronomy was not practised as a pure science based on observation or theoretical background, but rather to discover items of immediate usefulness. Knowledge was mainly obtained from outside the country and research was hardly ever undertaken. For this reason, the development of astronomy in Thailand was slow.

In the last twenty years, astronomy became more popularized and interesting to the public. Both government and private sectors promoted many astronomical activities. However, higher education and research activities in astronomy are still growing rather slowly in Thailand. Some universities initiated

astronomy as a field of studies in the school of science, both at undergraduate and graduate levels. A few astronomical observatories were founded to serve educational, research and social needs.

However, due to the limited budget for the development of astronomy in Thailand, only a modest-sized telescope was provided for each observatory. Many local astronomers have put their efforts into developing astronomical facilities. Various kinds of detectors e.g. photoelectric photometer, CCD photometer, CCD spectrograph etc. were provided as equipment for existing telescopes.

2. What can be done with Small Telescopes?

Small telescopes 40 cm to 60 cm in diameter, with modern detectors, can do good astronomical research. If all the correct procedures of data collection are followed, data of good quality can be obtained from these telescopes.

Chiang Mai University, the main educational institute in northern Thailand, possesses an observatory named "Sirindhorn Observatory", founded in January 1977. The site of this observatory is in Doi Suthep-Pui National Park in Chiang Mai province at an altitude of 784 metres above sea level, at latitude 18° 47′ 19″.5 N and longitude 98° 55′ 29″.9 E.

From the beginning, the major instrument has been a 40-cm Cassegrain reflecting telescope with an SSP-3A solid-state photometer with standard BVRI filter system. The main purpose is to use this telescope to support astronomical research work, teaching and social public service at the Chiang Mai University.

The main concern after completion of the Observatory was how to design good projects for this small telescope and solid-state photometer. We first realized that if we worked on sufficiently bright stars, a small telescope is capable of the same photometric accuracy as a large telescope.

The next problem was: what types of celestial objects should be selected for observation with the telescope in order to gain the maximum outcome? We finally came to the conclusion that there are many areas, particularly in binary-star research, where powerful contributions can be made, even with only a small telescope.

Several astronomical projects on binary stars were then planned for the 40-cm Cassegrain reflecting telescope and solid-state photometer. Finally, many close binary systems e.g. RZ Cas, IU Aur etc. were observed and their light-curves were obtained. Times of minima and contact times were determined for U Cep, during the hours of totality, with this small telescope, as shown in Figure 1. Absolute photometry was also undertaken; extinction coefficients were obtained at Sirindhorn Observatory.

However, observations on faint celestial objects, normally stars fainter than eighth magnitude, showed that, for this small telescope and solid-state photometer, the fluctuations in light-curves were too large, under the sky conditions of Chiang Mai, for good-quality data to be obtained.

https://doi.org/10.1017/S0251107X00000900 Published online by Cambridge University Press

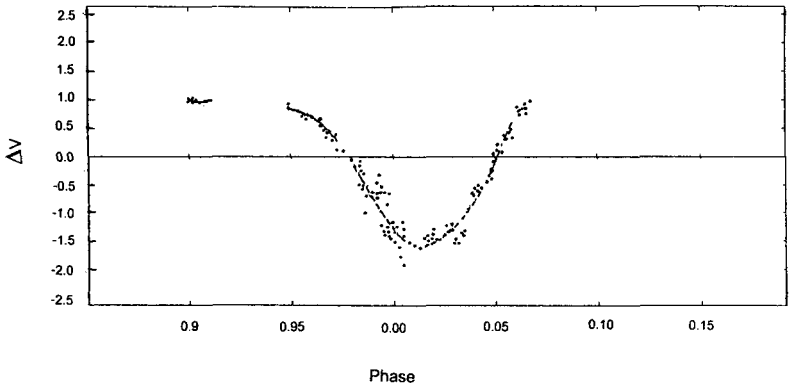

Figure 1. Observations of U Cephei at primary minimum, using the 40-cm telescope and SSP-3A photometer.

3. Improvements in using a Small Telescope at Sirindhorn Observatory

Since 1992, astronomical collaboration between Thailand and the Peoples' Republic of China has been initiated through government support from both countries. Two major research works were proposed. The first proposal emphasized photometric and spectroscopic studies of starspots on RS CVn binary systems, in collaboration with Beijing Astronomical Observatory. The second proposal emphasized photometric studies of some near-contact and contact binary systems, in collaboration with the Yunnan Observatory.

By these collaborations we received opportunities to use 60-cm, 1.00-m and 2.14-m telescopes in China for photometric and spectroscopic observations. More experience was gained in observational techniques with CCD photometers and spectrographs. We also gained more experience in using some software for data reduction and analysis, e.g. IRAF image-reduction program, Wilson-Devinney program etc.

The astronomical facilities at Sirindhorn Observatory were also improved during these collaborations. A Star I CCD camera system and CompuScope CCD 800 integrating camera were provided for use with the 40-cm Cassegrain reflecting telescope as CCD photometers. Observations on faint celestial objects are now easily made with the small telescope and CCD photometer. The IRAF image-reduction program has been installed under the LINUX operating system at Chiang Mai University.

A CCD spectrograph with a dispersion of 120 A mm^{-1} has been provided to upgrade astronomical research with the 40-cm Cassegrain reflecting telescope at Sirindhorn Observatory as shown in Figure 2. Several spectroscopic projects can be undertaken with this combination. Typical projects fall into two main categories: measurement of spectral properties to determine chemical and physical processes in celestial objects and measurement of radial velocities. A sample CCD spectrogram is shownin Figure 3.

https://doi.org/10.1017/S0251107X00000900 Published online by Cambridge University Press

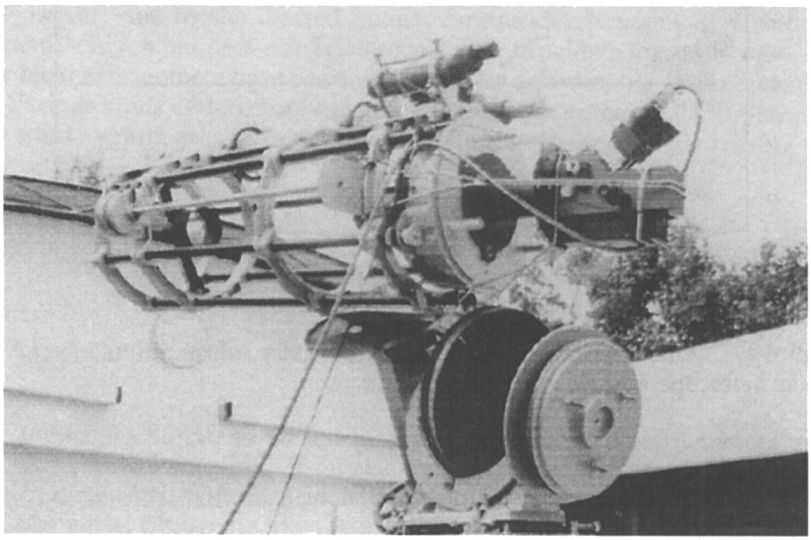

Figure 2. The 40-cm Cassegrain reflecting telescope and CCD spectrograph.

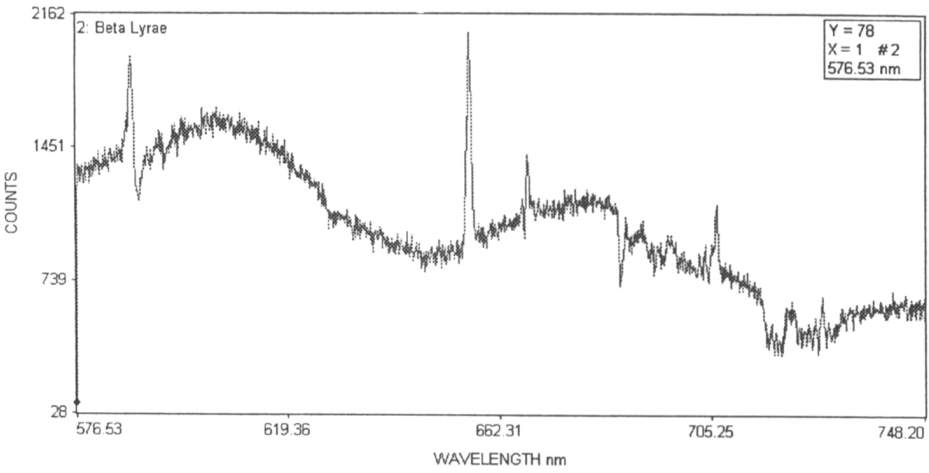

Figure 3. Spectrogram of β Lyrae obtained with the small telescope and CCD spectrograph.

https://doi.org/10.1017/S0251107X00000900 Published online by Cambridge University Press

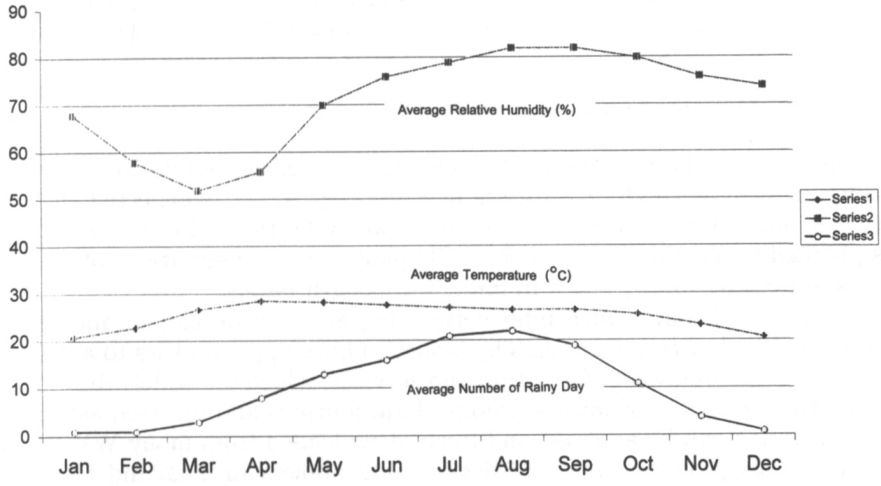

Figure 4. Climatic data for Chiang Mai averaged during 1988-1997.

4. Working in a Hot and Humid Climate

Chiang Mai is the major city in northern Thailand. The city lies in a fertile valley region between terraced mountain ranges. The climate of Chiang Mai is slightly different from those of other parts of Thailand, mainly due to the highland structure in this region. The altitude of Chiang Mai is about 300 metres above sea level. Climatic data for Chiang Mai, averaged for the period 1988-1997, are shown in Figure 4. From these data, the average climate in Chiang Mai is seen to be rather hot and humid, with average temperature and relative humidity of 25°.4C and 71%, respectively.

The cool season lasts from late October to the end of February. The average daytime temperature is 21°C; nights are much cooler, the temperature can go as low as 0°C in many areas. The coolest months are December and January. The hot season is from early March until the end of May, when the average daytime temperature is 30°C. The hottest month is April. The rainy season usually begins in early June and lasts until the end of October. The average temperature then is 25°C. The wettest month is September.

Heat, humidity and rain all jeopardize telescopes and other astronomical equipment. Therefore, regular maintenance is needed at Sirindhorn Observatory. In the hot climate of Chiang Mai, where the relative humidity remains above 60%, lenses, mirrors and other equipment have to be regularly checked and kept in a dry place. Crystals of silica gel are also used to protect lenses and mirrors from moisture. As the wet season approaches, the wet and humid weather presents an obstacle to any observation. The Observatory is always closed all through the wet season and maintenance of the telescope is done annually at the beginning of the cool season.

https://doi.org/10.1017/S0251107X00000900 Published online by Cambridge University Press

The sky in Chiang Mai is always clear in the cool season. There are about 130-160 nights in a year available for observations at Sirindhorn Observatory. Some spectroscopic observations can be made during the hot season.

5. Future Development

The construction of a new 50-cm Ritchey-Chretien reflecting telescope in a new housing at Sirindhorn Observatory is now in progress. It is expected that the new telescope will be installed at the Observatory by the end of the year 2000. It is planned to use this telescope for CCD photometric observations of celestial objects, especially binary stars, in multi-wavelength bands.

Computing facilites with inter-networking are now developed and widely used in Thailand; astronomers in Thailand also have opportunities to access astronomical data archives, information and services, which are widely distributed through the internet. Software, catalogs, data, journals and updated astronomical information can be accessed and freely downloaded from many WWW and ftp sites. This provides opportunities for astronomers in Thailand to obtain high-quality data and standard software packages which are very important in supporting future research and international collaboration for the staff at Sirindhorn Observatory, even though only small telescopes are available to them.

Acknowledgments. The author would like to express his thanks to Dr Alan Batten for giving him the opportunity to participate and to give an oral presentation in the Special Session of the XXIV General Assembly of the IAU in Manchester, U.K. Financial support from both the International Astronomical Union and Chiang Mai University are gratefully appreciated.

References

The following documents, although not specifically cited in the text, give further background information:

Model 10c Cassegrain Spectrograph, Optomechanics Research, Inc. 1997.

Model SSP-3A Solid State Stellar Photometer: Technical Manual for Theory of Operation and Operating Procedures, Optec., Inc, 1988.

Star I CCD Camera System: Hardware Reference Manual, Photometrics LTD., 1989.

The Compuscope CCD 800/1600 Integrating Camera: User's Hardware Guide, Compuscope Precision Instrument and Software, 1993.

Kannapan, S. and Fabricant, D., 2000, Sky and Telescope 100, No. 1, pp.125-132.

Percy, J.R., 1986, in *The Study of Variable Stars Using Small Telescopes*, Cambridge University Press, Cambridge.

Discussion

Dworetsky pointed out that the Starlink software distribution is available free of charge on CD-ROM, from the Starlink Project at the Rutherford-Appleton Laboratory in the U.K. It includes many types of extraction and reduction programs and can be obtained in LINUX, Solaris and Dec Alpha programs.

https://doi.org/10.1017/S0251107X00000900 Published online by Cambridge University Press