

ASTRONOMY AT CHIANG RAI RAJABHAT UNIVERSITY

Farung Surina*, Sirinapa Arjyotha, and Chainarong Raktham

Received: March 12, 2015; Revised date: June 28, 2015; Accepted date: June 29, 2015

Abstract

Chiang Rai Rajabhat University since 2006 has established its own observatory, operating 20-inch telescope on campus, and it is now one of the joint partners of Thai national regional observatories. The university observatory has three main duties. First, 20% of the telescope time is allocated for sole university student researches. Meanwhile researches produced by lecturers are generated from the data of Thai National Telescopes plus some from international collaborations. The research areas of interest among the lecturers cover the fields of binary stars, cataclysmic variable, novae, Archeoastronomy, and the related atmospheric science. Second, 80% of the telescope time is dedicated to the public outreach activities. By approximation, for three nights each week it is used by local elementary and high schools totaling over 3000 visitors per year. Third, the observatory is used for the short term class called a Certificate of Astronomy and Atmospheric Science (CAAS) for the public.

Keywords: Astronomy, observatory, Chiang Rai, Chiang Rai Rajabhat University, Astrophysics
Research Centre of Chiang Rai Rajabhat University, ARC-CRRU

Introduction

Chiang Rai Rajabhat University (CRRU), located at approximately 500 m above sea level, had built up an observatory with the 20-inch telescope on campus in 2006. According to the MOU between CRRU and the National Astronomical Research Institute of Thailand (NARIT), Chiang Rai Rajabhat University Observatory has become one of the joint partners of Thai national regional observatories in 2011. After eight years of hard working in serving the public, the observatory has promoted by the university to become the Astronomical

Research Centre of Chiang Rai Rajabhat University (ARC-CRRU) in 2014 in order to initiate the astronomical research in the university. The images of the observatory, the telescope and its instrument as well as the ARC-CRRU logo are shown in Figure 1.

The missions of the observatory, or so called ARC-CRRU now, have been the three main tasks including student researches, public outreach, and teaching. The aim of this article is therefore to present an overview of the work that ARC-CRRU would dedicate to Thai

Department of Physics, Faculty of Science and Technology, Chiang Rai Rajabhat University, 80 Moo 9, Bandu, Muang, Chiang Rai, 57100. E-mail: sc_farung@crru.ac.th

** Corresponding author*

astronomical society as will be discussed in the following sections.

Research Areas of Interest at ARC-CRRU

The fields of interest covers binary stars, cataclysmic variable, classical and recurrent novae, Archaeoastronomy, and the related atmospheric science. In each field, there are three lecturers presently working at ARC-CRRU including Dr. Farung Surina (classical and recurrent novae; Archaeoastronomy), Sirinapa Arjyotha (cataclysmic variables), and Dr. Chainarong Raktham (atmospheric science). In each academic year, there will be about 10 students at CRRU taking up a small student researches related to these topics and making use of the data from our own 20-inch telescope on the campus out of only 20% of the telescope time.

Dr. Farung Surina has been doing research on the Classical novae (CNe) and Recurrent novae (RNe). The CNe are interacting binary systems whose outbursts are powered by a thermonuclear runaway in accreted material

on the surface of a white dwarf (WD). The secondary stars in such systems fill their Roche lobe and material is transferred onto the WD primary star via an accretion disk (Starrfield *et al.*, 2008), as shown in Figure 2. Recurrent novae (RNe) show many similarities to CNe, but have had more than one recorded outburst. RNe play an important role as one of the suspected progenitor systems of Type Ia supernovae which are used as primary distance indicators in cosmology (Bode, 2010). Thus, it is important to investigate the nature of their central binary systems to determine the relation between the parameters of the central system and outburst type, and finally ascertain the population of novae that might be available to give rise to the progenitors of Type Ia SNe (Surina *et al.*, 2015). Low outburst amplitude is adopted as a criterion that may help distinguish RNe from CNe and was therefore used to select targets for observations from ground-based observations including the Liverpool Telescope and the Southern African Large Telescope (SALT) and also the full-sky space-based archive of the Solar Mass Ejection Imager (SMEI). We found that at least four objects



Figure 1. The photo of the observatory (upper left), the 20-inch telescope with taken with the author (lower left), the SBIG 2184 × 1472 pixel ccd camera mounted at the telescope (upper right), and the logo of ARC-CRRU (lower right)

currently classified as CNe are suggested to be RNe candidates based on their quiescent spectra. We also searched the SMEI archive for additional outbursts of bright CNe that might otherwise have been missed but did not find conclusive example (Surina *et al.*, 2015).

Sirinapa Arjyotha, working firmly with Narasuan University, is interested in studying new cataclysmic variables (CVs) which are bright around 12-20 with the orbital period of hours. This study allows us to examine the physics of accretion disks which can be seen in many types of celestial objects. Studying CVs is important since they are also suspected SNe Ia progenitors (Aungwerojwit, 2009).

Atmospheric vs. Astronomical Data as a Probe to Each Other at ARC-CRRU

To integrate astronomy to another important field, Dr. Chainarong Raktham, specialized in modeling the global warming, is making use of the atmospheric data from the weather station mounted on top of the dome of the ARC-CRRU observatory which reports and uploads data online every 10 min. With this high cadence of data, he plans to work on how atmospheric science and astronomy can be such a probe for each other.

The Particulate Matter (PM10) over northern Thailand was found to accumulate within about 161–401 $\mu\text{g}/\text{m}^3$ in 2007 and 32–80 $\mu\text{g}/\text{m}^3$ in 2008, consistent with the observed values, which were concentrations of the air pollutant (Amnuaylojaroen and Kreasuwun, 2012). It is found that organic carbon aerosol is the main contribution that affects the future (2030–2034) in Thailand especially northern Thailand. Moreover, the relationship of anthropogenic signal also contributes to intense hurricane in different parts of the world and Webster *et al.* 2005 gave a positive trend of intense tropical cyclones for last 30 years in any ocean basin including the Northwest Pacific (Holland and Bruyère, 2013). Thus, Dr. Chainarong initially investigates the sensitivity study to possibly simulate tropical cyclone with Regional Climate Model for SE Asia (Raktham *et al.* 2014) and now tries to apply the atmospheric data to measure and to model the pattern of the seeing above ARC-CRRU observatory.

Archeo-astronomical Researches at ARC-CRRU

Archeo-astronomy is the archeological investigation of ancient sites which may have employed astronomical alignment in their

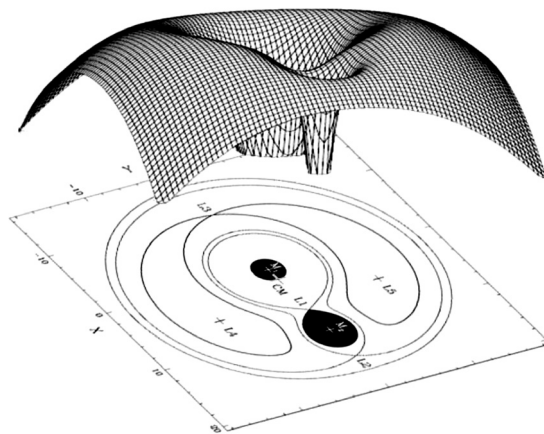


Figure 2. The equipotential surfaces in a binary system. The lines represent the effective gravity in the co-rotating frame of a binary system with a mass ratio (M_1/M_2) of 2. The points of zero effective gravity are the Lagrangian points ($L_1, 2, 3, 4, 5$). The Roche lobes are the equipotential surfaces that only intersect at L_1 . In this Figure, the secondary star has filled its Roche lobe and is transferring material to the primary (Picture from Surina 2014a)

construction. The work called “Existing Suwannaphum at Wat Pra Yeun” by Associate Professor Smai Yodindra and colleagues (Yodindra, 2007), as shown in Figure 3, has inspired us to investigate the alignment of other historical places in Thailand using the astronomical techniques and equipment. The angle measurement can be done by using a telescope identifying the apparent sun’s positions and then, with an observed local time, one can calculate the true direction of the alignment relative to the sun as proposed by Surina (2005).

Such investigation is now planned to be carried out by Dr. Farung Surina and her students at the historical places in Chiang Rai, e.g. the Navel City Pillar of Chiang Rai, in order to first check the method and the accuracy.

Even if it would turn out not to be astronomical aligned, we aim to educate the public about the apparent sun’s position via those historical places as the educative tourist destination. On the other hand, the method and technique would be applied to the more possible target to be astronomical aligned such as Prasat Hin Phimai, Nakhon Ratchasima, Thailand if the technique is successful.

Research Collaborations

The researches produced by lecturers are at the present generated from both national and international collaborations. We work with our colleagues in Naresuan University, Chiang Mai University, and NARIT to get data from the 2.4-m

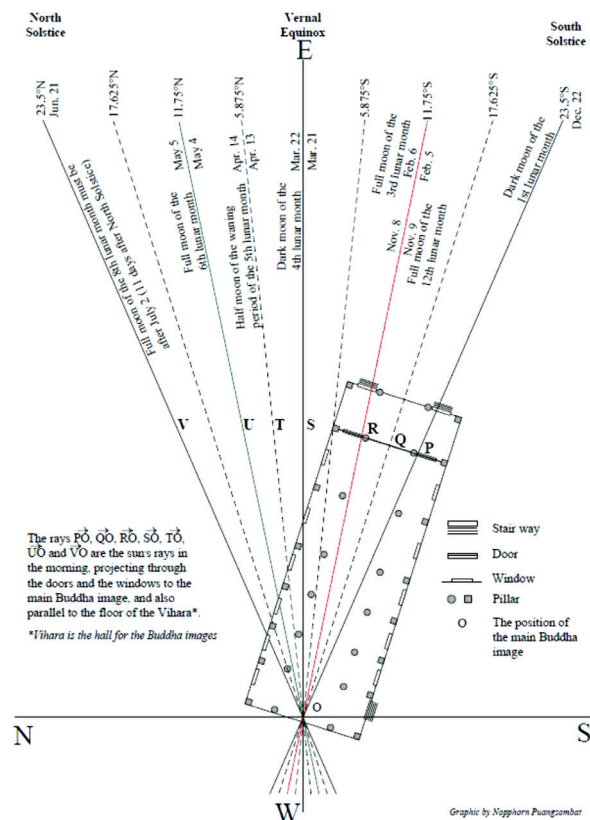


Figure 3. The planar projection diagram of the Sun’s rays at the Vihara of Wat Pra Yeun, Lamphun, Thailand. The diagram shows the pillars, windows and doors are somewhat relevant to the Sun’s rays. Picture from Yodindra (2007)

Thai National Telescope in Chiang Mai and the international collaborations such as the 2-m Liverpool Telescope of Liverpool John Moores University (see Steele *et al.* 2004 for details), the Southern African Large telescope (see Surina *et al.* 2014b), and Solar Mass Ejection Imager or SMEI of University of California San Diego (see Hounsell *et al.* 2010).

Public Outreach

Most of the telescope time (80%) at ARC-CRRU is dedicated to the public outreach activities. During five months of stargazing season (from October to February of each year), approximately three nights each week the telescope is used by local elementary and high schools from all over Chiang Rai and Phayao provinces, totaling more than 3000 visitors per year. The Observatory opens its doors to the public, including townspeople and students who wish to stay overnight, provides the tents for camping, as shown in Figure 4. The Astro-camps are hosted by Astronomy Club

staffs who are university students at CRRU. The student staffs operate the telescopes, answer many questions, and display educational videos, while the lectures are given by the lecturers. On special occasions, such as the passage of a bright comet, an eclipse, or an opposition of a prominent planet, as many as 200 visitors have crowded the observatory on a single night. All public outreach activities can be followed via a facebook page <https://www.facebook.com/groups/cruastronomyclub/>.

Teaching Astronomy

The ARC-CRRU is currently setting up a short term class called a Certificate of Astronomy and Atmospheric Science (CAAS) for the public. This can be either a non-degree course or a pre-degree course opened for people to take 90-hours classes.

For the university students at CRRU, the ARC-CRRU opens the free-elective class “Astronomy 1 PH2101” for all general students



Figure 4. Astro-camps at ARC-CRRU provide activities for townpeople and student over 3000 visitors per years. Picture from <https://www.facebook.com/groups/cruastronomyclub/>

to take. This course turns out to be more popular among the social science faculties rather than the scientific faculties.

Conclusions

With the equipment and staffs on hand, Chiang Rai Rajabhat University has established the Astronomical Research Centre of Chiang Rai Rajabhat University (ARC-CRRU) for three main duties; research, public outreach, and teaching astronomy to the public. However, the demand of Astro-camps from schools all over Chiang Rai and Phayao provinces are significantly increased so the number of staffs are inadequate. This is due to the lack of confidence in teaching astronomy in school of school teachers. Therefore, we suggest the inter-collaboration of training school teachers more frequently and more effectively.

References

- Amnuaylojaroen, T. and Kreasuwun, J. (2012). The prediction of aerosol optical depth over Thailand in the future. *Chiang Mai J. Sci.*, 39(2):311.
- Bode, M.F. (2010). The outbursts of classical and recurrent novae. *Astronomische Nachrichten*, 331:160.
- Darnley, M.J., Bode, M.F., Harman, D.J., Hounsell, R.A., Munari, U., Ribeiro, V.A.R.M., Surina, F., Williams, R. P., & Williams, S. C. (2013 in print). On the Galactic Nova Progenitor Population. in *Stella Novae: Future and Past Decades*, P. A. Woudt & V. A. R. M. Ribeiro (eds), ASPCS, 490
- Aungwerojwit, A. and Gänsicke, B.T. (2009). On the Orbital Period Distribution of Cataclysmic Variables from Hamburg Quasar Survey. *ASPC*, 404:276.
- Holland, G.J. and Bruyère, C.L. (2013). Recent intense hurricane response to global climate change. *Clim Dyn.* doi:10.1007/s00382-013-1713-0.
- Hounsell, R. (2010). Exquisite Nova Light Curves from the Solar Mass Ejection Imager (SMEI). *ApJ.*, 724:480.
- Raktham, C., Bruyere, C.L., Kreasuwun, J., Done, J., Thongbai, C., and Promnopas, W. (2014). Simulation Sentivities of the Major Weather Regimes of the Southeast Asia Region. Springer, May 2014, DOI: 10.1007/s00382-014-2156-y
- Starrfield, S., Iliadis, C., and Hix, W. (2008). *Classical Novae*. Bode, M.F. and Evans, A. (ed.) 2nd ed. Cambridge: Cambridge Univ. Press, p.77.
- Steele, I. A., Smith, R.J., Rees, P.C., Baker, I.P., Bates, S.D., Bode, M.F., Bowman, M.K., Carter, D., Etherton, J., Ford, M.J., Fraser, S.N., Gomboc, A., Lett, R.D.J., Mansfield, A.G., Marchant, J.M., Medrano-Cerda, G.A., Mottram, C.J., Raback, D., Scott, A.B., Tomlinson, M.D. and Zamanov, R. (2004). The Liverpool Telescope: performance and first results. In: Oschmann Jr., J.M. (editor). *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, October 2004, 5489: 679-692.
- Surina, F. (2005). The Astronomical Alignment of The Photharam Temple (Wat Jed Yod) of Chiang mai. A Bachelor degree dissertation of Chiang Mai University.
- Surina, F. (2014a). Investigation of the Progenitors and Outbursts of Classical and Recurrent Novae, [Ph.D. thesis]. Liverpool John Moores University.
- Surina, F., Hounsell, R.A., Bode, M.F., Darnley, M.J., Harman, D.J. and Walter, F.M. (2014b). A detailed photometric and spectroscopic study of the 2011 outburst of the recurrent nova T Pyxidis from 0.8 to 250 days after discovery. *AJ*, 147:107.
- Surina F., Bode, M. F., and Darnley, M. J. (2015 in print). Investigation of Galactic Classical and Recurrent Novae with Ground-based Observations and Solar Mass Ejection Imager. Publications of the Korean Astronomical Society (PKAS), The Pacific Rim Conference Series Proceeding.
- Yodintr, S. (2007). The Existing Suvannaphum at Wat Pra Yeun. *Chiang Mai Journal of Science*, 34(2): 143-149.