First Results of the Maidanak UBAI-NCU Collaboration

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Abstract

Some results of broadband and narrow-band CCD imaging of the young star cluster NGC 6823 made in August 2001 at Maidanak Observatory (Uzbekistan) are given. This signifies the collaborative initiative between the Graduate Institute of Astronomy of the National Central University of Taiwan (NCU), and Ulugh Beg Astronomical Institute of the Uzbek Academy of Sciences (UBAI). The two institutes, along with colleagues from Lithuania and and Latvia, are working together to modernize and instrument the existing telescope facilities at Maidanak to make use of the excellent astro-climate of the site. As a pilot project, we selected candidate young stars in NGC 6823, based on their 2MASS near-infrared colors. The youthful nature of some of them were then confirmed by spectra taken with the 2-m telescope at Beijing Observatory. This demonstrates that the combination of small telescopes and existing databases, such as those of 2MASS and ROSAT/Chandra, can yield fruitful science. Other Uzbek-Taiwan collaborations in the planning are outlined, including monitoring programs of young stars and variable stars.

1 Introduction and Background

Astronomy has well known ancient roots in China and Uzbekistan. In the last century Uzbekistan, being part of the Former Soviet Union (FSU), could develop her science including astronomy only within the frames of Soviet science. After dissolution of the FSU in 1991, Uzbekistan would have enjoyed independent research, except for a deep aftermath economic crisis and the infancy of the newly independent state. This caused financial difficulty for science in general, astronomy included. Therefore many scientists and engineers have escaped laboratories and science (sometimes the country as well) .

One effective way to advance astronomy research in Uzbekistan is through international cooperation by fostering the intellectual and financial resources of different countries in a mutually beneficial manner. This will help Uzbek astronomers to continue their research, and at the same time provide the international community telescope access to the Uzbek facilities.

Our collaboration was initiated in January 2001 during an IAU colloquium about small-telescope astronomy held in Kenting, Taiwan. In the subsequent summer a Taiwanese team visited Tashkent Astronomical Institute and observed at the Maidanak Observatory in Uzbekistan. A Memorandum on Scientific and Technical Collaboration was signed in early 2002 between the two institutions.

2 Why Maidanak?

Mount Maidanak (E66°56′; N38°41′) was chosen as the best for an astronomical observatory among a few dozen sites tested in the early 1960s. The reason was that within the FSU sovereignty the southern-western part of Central Asia was found to have a maximum number of clear nights, the highest atmospheric stability, and the least water vapor content in the air. Maidanak, at an altitude of 2600 m, is an isolated summit as part of the Pamir and Alay mountain range. Figure 1 shows the location of the Maidanak Observatory in a world map together with some other astronomical observatories.

An astro-climatic exploration starting August 1969 indicated that Maidanak had excellent seeing conditions, typically at subarcsecond levels, a sufficient number of clear nights, dark night sky, and good atmospheric transparency. It thus competes as one of the most favorable sites worldwide for ground-based astronomy. Latest tests with an ESO Differential Image Motion Monitor (also used for site testing in Chile) and a Generalized Seeing Monitor reconfirmed the previous conclusions (Hojaev 2001).

Currently the Observatory hosts a suite of telescopes, including a 1.5-m, a 1.0-m, and 9 others with aperture sizes of 60 cm or less. These facilities, when properly equipped, together with the astro-climatic and geographic advantages of the site, will make Maidanak very competitive for observational astronomy, especially in high-angular resolution imaging and long-term monitoring programs. The NCU, actively developing its own small-telescope facility in Taiwan, takes up the opportunity and teams up with UBAI, along with colleagues in Lithuania (ITPA, Vilnius University) and Latvia (IAPS and University of Latvia), for a collaboration, initially on open cluster study. This network of small telescopes include the Maidanak 1-m and Lulin 1-m for CCD imaging, and the Moletai 1.65-m and other telescopes for spectroscopy (with a CORAVEL-like spectrometer). In the future this network will expand to take part in global variability monitoring campaigns, e.g., for asteroseismology or X-ray binaries. Here we report the preliminary result of our study of the star cluster NGC 6823.

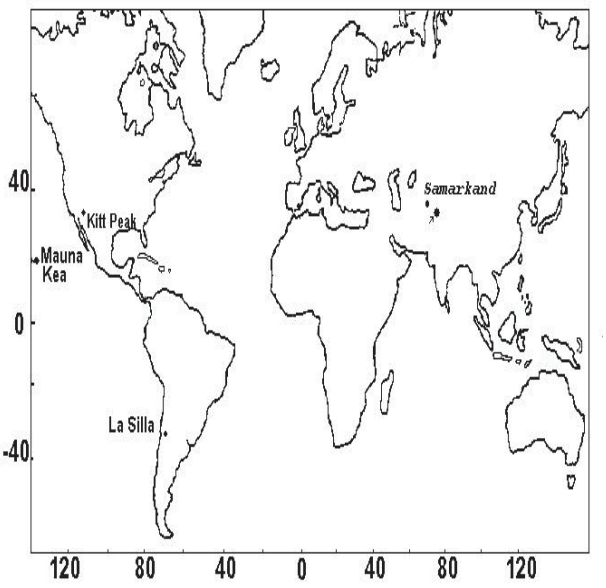

Figure 1: Maidanak Observatory of Uzbeksitan, marked by an arrow, is well located geographically for a global telescope network.

3 Pilot Observations of NGC 6823

We have selected a sample of candidate young stars (T Tauri stars and Herbig Ae/Be stars), based on their 2MASS near-infrared colors (Lee & Chen 2002), in the general region around the bright H II nebulosity NGC 6820 and the star cluster NGC 6823 (Figure 2). A total of 20 Herbig Ae/Be and 40 T Tauri candidates have been identified. Imaging observations were carried out at Maidanak Observatory in August 2001. Of the 10 nights of our observing run, 8 were perfectly clear and one was partially cloudy before a rainy day. The seeing was remarkable, with 0.6" average.

We utilized the 1.5-m and one of the 0.6-m telescopes. The 0.6-m, made by Carl Zeiss Jena (Germany), was used for survey imaging. A high sensitive (QE ∼90%) water-cooled CCD-camera AP8e SITe SI-003AB 1024 × 1024 CCD (Apogee Technology Inc.) was used, with UBVRI, Hα, [OIII] (500.7 nm; passband: 30 nm) and [SII] (672.4 nm (doublet); passband: 50 nm) filters. For the NGC 6823 observations, the R and I filters were used. The entire NGC 6820/6823 region was surveyed by a mosaic.

The 1.5-m AZT-22 telescope, made by LOMO (Russia) with near diffraction-limited optics and careful thermostabilization, allows for high-angular resolution imaging. It is

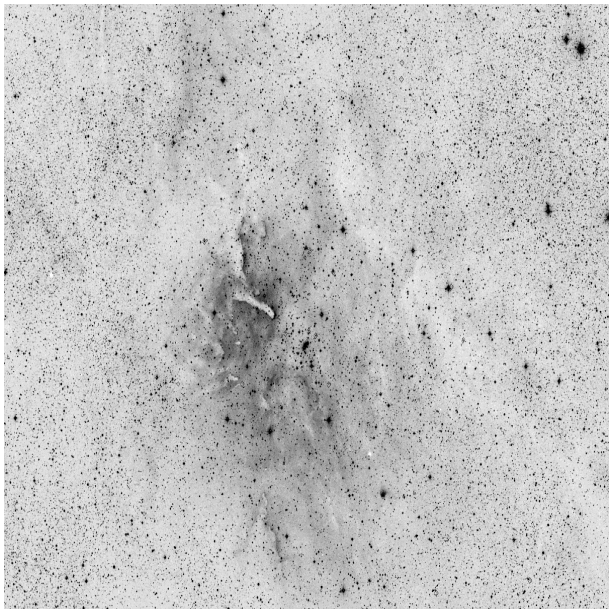

Figure 2: The DSS image of the central nebulosity of the young star cluster NGC 6823.

equipped with a professional LN-cooled CCD-camera, SITe-005 2000 × 800 CCD, provided by Maidanak Foundation and manufactured in J. Andersen's laboratory in Copenhagen (Denmark) with standard Johnson UBVRI as well as narrow band Hα (656.3 nm; 30 nm passband) filters. For our NGC 6823 observations, the 1.5-m was used in Hα for small regions that called for careful examination in the images taken by the 0.6-m.

Some of the young star candidates were observed in October 2001 and in February 2002 with the spectrometer on the 2.16-m of Beijing Observatory in China. Both medium-dispersion (D = 50 Å/mm, 1.2 Å/pixel and 2.5' slit) and low-dispersion (200Å/mm) spectra were obtained. Table 1 lists the emission-line objects we have found and Figure 3 shows typical low-resolution spectra of an early-type and a late-type young star, respectively.

RA (2000)	DEC	Class	J (mag)	H (mag)	Ks (mag)
19 42 27.9	+23 05 15	CTTS	11.05	10.28	9.69
19 42 55.0	+23 24 15	CTTS	10.34	9.33	8.40
19 42 57.7	+23 22 52	CTTS	12.95	12.21	11.62
19 43 04.4	+23 18 49	HAEBE	11.58	10.52	9.60
19 43 07.5	+23 26 03	HAEBE	12.75	11.81	10.97
19 43 09.0	+23 25 46	HAEBE	13.60	12.78	12.07
19 43 10.2	+23 25 31	HAEBE	13.56	12.30	11.38
19 43 21.0	+23 19 02	HAEBE	13.06	11.56	10.36

Table 1: H_α emission-line stars in NGC 6823

4 Into the Future

Our pilot project on NGC 6820/23 demonstrates the effectiveness of combining databases (2MASS, ROSAT or Chandra) and small-telescope observations (imaging photometry and spectroscopy) for a comprehensive study of a targeted star-forming region. As outlined earlier, the collaboration now includes Latvia and Lithuania astronomers for open clusters and variable star studies. A two-year grant has recently been awarded, under the Taiwan-Baltic Foundation, to reinforce the scientific interaction among these countries. We foresee scholar and student exchanges, joint workshop conferences, and research ventures. Our first endeavor would be to bring the Maidanak 1-m up to modern standards, and equip it with

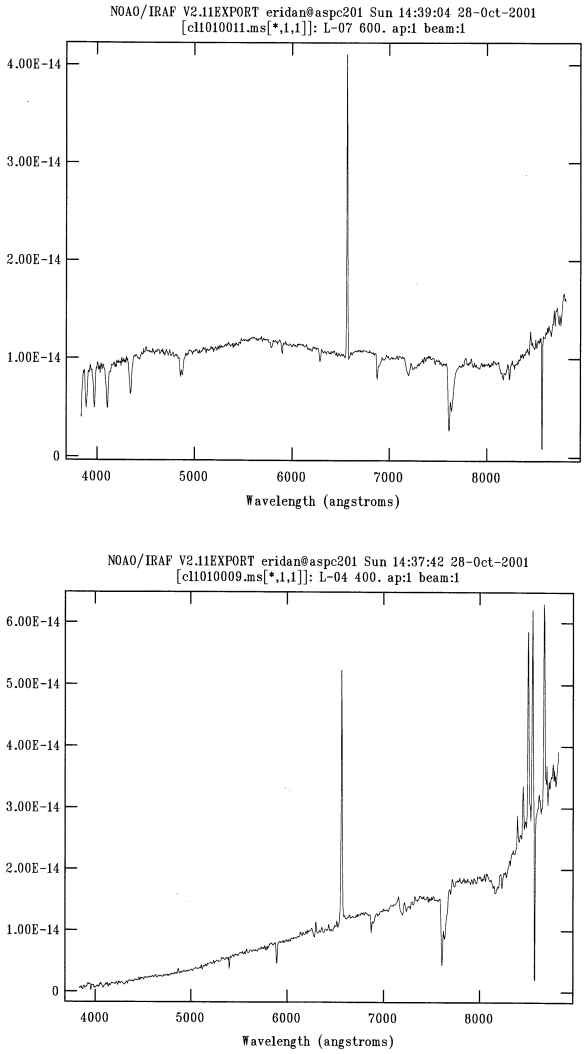

Figure 3: Sample spectra taken at the Beijing Observatory of (top) a Herbig/AeBe star 194304+231849, and (bottom) a T Tauri star 194255+232415, in NGC 6823, each showing a prominent λ6563 Å Hα in emission.

a good CCD camera. Instrumentation development will be our next major step, especially IR cameras for imaging and low-resolution spectrometer, for which new partners are very welcome.

We are very grateful to our partners in the Taiwan-Baltic collaboration, especially Drs. Grazina Tautvaisiene, Stanislava Bartasiute and Laimons Zacs for their kind participation in the Maidanak renovation and scientific cooperation. We acknowledge the assistance of BAO staff during our observing in Beijing. We are also thankful to the Taiwan-Baltic Foundation for awarding the grant NSC91-2112-M-008-036 for our project.

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