

# Strategic Plan of Development of Astromomy in DPRK

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**Abstract.** I would like to outline briefly, at first, an introduction to the Pyongyang Astronomical Observatory (PAO) and the present status of PAO. Next, I will mention about its future strategic plan for the development of astronomy research and education as well as the public outreach in DPRK, and the ways and means for its achievement, mainly emphasizing the international cooperation and support by the IAU such as via ROAD and cooperation programs.

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## 1. History of Korean Astronomy and Present State of Astronomy in DPR Korea

**Korean Ancient Astronomy:** Korea has a long and glorious history of astronomical observation and a large number of astronomical relics still remain in the territory of the DPR Korea.. Before BC 2000 3000, for the first time in human history, our ancestors carved star maps with more than a hundred stars on the lids of dolmen-graves in ancient Korea. More than ten thousand dolmen-graves have been discovered in the DPR Korea, about two hundred of which include star maps. Until now, hundreds of stars in tens of constellations have been identified on dolmen-grave star maps dating from before BC 2000 3000. Astronomical charts carved on stone have also been found that date from AD 400, during the era of the Three Kingdoms. Still later, in 1395, during the Ri-dynasty era, a star map was made called CHON SANG RYOL CHA BUN YA JI DO, that is regarded by our nation with great pride. Some researchers in Pyongyang Astronomical Observatory (PAO) have attempted to clarify inherent evolution in ancient Korean star maps from dolmen-grave, through the astronomical chart carved on stone, up to CHON SANG RYOL CHA BUN YA JI DO. Between BC 3000 and 1000, our ancestors established a professional state apparatus to conduct regular observation of astronomical phenomena. The first recorded Korean observation of an eclipse was in BC 54 and that of a comet was in BC 49. Other ancient records include systemic observation of novae and supernovae.

**Pyongyang Astronomical Observatory:** The Pyongyang Astronomical Observatory, State Academy of Sciences of the DPR Korea, established in 1957, is the unique national astronomical research institution that plays a leading role in professional research work and public enlightenment in the DPR Korea. It is located 20 km north east of Pyongyang city, on the hill 35 m above sea level. PAO consists of about 40 researchers and engineering staff, including 6 professors and 11 PhD-level astronomers. Its research departments are Theoretical Astrophysics, Solar-terrestrial Physics, Radio Astronomy, Astrometry and Astro-geodynamics, Ephemeris, Astronomical Instruments, Korean Ancient Astronomy and an Astronomical Data Service Centre. PAO also operates its own graduate school, with Masters and PhD courses in solar physics, stellar astrophysics, and astro-geodynamics. Currently, 2 doctoral students and 6 Master students work in the graduate school together with senior researchers from several departments of PAO. PAO operates two observing stations close to Pyongyang: Sunan Geomagnetic Observing

Station and Jaesan Solar Radio Observing Station. Our observatory is also responsible for determining, maintaining and disseminating the national standard time and calculating the almanac. The main observing facilities presently in operation are a 13cm refractor, a photoelectric transit instrument, a horizontal multi-channel spectrograph manufactured by PAO and 2 radio telescope constructed by PAO, with operating frequencies of 723 MHz and 600MHz respectively. The Observatory is in charge of producing of the country-level academic quarterly journal *Bulletin of Astronomy*, which is the sole astronomical journal of the country and also publishes an *Astronomical Calendar* and a *Nautical Almanac* annually. PAO also has a planetarium that plays an active role in public outreach for astronomy.

**Other Relevant Organizations:** The Kim Il Sung University, the largest university in the country, has an astronomy faculty within its physics department. Its astronomy faculty consists of 4 astronomers, who provide lectures on basic astronomy to undergraduate students in the physics department. The Kim Hyong Jik Normal University is equipped with a domed astronomical telescope, devoted to stimulating interest in astronomical education and research. The Pyongyang Childrens Palace has an astronomy circle, including about 30 primary school pupils, equipped with a telescope. This is a center of astronomy education for children. The Cosmic Exhibition in Pyongyang city is a center of public outreach together with PAO Planetarium.

**International Collaboration:** In recent years, international collaboration with DPRK astronomers has developed substantially. PAO has collaborated with astronomers in foreign countries to perform cooperative research works and train young researchers by means of up-to-date instruments and using observing data of the institutions. During the last decade, dozens of researchers and students have visited astronomical institutions in foreign countries, mainly China. These international contacts include the Cosmology Group, at Huairou Solar Observing Station, Changchun Observatory, Yunnan Astronomical Observatory, of National Astronomical Observatories of Chinese Academy of Sciences (NAOC), National Time Service Center (previous Shanxi Astronomical Observatory), Shanghai Astronomical Observatory, and International Center of Relativistic Astrophysics in Italy. Such visits have helped the development of astronomy in the country substantially. Recently, PAO members have taken active part in several educational activities carried out by the IAU. In 2007 three PAO staff members attended the 29th International School for Young Astronomers (ISYA). During the school, Prof. Edward Guinan, then chair of the IAU TAD program, suggested that the DPR Korea consider rejoining the IAU. This issue was discussed further between Prof. Edward Guinan and our astronomers through the 8th Pacific Rim Conference on Stellar Astrophysics in Thailand in 2008, and the discussion was followed up by a meeting held between Prof. George Miley, Vice-President of the IAU with me and two other DPRK astronomers at an IAU TAD school in Mongolia during 2008. In 2010, 4 PAO members attended the 31st ISYA, held in China. Recently, the IAU supported a visit of our 2 staffs invited kindly by NAOC, and during the visit an agreement was made between NAOC and PAO for future collaboration and regional cooperation. The IAU also donated about a dozen astronomical books to PAO through Prof Michele Gerbaldi. These books have been of great value in pursuing our work.

## 2. Strategic Plan for Astronomy Development in DPR Korea

The long-term vision of PAO is to raise the level of astronomy of DPR Korea in all areas of research, education and public outreach to an internationally high level. This includes: (i) Conducting cutting-edge professional research in all of the most important

areas of astronomy. (ii) Educating all people in our country in astronomy to a sufficient level to secure the benefit of astronomy as a tool of national capacity building. This objective is based upon appreciation for astronomy as a tool for technical advancement and intellectual capacity building. To achieve this ultimate vision, the first priority of PAO is to enlarge our human resources both quantitatively and qualitatively in all of professional research, school education and public outreach. It is a human-resource-centered policy.

PAOs goals for the next decade (2013-2022) are: (i) To raise the research level of several selected key areas of astronomy to an international standard; (ii) To build an infrastructure that can sustain a full-scale program of school education and public outreach in the DPRK.

The following areas of astronomy have been selected for such special focus: Stellar Astrophysics, Solar Physics, Cosmology and Applied Astronomy. Specific aspects that will be emphasized are: accretion disks on all scales, galactic dynamics, structure formation in the early universe, coronal mass ejections and solar activity and solar and astrophysical dynamos. A prerequisite for achieving these goals is to form a group of at least 10 senior researchers and more than 30 PhDs in the key areas.

In addition we plan to build an infrastructure for education and outreach, with sufficient personnel and material resources involved to achieve the above goals. We envisage continuing and expanding existing efforts and launching new programs.

Elements of the decadal plan are;

**1) Increasing the PAO budget by the State Academy of Sciences:** Because astronomy is an essential ingredient in the science and technology of the DPR Korea, a continual and increasing support from internal, national sources is indispensable for its stable and further development. This year, the Academy of Sciences finalized a plan for a gradual increase in the PAO budget. Initially these funds will be appropriated for reconstructing the PAO headquarters building, updating existing observational instruments and purchasing computers for our research infrastructure. In order to enlarge human resources to carry forward development and education of astronomy, funds will also be applied to provide as many postgraduate positions as possible.

**2) Carrying out Postdoctoral and Doctoral works in foreign advanced institution:** The most efficient way for us to enlarge human resources for astronomy quantitatively and improve it qualitatively is to provide senior researchers with postdoctoral courses or extended research visits and to educate PhDs, through doctoral courses in foreign advanced institutions. The IAUs support in negotiating the provision of such postdoctoral and doctoral positions is a main motivation for rejoining the IAU. To achieve our goals we need 2 postdoctoral positions (for less than 2 years periods) every 2 years and 2 doctoral positions (for 3 years periods) every year. An objective of this training will be to produce senior researchers, who will be key members of our staff, lead research groups and be supervisors for domestic postgraduate courses.

Recently, an agreement on collaboration was made between NAOC and PAO, that provides for the initiation of joint PhD programs and advanced training programs. Funds to support this program consist of an in-kind contribution from the NAOC and scholarships from the foreign student program of the Graduate School of Chinese Academy of Sciences (GSCAS). These programs will both provide an important start to the training needed to accomplish the DPRK astronomy strategic plan and are excellent examples of regional collaboration.

We look to the IAU OAD and the IAU East Asia ROAD to help us to find suitable postdoctoral and doctoral positions at up-to-date institutions abroad, including European countries and the East Asia region. We hope that leading astronomers, who are deeply concerned for astronomy development in our country, will exercise their

influence in making available non-IAU resources and in-kind contributions from astronomy institutions throughout the world.

**3) Taking active part in the IAUs existing and newly launched programs:** Previous IAU educational and development activities such as ISYA and TAD have played an important role in awakening and improving astronomy development in our country. We consider the IAUs newly launched programs such as Astronomy Institute Twinning and the Endowed Lecturer Program to be very useful in context of our national strategic plan. We hope that twinning of the PAO with appropriate institutions abroad will help provide material resources for research and education, advice on the optimum strategy for DPRK astronomy and help in creating new disciplines and graduate courses.

**4) Developing Astronomy Education in Universities** More than ten DPRK universities including Kim Il Sung University; University of Natural Sciences and Kim Hyong Jik Normal University have physics departments, and the graduates are a good source of future astronomy researchers. We intend to provide active backing to these universities in intensifying their astronomy education; especially by giving lectures on general astronomy and through supervising graduate students from these universities. During the next decade, PAO will work constructively to introduce astrophysics as a subject in the physics curriculum of DPRK university physics departments.

**5) Activating school education and public outreach** The 5-member PAO planetary group is presently involved in school education and public outreach throughout the country. The group is responsible for liaison with relevant organizations including the Ministry of Education and for the development of educational resources. They also devote effort into propagating the knowledge of astronomical phenomena and universe through widespread communication. The group will be expanded to a center for coordinating domestic activities and introducing external advanced resources in school education and public outreach.

Our guiding principle in developing material resources for education and outreach is that of introduction and distribution rather than self-creation. We shall concentrate our efforts on introducing ready-made resources from over the world and distributing them widely to each level of domestic organization rather than making completely new material. Our staff will endeavor to accumulate high quality educational resources in consultation with appropriate organizations throughout the world and to spread these widely to schools and other relevant organizations in the DPRK.

**6) Constructing Observational Instruments** Nowadays frontier astronomical facilities are too expensive even for rich countries to build alone. For the present, we will endeavor to access international observational data and build a computer infrastructure that can reduce and analyze these data using open-source data reduction packages. We hope to obtain knowledge about the use of such packages and practical techniques of data reduction through the visits to foreign institutes mentioned above. In order to gain expertise in the manufacture of instrumentation and telescopes for future work, we also plan to construct some small-scale instruments. In the near future we have a plan to make a telescope for an artificial satellite.

### **3. Concluding Remark**

PAO, the main body for astronomy in the DPRK, has launched an ambitious strategic plan to boost astronomical research, education and public outreach and to use it as a tool for national development. Rejoining the IAU is an important milestone towards achieving this plan. The plan involves training senior researchers and graduate students, who will become our future key astronomers. The plan needs both internal and external

support and is based on the assumption that we will obtain maximum support from the IAU's various Astronomy for Development programs including the OAD and the East Asia ROAD/LOAD. We also seek help from the IAU in negotiating long-term visits at foreign institutions needed to realize our goals. We sincerely hope that the IAU and the world astronomy community will support our ambitious efforts.

#### **4. Acknowledgement**

On the significant occasion of rejoining the IAU, I express my sincere thanks to Prof. George Miley for kind advice and patient effort and Prof. Ed Guinan for his pioneering suggestion and continual care. I thank the Local Organizing Committee for supporting attendance of DPR Korea delegation to IAU General Assembly.