Session:	**[B2A-2] S7 : Historical Astronomy, Astronomy Education and Public Outreach**
Date:	August 19, 2014 (Tuesday)
Time:	11:00~12:35
Room:	Room B (Room 103)
Chair:	Il-Sung Nha

[B2A-2-1] **11:00~11:20**

[Invited] Pre-Copernican Non-Ptolemaic Planetary Models: Copernicus and His Islamic Predecessors

Tofigh Heidarzadeh (University of California, USA)

A few decades after the rise of Islam (610 A.D) in Mecca, Muslims were able to establish a vast empire extending from North Africa to India. It was through this expansion that they became familiar with the theory and practice of astronomy from various Persian, Indian, and Hellenistic traditions. During the eighth and ninth centuries, Ptolemy's Almagest was translated at least four times into Arabic, and soon Muslim astronomers not only realized that they have to perform new observations to improve the accuracy of basic astronomical parameters, but also they started to find solutions for the most important cosmological problem found in the Ptolemaic astronomy. This problem simply was Ptolemy's violation of the Aristotle's concept of the uniform circular motion of celestial bodies around the central earth. Ptolemy, by introducing the equant point – the point that was not coincided with the earth but considered as the center of uniform motions – produced a system that was not consistent with the accepted cosmological principle.
In this paper, the author will review the major innovative planetary models proposed by Muslim astronomers and will emphasize mainly on those concepts or models which were used by Copernicus in the construction of the heliocentric system of the world. In addition, the possible routs of the transmission of the Islamic non-Ptolemaic planetary models to the Latin West will be discussed.

[B2A-2-2] **11:20~11:35**

The Change of the Timekeeping System(時刻制度) Before and After the Solar Calendar in Korea

Goeun Choi (University of Science & Technology, Korea) and Young Sook Ahn

In the Joseon Dynasty, A day divided into 100 gak (刻, approximately a quarter) or 12 Sijin (時辰, double hours) that was composed of half-Sijin as Cho (初, beginnings of double hours) and Jeong (正, mid-points double hours). The timekeeping system was changed from 100 gak to 96 gak with using shíxiàn calendar (時憲曆) in 1654. And then 12 Sijin was changed to the 24-hours system in the same manner as current with the enforcement of the solar calendar (太陽曆) in 1896. We examine the record of the timekeeping system and notation of hours from the astronomical almanacs and official gazettes during 50 years after 1896. The Korean Empire Government first adopted the standard meridian of the Gyeongseong (former name of the Seoul in Korea) in 1908. However the mean solar time was applied to the almanac since 1913. After 1896, the year of enforcement of the solar calendar, the expression of times on a Korean almanac was written with O-jeon (午前, morning) and O-hu (午後, afternoon). The definition of 1day 24-hours system was first stated by the legislation in 1900. The expression of times was used 24 hours without O-jeon and O-hu in 1916. In daily life, the 24-hours system has used in parallel with 12-hours system divided into morning and afternoon even today.

[B2A-2-3] **11:35~11:50**

An Account of Indian Astronomical Heritage from 5th CE to 12th CE

Somenath Chatterjee (Sabitri Debi Institute of Technology, India)

Astronomical observation is the beginning of scientific attitude in the history of mankind. According to Indian tradition, there existed 18 early astronomical texts (siddhāntas) composed by Surya, Pitamaha and many others. Varāhamihira compiled five astronomical texts in a book named pancasiddhāntikā which is now the link between early and later siddhāntas. Indian scholars had no practice to write their own name in their works so, it is very difficult to identify them. Āryabhata is the first name noticed in the book Āryabhatiya. After that most of the astronomers and astro writers wrote their names in their works. In this paper I have tried to analyze the works of the astronomers like Āryabhata, Varāhamihira, Brahmagupta, Bhāskara I, Vateswara, Sripati and Bhāskaracharya; in modern context and get an account of Indian astronomical knowledge. Āryabhata is the first Indian astronomer in stating that the rising and setting of the sun, the moon and other heavenly bodies is due to relative motion of the earth caused by the rotation of the earth about its own axis. He also makes the 'yuga' theory (one Mahayuga = 432000 tears). Varāhamihira compiled pancasiddhāntikā and wrote Bṛhatsamhitā. Brahmagupta is the most distinguished astronomer known to us. His two major works are i) Brahmasphutasiddhānta and ii) Khandkhādaka. Bhāskara I was the follower of Āryabhata. His three known works are Mahābhāskariya, Laghubhāskariya and Āryabhatiyabhāsya. Vateswara follows Āryapaksha and Saurapaksha. His master work is Vateswarasiddhānta. Sripati in his siddhāntasekhara, gives the rule for determining the moon's second inequality. Bhāskara II wrote most comprehensive astronomical work in Indian astronomy. The result of this work is an account on India astronomical heritage has been completed. These works are written in Sanskrit language. Very few of these manuscripts are translated in to English but many are yet to be done. So, it is necessary to translate these astronomical texts in to English with proper commentary for the modern scholars. This paper will be helpful in this work.

[B2A-2-4] **11:50~12:05**

A Study about Celestial Movement Apparatus of Choi Yu Ji's Honcheonui

Seon Young Ham (Chungbuk National University, Korea), Sang Hyuk Kim, and Yong Sam Lee

This is a study about celestial movement apparatus of traditional astronomical clock in China and Korea in Joseon Dynasty. We investigated and analyzed the relics and literature records of China and Korea in Joseon Dynasty, and carried out conceptual design of the celestial movement apparatus of Choi Yu Ji(崔攸之, 1603-1673)'s Honcheonui(渾天儀, armillary sphere). There were astronomical clocks, traditionally made in East Asia, which had celestial movement apparatuses, reproducing the movements of heavenly bodies mechanically. Through the investigation of relics passed down to the present, Chinese literatures such as 『Jiù Táng Shū(舊唐書)』 「Tiān Wén Zhì(天文誌)」, 『Sòng Shǐ(宋史)』, 『Xin Yi Xiang Fǎ Yào(新儀 象法要)』 etc, and Korean literatures in Joseon Dynasty such as『Jo Seon Wang Jo Sil Lok(朝鮮王朝實錄)』, 『Jeung Bo Moon Heon Bi Go(增補文獻備考)』, we examined the structures of celestial movement apparatuses of astronomical clock which were made in China and Korea in Joseon Dynasty. The first celestial movement apparatus of Chinese astronomical clock was at the <Shuǐ Yùn Hún Tiān Fǔ Shì Tú(水運渾天俯視圖)> in the Tang(唐, 618-907) dynasty. After the age, it was found at the astronomical clock in the Northern Sung(北宋, 960-1127) dynasty only. We found out two features of the celestial movement apparatuses of Chinese astronomical clocks. First, both solar and lunar movement apparatuses were started to be installed in early astronomical clocks. Second, the celestial movement apparatuses of <Shuǐ Yùn Hún Tiān Fǔ Shì Tú> and <Shuǐ Yùn Yí Xiàng Tái(水運儀象臺)> were run manually. The apparatuses of other astronomical clocks were run automatically, but they showed shortage that both solar and lunar movement apparatuses were installed and run on a plane or the ecliptic. The celestial movement apparatuses made in Joseon Dynasty had different features. First, astronomical clock in early period of Joseon Dynasty had solar movement apparatus only. Both solar and lunar movement apparatuses were firstly installed on the Choi Yu Ji's Honcheonui. Second, solar and lunar movement apparatuses were installed on Hwangdohwan(黃道環, the ecliptic ring) and Baekdohwan(白道環, the moon-path ring) respectively and run automatically. Through these features, we found out that the apparatus of astronomical clock in Joseon Dynasty showed more advanced aspect than that in China. Especially, the celestial movement apparatus of Choi Yuji's Honcheonui was developed into mechanical structure using Gyeonggak(梗角), Chajeon(叉箭), and Banggak(方角), so-called gears. Based on the content of <Juk Won Ja Seol(竹圓子說)> in the 「GanHoJip(艮湖集)」, Choi Yu Ji's personal collection of works, we suggested the process of development of the celestial movement apparatus in the Joseon Dynasty through the study and conceptual design of the celestial movement apparatus.

[B2A-2-5] 12:05~12:20

Imkanur Rukyah as the Best Method in Determining Islamic Caledar

Anuwar Syafiq B. Idrus (Islamic Science University of Malaysia, Malaysia)

Rukyah method is seeing the new moon at sunset on the 29th day of Hijri with the naked eye or with the help of tools such as the telescope and the theodolite. This method is used for the purpose of determining the beginning of Ramadan, Shawwal and Dhu al-Hijjah in the country before the adoption of rukyah and mathematics.
According to the calculation method enacted, the new month starts when the conjunction occurs before sunset regardless of whether or not there is new moon. Hijri calendar that uses this concept called the Ultimate Hijri Calendar. If the existence of the new moon after the conjunction serve as the basis of determining the initial months, the calendar is called Hijri Calendar Wujudul - hilal.

[B2A-2-6] 12:20~12:35

Study on the Manufacturing Technology and Astronomical Analysis of Portable Sundials of the Late Joseon

Sang Hyuk Kim (Korea Astronomy and Space Science Institute, Korea), Ki-Won Lee, and Yong Sam Lee

It is known that many clocks were manufactured by Jinju Kang family in the late Joseon dynasty. In particular, Kang Yun (姜潤, 1830~1898) and his younger brother, Kang Geon (姜健, 1843~1909), made twelve portable sundials: nine of scaphe sundials and three of planar ones. In this study, we investigate the physical characteristics of those sundials and verify the accuracy of the lines related with the time for three sundials. First, we compiled the catalogue of twelve sundials with the ownership, material, dimension, production year, and so forth based on various references. Then, we examined the lines of the hour and 24 seasonal subdivisions including the position of Yeongchim (gnomon) for selected sundials. The basic methodology is to obtain the 2D image of a real sundial using a camera or scanner and compare with the result of theoretical calculations. As a result, we found that the sundials are moderately precise considering the fact that they are portable. In conclusion, we believe that the projection method employed in this study is useful to verify the accuracy of a sundial, in particular of the old one needed to minimize physical damage.