CONTEMPORARY ISSUES IN SPACE TECH LAW: BATTLE BETWEEN SATELLITES AND TELESCOPES

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ABSTRACT

A number applied scientists have shown their reservations and called for a legal action to stop the launch of a vast number of satellites designed to beam high speed internet around the world until their impact on the night sky can be assessed. This paper is an attempt to highlight the pragmatic importance of a purpose-built telescope namely LAMOST and argues that telescopes such as LAMOST which provides reliable data can help in the stoppage of opening a new battle front in space. Whereas satellites blur the vision of sophisticated telescopes such as LAMOST. Until the decisions of scientific community about the satellites are not incorporated in proper legal framework, companies should stop their aggressive advancements towards space through satellites.

Keywords: *LAMOST, CAS, Space Law, Commercial Satellites, SPACEX*

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СОВРЕМЕННЫЕ ПРОБЛЕМЫ КОСМИЧЕСКОГО ПРАВА: БИТВА СПУТНИКОВ И ТЕЛЕСКОПОВ

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АННОТАЦИЯ

Ряд ученых-прикладников высказали свои оговорки и призвали к судебному процессу, чтобы остановить запуск огромного количества спутников, предназначенных для передачи высокоскоростного Интернета по всему миру, до тех пор, пока не будет оценено их влияние на ночное небо. Эта статья представляет собой попытку подчеркнуть прагматическую важность специально созданного телескопа, а именно LAMOST, и утверждает, что телескопы, такие как LAMOST, которые предоставляют надежные данные, могут помочь предотвратить открытие нового фронта битвы в космосе. Тогда как спутники затуманивают видимость сложных телескопов, таких как LAMOST. До тех пор, пока решения научного сообщества о спутниках не будут включены в надлежащую правовую базу, компании должны прекратить свое агрессивное продвижение в космос с помощью спутников.

Ключевые слова: *LAMOST, CAS, космическое право, коммерческие спутники, SPACEX.*

BACKGROUND

The sky has been a personification of mystery since antiquity and astronomical observations have been the only source of noting time. The movement of celestial bodies was used as a time scale from doing daily chores to the fixing of dates for the festivals. Communal man wouldn't transit between revolutions if it wouldn't have the facility to observe, relate and contextualize these natural phenomena above its head.

We have seen Mesopotamian agriculturalist and shepherd of 3000B.C. glancing at the position of the sun or the direction and length of his shadow to judge the time of the day. We imagine the astronomer-priests of Babylon grouping the brighter starts into constellations and recording on clay tablets the waxing and waning of the moon, the occurrence of eclipses and the rising and setting of planets. Man passed from the observation of simple sun dials at a very early date. The earliest known shadow clock in an Egyptian one of the tenth to eighth century B.C.[1] and the first sun dials no doubt consisted of a vertical post surrounded by steps or graduations on stones. The invention of water clocks and calendar increased the pragmatic importance of the sky and the involvement of astrologers and astronomers and later philosophers in the Astro studies is an evidence that how mystic the space was in its nature throughout the history.

[1] Henry C. Kind (1955), The History of the Telescope, Dover Publications, INC. NY

With the passage of time and advancement in science, observations started becoming more and more empirical and the role of predictions decreased. People started realizing that the sky is not supported by columns of mountains. Even though, we have scientific instruments to ensure certainty beyond doubt in comprehending certain astronomical phenomena, but we also have astrologers, philosophers and even applied scientists who claim differently than the mainstream applied scientific community. Ancient battle among scholars of that time about earth being flat or round still exists and taken seriously by certain members of scientific community.

The curiosity of exploring space and taking extreme actions for this is not new to the mankind. There have been a number of incidents when different kings tried to build towers to reach to the heavens by using an army of slaves. A present-day example of this can be the launching namouras satellites with an aim to explore space in detail. However, this can better be done by using telescopes which are providing more sophisticated data without travelling that far.

INTRODUCTION

The paradigm shift in the traditional scientific thought has always been dangerous for the truth seeker. For example: Galileo's challenge of the Church's authority through his assault on the Aristotelian conception of the Universe eventually got him into deep trouble with the Inquisition. Late in his life he was forced to recant publicly his Copernican views and spent his last years essentially under house arrest. His story certainly constitutes one of the sadder examples of the conflict between the scientific method and "science" based on unquestioned authority. Unfortunately, there still are many forces in modern society that would shackle the scientific method of open enquiry in ideological chains of one kind or another.[2] This doesn’t mean that the scientists should halt their experiments or go into a static phase. This means that the challenges bring more inertia in scientific discoveries and increase the confidence of those working to contribute towards the betterment of the mankind.

This similar scenario happened when US firm SpaceX who has already launched 240 satellites as part of its planned Starlink constellation of up to 42,000 satellites. Others, such as the UK company OneWeb, plan to launch hundreds of their own. There are currently 1500 active satellites orbiting Earth. Starlink satellites have created bright streaks in some telescope images affecting astronomical observations.

[2] Galileo: the Telescope & the Laws of Dynamics, http://www.pas.rochester.edu/~blackman/ast104/galileo12.html

Some including us worry that the thousands of bright points of light could alter the sky for the public and astronomers forever.

Michele Maris at the Astronomical Observatory of Trieste in Italy who is the part of the group calling for legal action said, "The ideal thing would be to stop the deployment of these kind of satellites until the problem is very well studied. We have to understand what the impact is on the sky,". The group says that to halt mega constellations, a case could be brought to the International Court of Justice to argue that the night sky is a shared human right under the World Heritage Convention. "The harm here is damage to our cultural heritage, the night sky, and monetary damages due to the loss of radio and other types of astronomy," the astronomers write. Or a case could be filed against the Federal Communications Commission (FCC) in the US for licensing Starlink, which the group says may have been in breach of the National Environmental Policy Act (NEPA).[3] "It would be desirable to adopt contingent and limiting resolutions to be ratified as shared international rules," the astronomers write. They also suggest that in the meantime all mega constellations should be put on hold. An associated petition to temporarily halt further launches has more than 1400 signatures.

Chris Johnson, a space law advisor at the Colorado-based pressure group the Secure World Foundation, says that the chances of legal action being successful are slim, but there is an argument that could be made. He also mentioned, "It's time for the larger space community to think what means more: ground-based astronomy and traditional views of the night sky, or cheaper internet from space."

The FCC said in a statement it "strongly reject[ed]" any claims it has violated NEPA and its approval of Starlink was "entirely lawful". SpaceX has attempted to ease concerns by testing a Starlink satellite coated in a darker material so that it won't reflect as much light. However, launches are ongoing, with SpaceX set to send up 1500 Starlink satellites in 2020. "If it is not possible to leave a better planet for future generations, we can at least try not to make it worse," says group member Stefano Gallozzi at the Astronomical Observatory of Rome in Italy.[4]

PROBLEMS WITH SATELLITES

Different empirical studies have already highlight the impact for ground based astronomical observations in different windows of the electromagnetic spectrum

[3] New Scientist,Legal Action Could Be Used To Stop Starlink Affecting Telescope Images, https://www.newscientist.com/article/2232324-legal-action-could-be-used-to-stop-starlink-affecting-telescope-images/#ixzz6gk7hf8r6

[4] Stefano Gallozzi and others (2020), Cornell University, Astrophysics > Instrumentation and Methods for Astrophysics, Concerns about ground based astronomical observations: a step to safeguard the astronomical sky, https://arxiv.org/abs/2001.10952

coming from the deployment of fleets of telecommunications satellites. A particular attention is given to the problem of crowding of circumterrestrial space by medium/small size orbiting objects. Depending on their altitude and surface reflectivity, their contribution to the sky brightness is not negligible for professional ground-based observations. With the huge amount of about 50,000 new artificial satellites for telecommunications planned to be launched in Medium and Low Earth Orbit, the mean density of artificial objects will be of >1 satellite for square sky degree; this will inevitably harm professional astronomical images leaving trails on them. Only one of these project, Starlink@SpaceX's, authorized by US Federal Communication Commission, plans to deploy about 42,000 not geostationary satellites, which will shine in sky after sunset and before sun dawn.

Satellites will be observed in deep field images and particularly negative for scientific large area images used to search for Near Earth Objects, predicting and, eventually, avoiding possible impact events. Serious concerns are also common to other wavelengths eligible for ground based investigation, in particular for radio-astronomy, whose detectors are already saturated by the ubiquitous irradiation of satellites communication from Space stations as well as from the ground. The risk of running into the "Kessler syndrome" is also noteworthy. Understanding the risk for astronomical community, a set of actions are proposed in this paper to mitigate and contain the most dangerous effects arising from such changes in the population of small satellites.[5]

LEGACY OF LAMOST

According to the Xinhua news, China has released 11.25 million spectra of celestial objects acquired by the Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST) to astronomers worldwide, according to the National Astronomical Observatories of China (NAOC) of the Chinese Academy of Sciences. As the world's largest spectral survey telescope, LAMOST marks the world's first spectral survey project to obtain more than 10 million spectra.

Spectra are key for astronomers to read celestial bodies' chemical compositions, densities, atmospheres and magnetism. Among the released spectra, there are 9.37 million high-quality spectra, which is twice the total number of other astronomic surveys internationally. There are also 6.36 million stellar spectra, creating the largest stellar parameter catalog in the world.

[5] Ibid

Finished in 2008, LAMOST began regular surveys in 2012. The telescope is located in NAOC's Xinglong Observatory, in north China's Hebei Province. The telescope can observe about 4,000 celestial bodies at one time. It can also help calculate the age of more than a million stars, providing basic data to study the evolution of our galaxy.

According to Zhao Yongheng, a researcher from the NAOC, LAMOST's latest spectra data is the world's most complete astronomical data set with the largest survey volume, the highest sampling density and the largest number of samples. It provides a reference for the formation and evolution of the Milky Way as well as other galaxies. More than 100 institutes and universities from the U.S., Germany, Belgium, Denmark and other countries and regions around the world are using this data to carry out research on the evolution of the Milky Way, stellar physics and special celestial body search. NAOC has set up an online platform for the spectra data release, allowing users to download it for free.

With LAMOST, Chinese astronomers have reported a series of new findings. They have discovered the most lithium-rich giant star ever known. They also discovered more than 10,000 metal-poor star candidates, which may help shed light on the early universe and the emergence of the first stars and galaxies.[6]

STRUCTURE OF LAMOST

The Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST), as one of the National Major Scientific Projects undertaken by the Chinese Academy of Science, is a special quasi-meridian reflecting Schmidt telescope located in Xinglong Station of national Astronomical Observatory, China (a national facility open to the astronomical community). After being approved by National Development and Reform Commission on Oct.1997, LAMOST began construction on Sep. 2001 and finished on Oct. 2008. LAMOST project smoothly passed the national acceptance on Jun. 2009. LAMOST optical system consists of a reflecting Schmidt Ma at the northern end, a spherical primary mirror Mb at the southern end and a focal surface in between. Mb has a size of 6.67m×6.05m, which consists of 37 hexagonal spherical sub-mirrors, each of them having a diagonal diameter of 1.1m and a thickness of 75mm. Ma is 5.72m×4.40m, which consists of 24 hexagonal plane sub-mirrors, each of them having a diagonal diameter of 1.1m and a thickness of 25 mm. Both the primary mirror and the focal surface are fixed on their ground bases,

[6] Xinhuanet, Chinese telescope collects more than 11 mln spectra, http://www.xinhuanet.com/english/2019-03/29/c_137934065.htm

and the reflecting corrector tracks the motion of celestial objects. Hence, the celestial objects are observed around their meridian passages.

Figure 1 LAMOST

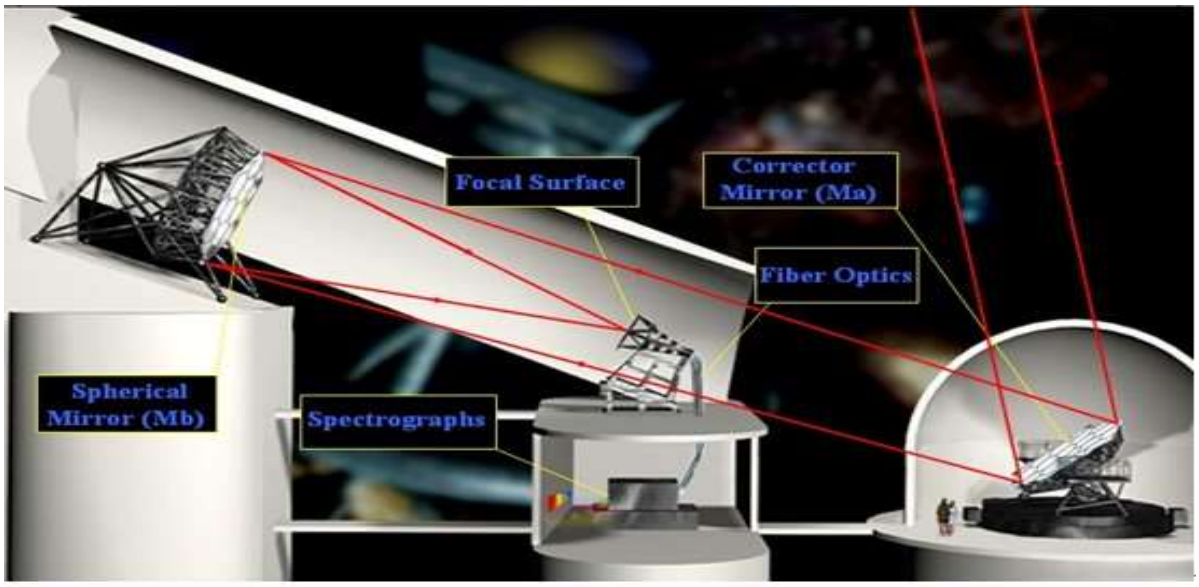

Figure 2 LAMOST overview

As shown in figure 2, the light collected is reflected from Ma to Mb, again reflected by Mb and forms image of the observed sky on the focal surface. The light of individual objects is fed into the front ends of optical fibers accurately positioned on the focal surface, and then transferred into the spectrographs fixed in the room underneath, to be dispersed into spectra and recorded on the CCD detectors, respectively and simultaneously. The overall concept and key technical innovations makes it a unique astronomical instrument in combining a large aperture with a wide

field of view. The available large focal surface accommodates up to 4000 fibers, by which the collected light of distant and faint celestial objects down to 20.5 magnitudes is fed into the spectrographs, promising a very high spectrum acquiring rate of several ten-thousands of spectra per night.

The engineering of LAMOST consists of eight subsystems, optic system, active optics and mirror supporting system, mounting and tracking system, telescope control system, focal plane instruments, telescope enclosure, observatory control and data processing, and input catalogue and survey strategy. After the two year commission period from 2009, it is doing a pilot spectroscopic survey with LAMOST from October 2011 to June 2012. The first year observation mission of the LAMOST regular survey launched on September 28, 2012, and have been already successfully accomplished on Jule15,2013.[7]

DISCOVERIES BY LAMOST

Answers to the number of questions have become clearer. Such as: How has the universe been formed and evolved? The Milky Way, our own galaxy, consists of several tens of billions of stars. How has it been formed and evolved? In the whole history of human civilization, these basic and profound questions inspirit people to explore the nature. The optical spectrum contains abundant physical information of distant celestial objects, and acquiring spectra of a large number of celestial objects is desperately needed in astronomy, which touches various cutting-edge researches of contemporary astronomy and astrophysics.

The scientific goal of LAMOST focuses on the extragalactic observation, structure and evolution of the Galaxy, and multi-wave identification. The spectroscopic survey carried out by LAMOST of tens of millions of galaxies and others will make substantial contribution to the study of extra-galactic astrophysics and cosmology, such as galaxies, quasars and the large-scale structure of the universe. Its spectroscopic survey of large number of stars made substantial contribution to the study of stellar astrophysics and the Galaxy. Its spectroscopic survey combining with the surveys in other wavebands, such as radio, infrared, X-ray and γ-ray made important contribution to the cross-identification of multi-waveband of celestial objects. The large sample spectroscopic sky survey has been made dramatic progress in recent years, especially due to the success of 2dFand SDSS projects. With its powerful spectroscopic survey ability, LAMOST is expected to push it deeper and wider.

[7] Telescope, LAMOST, http://www.lamost.org/public/instrument?locale=en

To maximize the scientific potential of the facility, wide national participation and international collaboration have been emphasized. The survey has two major components: the LAMOST ExtraGAlactic Survey (LEGAS) and the LAMOST Experiment for Galactic Understanding and Exploration (LEGUE) survey of Milky Way stellar structure.[8]

BATTLE BETWEEN SATELLITES AND TELESCOPES

It is obvious that the flow of satellites into the sky will dull the vision of telescopes such as LAMOST which are providing sophisticated data and constantly unlocking the mysteries of this universe. Hundreds of satellites are already revolving around the Earth and many of them are not for any purpose. There only purpose to satisfy the ego of some country, company or even persons to demonstrate their dominancy on space. Contrary to this, telescope are purpose build and a lot of time and resources are invested in their maintenance so that sophisticated data could be generated for the applied scientists.

Moreover, the history has proved that the celestial observations from the Earth are more beneficial for the mankind as whole as compared to the exploration of space by physically going there.

CONCLUSION

If the question is of reliability, the data from the LAMOST has proven to be reliable and helpful in giving answers to many questions related to the structure of our universe. The persistency in data collection is very important to keep our results continuous, thus findings about our universe reliable. On the other hand, majority of the satellites are being lunched on experimental basis. These satellites directly impact on the functioning of the telescope and interact the process of data collection.

Furthermore, there is not any legal framework which regulates the satellites in space. Many countries and now commercial projects are being lunched to dominate the space. Thus, there is a need to formulate a proper legal framework in which satellites and commercial projects related to them will operate. Until then, for the better functioning of the telescopes, satellites missions should be put on halt for the betterment of the mankind.

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