Integration and Sharing of Traditional Chinese Star Chart Resources in WWT: A Postprint

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Abstract

In the era of big data, effectively leveraging information technology to protect and disseminate China' s traditional starry sky culture represents a new challenge confronting astronomers and educators. Harnessing the powerful data fusion capabilities and advanced data visualization technologies of the WorldWide Telescope platform enables the integration and sharing of traditional Chinese starry sky culture data resources to magnificently showcase Chinese starry skies. Further integration into digital resources accessible for public self-directed learning and use, promoting the dual-driven approach of technology and education, embodies a crucial development direction for modern cultural dissemination and science popularization education.

Full Text

Integration and Sharing of Chinese Traditional Star Resources with WWT

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Abstract

In the era of big data, effectively leveraging information technology to protect and disseminate China' s traditional star culture presents a new challenge for

astronomers and educators. This paper utilizes the powerful data fusion capabilities and advanced visualization technologies of the World Wide Telescope (WWT) platform to integrate and share Chinese traditional star data resources, presenting a magnificent Chinese starry sky. These resources are further developed into digital educational materials accessible for public self-directed learning, promoting the dual-driven development of science and education—representing an important direction for modern cultural dissemination and science popularization.

Keywords: Chinese traditional star; World Wide Telescope; integration; sharing; digitalization

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Astronomy has entered a data-intensive and data-driven era. Effectively utilizing astronomical scientific data resources, integrating them, and promoting the open sharing of data and high-quality learning resources holds positive significance and important value for promoting traditional culture.

In the big data era, the protection and inheritance of Chinese traditional culture is a highly worthwhile research topic, particularly the Chinese traditional star system, acclaimed as a world cultural treasure. Most Chinese people are familiar with Western constellations such as "Scorpio" and "Orion," yet few know about the "Three Enclosures and Twenty-Eight Mansions." This is due to both the impact of Western constellation systems and the fact that ancient Chinese star charts exist in numerous versions with frequent errors and abstruse content, resulting in the lack of proper development and inheritance of Chinese ancient star culture. To date, most materials on Chinese ancient star culture remain in paper format, with some resources even endangered and at risk of being lost if not promptly preserved. How to effectively use information technology to protect and disseminate China' s traditional star culture is a new challenge facing astronomers and educators.

This paper employs modern astronomical observation data and visualization techniques, using for the first time the World Wide Telescope (WWT) as a platform to fuse the restored Song Dynasty traditional star data from *Wandering Through Chinese Starry Sky* [1], modern HR and SAO star catalog data, and the vivid, artistic representations of ancient Chinese asterisms drawn by Mr. Xu Gang. This integration digitally presents the Song Dynasty starscape and develops it into high-quality digital resources for public self-learning and research, openly shared with society to promote the dual-wheel drive of science and education.

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1. Chinese Traditional Star Data Resources

The authors of *Wandering Through Chinese Starry Sky* used Pan Nai' s compiled Huangyou Star Catalog as a framework, referencing historical documents

and comparing modern star charts to reconstruct a complete set of Huangyou asterism data. This encompasses the entire sky, including the Three Enclosures and Twenty-Eight Mansions, totaling 283 asterisms and 1,464 stars. To help the public better understand and appreciate the profound cultural heritage of Chinese traditional asterisms, Mr. Xu Gang began designing artistic representations of these asterisms in 2007, filling a void in illustrated Chinese star charts and, for the first time, presenting to the world a magnificent and grand "celestial realm."

2.1 Overview of WWT

The China Virtual Observatory (China-VO) , leveraging the robust research and technological capabilities of the National Astronomical Observatories, Chinese Academy of Sciences, has long been committed to data-driven education and science communication using the WWT visualization environment. Compared with other astronomical software, WWT offers several distinct advantages. First, it is based on massive amounts of authentic astronomical data, integrating hundreds of terabytes of data resources from major observatories worldwide into a seamless digital universe and presenting it to the public through highly innovative visualization methods. Second, it features simple and convenient tour creation capabilities with strong interactivity and inquiry-based learning potential; educators can develop tour-based courseware for instruction, while students can create their own cosmic tours to share with others [2]. Third, it provides extensive multi-wavelength data resources, allowing users to explore the sky not only in visible light but also in infrared, ultraviolet, radio, X-ray, and gamma-ray wavelengths. Fourth, it supports diverse operational and interactive methods—for instance, by installing ASCOM control software, users can interface WWT with telescopes; connecting an Oculus Rift enables immersive 3D experiences, and the platform is fully compatible with advanced devices such as Xbox and Kinect.

2.2 Visualization of Traditional Star Data Resources

The WWT Excel plugin offers powerful functionality, enabling the visualization of analyzed and processed data according to established standards to vividly present astronomical phenomena. The authors utilized WWT to comprehensively visualize ancient Chinese starry sky data, including the magnitudes and spectral types of 1,464 stars, the connections for 283 asterisms, the names of 341 asterisms, and nearly 100 asterism patterns.

First, for star point visualization, Excel was used to map stellar magnitudes and spectral types to celestial coordinates, which were then imported into WWT via the Excel plugin. Different sizes and colors of points represent various stellar

magnitudes and spectral types, with partial data shown in Figure 1 [Figure 1: see original paper].

Second, asterism connections were visualized by consulting *Wandering Through Chinese Starry Sky* to understand traditional linking patterns, then using Excel' s Linestring function to map stellar coordinates to connection standards before importing into WWT. The connections for the asterisms 【North Pole】, 【Four Advisors】, and 【Gouchen】 are illustrated in Figure 2 [Figure 2: see original paper].

Third, to display asterism names in WWT, the platform' s layer functionality was employed. Celestial coordinate data for individual stars or asterisms were matched with their names in Excel using the Text function, then imported into WWT, with results shown in Figure 3 [Figure 3: see original paper].

Fourth, asterism patterns were visualized by loading custom WWT "wtml" files. The pattern for "Chefu" (Chariot House) is shown in Figure 4 [Figure 4: see original paper]. Nearly 100 such patterns have been integrated into WWT and saved as the "chineseheaven.wtml" file.

2.3 Resource Open Sharing

The integration and open sharing of astronomical data resources are crucial for astronomical research and education popularization [3]. To further promote resource sharing, the four aforementioned data layers were integrated into a "Chineseheaven.wwtl" file using WWT' s "New Layer Group" function (where "wwtl" is WWT' s custom layer group format). This file is openly available to the public through the WWT Beijing Community website , allowing users to download it for research, teaching, or science popularization purposes. Additionally, users can locate the "Chinese Starry Sky" resources by adding "WWT Beijing Community" in WWT' s "Community" section, as shown in Figure 5 [Figure 5: see original paper].

The integration of Chinese traditional star data resources using WWT holds significant importance. First, WWT enables the presentation of Chinese traditional star culture through rich multimedia, enhancing the authenticity and expressive power of the resources [4]. Traditional Chinese star charts primarily consist of star points, connecting lines, and text, with numerous scattered asterisms that are difficult to comprehend through chalkboard instruction or verbal teaching alone. By leveraging WWT' s advanced visualization technology to merge Chinese star data with artistic asterism patterns, the presentability of traditional Chinese starry sky culture is substantially enhanced, helping audiences better understand this cultural heritage. Using these data resources, the tour *Wandering Through Chinese Starry Sky: The Purple Forbidden Enclosure* won first prize in the second "Sharing Cup" National College Student Science Resource Sharing Service Innovation Competition. The tour skillfully displays

the connections and patterns of asterisms within the Purple Forbidden Enclosure, including【Canopy】, 【Pole】, 【Five Emperors' Seats】, 【Celestial Kitchen】, and 【Celestial Flail】, as shown in Figure 6 [Figure 6: see original paper]. This visually intuitive presentation stimulates public interest in actively engaging with Chinese traditional star culture.

Second, WWT's interactive teaching capabilities allow educators and students to learn Chinese traditional star culture through human-computer "dialogue"by creating cosmic tours, thereby enhancing the inquiry-based nature of the resources. This approach simultaneously improves students' practical skills and research potential while promoting the dissemination of Chinese traditional star culture in primary, secondary, and higher education. WWT' s tour creation functionality transforms traditional transmission methods—turning static into dynamic, abstract into concrete, planar into three-dimensional, partial into panoramic, and simulated into authentic—achieving superior learning outcomes. For example, in the tour, certain asterisms of the Purple Forbidden Enclosure are matched one-to-one with the *Song of Pacing the Heavens* (as shown in Figure 7 [Figure 7: see original paper]), combining text with visuals to create immediate imagery. This enables learners to identify asterisms while reading the poem, unconsciously mastering the entire celestial sphere.

Third, this integration promotes the popularization of Chinese traditional star culture. Through WWT-integrated digital educational resources, all members of the public can access and use these materials via the internet, bringing top-tier professional astronomical resources—previously accessible only to astronomers—within reach of every ordinary citizen.

Fourth, it transforms silent paper-based resources into audible, instantly shareable digital materials, facilitating the dissemination and inheritance of Chinese traditional star culture. The *Wandering Through Chinese Starry Sky: The Purple Forbidden Enclosure* tour has been converted into videos that can be shared and learned from without requiring the WWT environment, achieving excellent outreach results through social media platforms such as Weibo, WeChat, and forums.

Fifth, it promotes the integration of Chinese traditional star culture with Western constellation culture, enhancing mutual appreciation, permeability, and fusion between different cultural systems. WWT' s rich astronomical data resources enable convenient integration and utilization, facilitating comparisons between ancient and modern, Chinese and Western systems. This allows for intuitive visualization of differences between the two star cultures, promoting East-West cultural exchange and strengthening the vitality of Chinese traditional star culture.

In summary, integrating Chinese traditional star data resources through the WWT platform helps protect, inherit, disseminate, and promote ancient Chinese star culture, enabling more people to understand the glorious achievements of ancient Chinese astronomy. It facilitates the fusion of ancient Chinese star

data with modern astronomical observations, enabling comparisons across time and promoting East-West cultural exchange. By processing Chinese traditional star culture data into educational resources for autonomous learning by scientists, educators, and students, the profound cultural and scientific information embedded in ancient Chinese star systems can be disseminated, developed, and utilized informatically—representing a deep integration of science, culture, art, and technology.

China possesses a long history and splendid culture, with vast amounts of traditional Chinese culture gradually becoming deeply embedded in the lifeblood of the Chinese nation, forming culturally distinctive genes. In the era of big data, advanced information technology bears an inescapable responsibility for inheriting and developing the unique characteristics of Chinese traditional culture. Effectively utilizing information technology and emerging communication methods to digitize traditional Chinese cultural resources—transforming singular, static text-based dissemination into vivid multimedia formats—fully excavates their modern significance. By inheriting the essence of Chinese traditional culture, promoting exchange and fusion between Chinese and Western cultures, and extending the vitality of Chinese traditional culture, we look forward to Chinese civilization once again leading global cultural trends.

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Note: Figure translations are in progress. See original paper for figures.