

Probing the universe

Giant telescope provides path to fun, profit

Potential revenues seen in tourism: Visitors welcome, but not cellphones

By YANG JUN
in Pingtang, Guizhou
and CHEN MENGWEI
in Beijing

As the world's largest single-aperture radio telescope for scanning the universe — China's FAST — made its debut on Sunday, the local government rolled out its own grand vision for high-end tourism. It takes the form of tourism, with ticket prices as high as 668 yuan (\$100).

Perhaps the better news is that, starting on Monday, a trial run at the scenic spot will begin at a discounted price of 368 yuan per person, almost 50 percent off, according to the tourism bureau of Pingtang county, Guizhou province, where the Five-hundred-meter Aperture Spherical Telescope sits. As many as 2,000 people can visit the site each day.

The ticket is more like an all-day pass that gives tourists access to most spots related to the giant telescope, including a 2,700-square-meter visitor's stand overlooking the installation, which is the size of 30 soccer fields. There's also an astronomy-themed museum and a cultural park. The FAST itself is not open to the public. Shuttles within the visitors' zone are free.

Going into the zone gives visitors a day of relief from the ball and chain of the internet in an era where everybody is connected to everybody by mobile phone, like it or not. The gigantic yet delicate radio telescope tolerates zero disturbance from cellular services, according to Peng Bo, deputy manager of the FAST project. Hence the governor of Guizhou signed an executive order in 2013 forbidding the use of any electronic



A news reporter takes a selfie at the telescope site in Pingtang, Guizhou province, on Saturday. The scenic spot will open to visitors on Monday. HOU LIQIANG / CHINA DAILY

devices within 5 kilometers of the telescope. Visitors are required to deposit all digital devices, including cellphones and digital cameras, in lockers before going into the signal-free zone. Conventional film cameras are allowed, for those who

want to take pictures. And if a person really needs to make a phone call, several free landlines can be found at the visitors' stand and tourist center. The hotspot-shaped FAST and the high-altitude natural basin in which it rests have jointly "created a rare scenic

New facility, new rules

A local regulation took effect on Sunday to further secure the safe operation of China's FAST, the world's largest single-aperture telescope, in Qiannan Buyi and Miao autonomous prefecture, Guizhou province. The new regulation, the first of its kind in Qiannan,

came out on the same day the big telescope was officially put into service. It prohibits unrelated construction within 5 kilometers of the telescope — designated as the "core zone". Improper existing buildings will be torn down. Logging, hunting, land reclamation and other unauthorized

activities that may harm the environment are banned. Rule-breakers will be fined from 1,000 to 10,000 yuan (\$150-\$1,500). No garbage of any sort may be dumped in the area, and offenders will be punished.

— CHEN MENGWEI

spot that perfectly combines modern technology and geology, which is an unparalleled tourism resource that will have a significant impact on the development of Guizhou's tourism industry", the Pingtang tourism bureau said on its official website. The United States' 305-meter Arecibo Observatory in Puerto Rico attracts about 130,000 tourists every year, bringing in more than \$50 million annual-

ly, a report in The Paper said. Li Yongzhong, 61, a retired middle school teacher, said: "I think the telescope will be beneficial to all Chinese and even people from all over the world. Here we get our income mainly from agriculture, and there are almost no other industries. I think it will bring a lot of tourists from other regions of the county and even from foreign countries that will increase people's income."

Yang Shenghu, 31, a farmer, said: "There have been big changes in transportation conditions here. It's quite something and brings prestige in talking with outsiders. I expect to find a job in town instead of leaving my hometown."

Hou Liqiang contributed to this story.

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FAST: Guizhou telescope is major breakthrough in science innovation

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outer space, the radio signal it sends will be similar to the signal we can receive when a radiation beam from a pulsar (spinning neutron star) is approaching us," Qian said.

Zhang Shuxin, deputy general manager of the project, said foreign scientists can start conducting their own space research at FAST once debugging is completed.

But before that is done, "we wouldn't feel very good" to start distributing time slots to foreign astronomers, he said.

"It's such a huge thing, you see," Zhang said. "And the technologies we use in both its driving device and reflecting surface are entirely new to us."

"As the first step, a parabola of 300 meters in diameter will be formed on the surface, with the help of the driving device, and start receiving signals," he explained. "We need to gather experience and develop methodology to ensure detection accuracy for that."

It may be three to five years before FAST can guarantee its best performance, Zhang said.

FAST's large hemispheric surface is made up of 4,450 1.3-millimeter-thin reflecting panels, each weighing 427 to 482.5 kilograms. The first panel was installed in August 2015. Patching all the panels together took 11 months.

Sun Caihong, deputy chief engineer for FAST, said the telescope's operators will focus on strong radio sources already known to them. He said scientists are also expecting to make some progress in research by analyzing data they receive in the debugging.

Wang Qiming, chief engineer for FAST, said: "We would like to finish debugging quickly. FAST will be the world leader in 10 to 20 years. We would like to make full use of this period."

FAST already had a good start, scientists said. In a recent test, it received a set of high-quality electromagnetic waves sent from a pulsar about 1,351 light-years away.

It was the best-quality signal that FAST had received since it started its trial obser-

vation in mid-September.

Wang said the most challenging part of debugging is adjusting the laser that performs measuring tasks on the reflecting surface. As long as the laser measuring device detects errors in a timely way, scientists can make immediate adjustments.

The telescope is located in an almost-perfect spherical landform, so there was no need to dig a hollow for it. The valley in Guizhou was chosen also for its karst landform, which ensures good drainage, meaning rainwater won't gather and damage the reflecting surface of the telescope.

Philip Diamond, director-general of Square Kilometer Array, a large multiradio telescope project, said: "FAST is the biggest single dish in the world. It will have new technology, and a new receiver system, to be much more efficient. Astronomers and scientists are queuing up all around the world to use it."

Diamond said the SKA, an international project in which China is a member, will be even larger than FAST. "But ours won't be in the form of one single dish. It will be hundreds and thousands of smaller dishes spread over a large area. They will work together," he said.

"You can think of FAST as a wide-angle lens and the SKA as a zoom lens. FAST will find a lot of objects, and SKA will offer a lot of details on these objects. They will be very complementary."

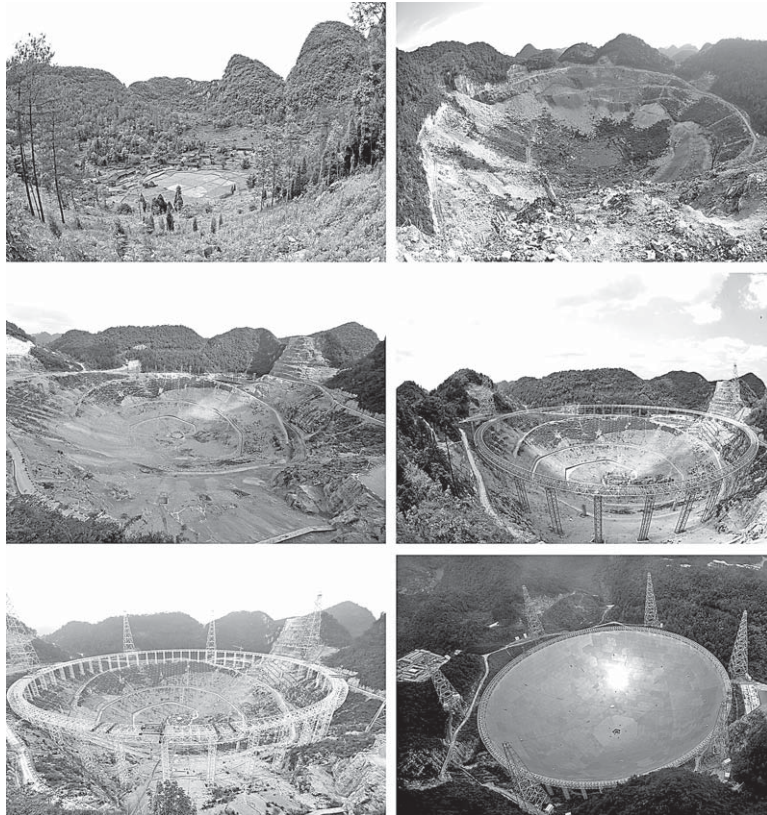
Anthony Beasley, director of National Radio Astronomy Observatory of the United States, said there are many areas of radio astronomy in which FAST will bring Chinese astronomers to the fore.

Beasley said it likely will be two to three years, while the telescope is brought to its full strength, before they use it.

Construction of the nearly 1.2 billion yuan (\$180 million) FAST project started in 2011, 17 years after it was proposed by Chinese astronomers.

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Xinhua and AP contributed to this story.



Bowl-shaped valley becomes space-age wonder in these start-to-finish photos showing the construction of the world's largest telescope in Guizhou province. HE JUNYI / FOR CHINA DAILY

From concept to completion

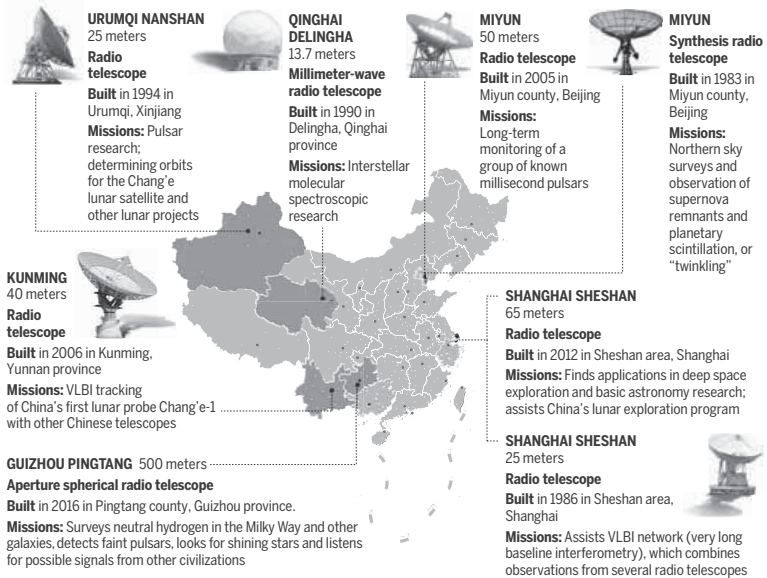
July 2006: Pingtang in Guizhou province named as the place to build the world's largest spherical radio telescope, known as the FAST project.
July 2007: Funding for the FAST project is approved by the National Development and Reform Commission.
December 2008: Groundbreaking ceremony.

2009: Sixty-five residents of the valley — members of 12 families — where the telescope was located are moved to a nearby town.
March 2011: Construction begins. It will last five years.
November 2015: Scientists carry out the final step in testing a key component of the telescope — the telescope's "retina," a

mechanism weighing 30 metric tons and suspended 140-160 meters above the half-finished reflector dish that will collect signals from the universe.
July 2016: Final reflector board is installed, completing the major work of the FAST project.
Sept 25: Project completed.

— CAO YIN

Where the telescopes are



Source: Skyandtelescope.com, universetoday.com, URSI

CHINA DAILY

China's big dish will gather data, listen for alien life

By XINHUA in Washington

China's Five-hundred-meter Aperture Spherical Telescope, known as FAST, may provide understanding of the origin and structure of the universe, and accelerate and even revolutionize the search for life beyond Earth, a renowned US theorist on alien intelligence said on Saturday.

Douglas Vakoch, president of METI International, an organization that promotes sending messages into space in search for extraterrestrial intelligence, said that astronomers worldwide will be invited to use the Chinese observatory if their proposals successfully pass competitive reviews.

"By opening FAST to use by the broader international community, China is demonstrating its commitment to fostering astronomy as a global scientific enterprise," he said, adding that it may lead to "discoveries beyond our wildest imagination."

As for FAST's scientific missions, Vakoch said it will be used to look for the signatures of complex organic molecules in interstellar space, which will show how widely the basic building blocks of life are distributed throughout the cosmos.

"For over a half-century, astronomers have been using radio telescopes to answer the haunting question: Are we alone?" he said. "But astronomers face a daunting challenge: The signals they seek are so weak that an incredibly sensitive telescope is needed to detect them."

"FAST's innovative design and huge collecting area give it unsurpassed speed and sensitivity, making it vital to the search for extraterrestrial intelligence in the coming decades," Vakoch said. "We can expect China to become a world leader in the search for extraterrestrial intelligence because of its demonstrated commitment in building FAST."

However, FAST will not initially be outfitted with the signal processing capabilities to search for aliens, he said; such technology will be added at a later stage. But when that happens, FAST will be able to scan the heavens for signals that "can't be created by nature, but only by advanced civilizations".

Based on the recent histo-



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Douglas Vakoch, president of METI International

ry of radio telescopes, he also predicted that FAST will lead to "a dramatic increase in the number and variety of pulsars discovered".

Pulsars, one of FAST's main scientific targets, are dense rotating stars that act as cosmic clocks, as they emit pulses regularly, like metronomes.

This could also provide scientists with the capability to detect gravitational waves, or ripples in space-time, from pairs of massive black holes, since FAST has the potential to precisely measure tiny changes of the pulsing rates of pulsars as gravitational waves pass by.

Vakoch highlighted FAST's role in underpinning China's space program, noting that the country has made great breakthroughs in space exploration, such as putting humans into Earth orbit and having astronauts dock with an orbiting module as a first step toward developing a Chinese space station.

"With the opening of FAST, China continues to demonstrate that it is a world leader in space exploration — now from an Earth-based observatory, as well as from space," he said. "Astronomers around the world can be grateful to China for creating an observatory that may lead to discoveries beyond our wildest imagination."