SITE SELECTION OF THE WORLD'S LARGEST RADIO TELESCOPE WITHIN THE DAWODANG KARST DEPRESSION

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Abstract

The world's largest single-aperture radio telescope, the Five-hundred-meter Aperture Spherical radio Telescope (FAST), was constructed within an extremely large karst depression, Dawodang, in Pingtang, Guizhou, China. The FAST system will improve the sensitivity and extent of astronomical investigations in the near future. In June 1994, astronomers decided to construct the next generation and largest radio telescope. Many types of topographical depressions such as mine pits, volcanic craters, meteor craters, karst depressions, and extremely large sinkholes were considered during the site selection process. Considering the size, spherical shape, bearing capacities, and ease of drainage of karst depressions, extremely large karst depressions were targeted areas for the FAST system. After careful investigation and site characterizations of more than 1000 large karst depressions, the Dawodang karst depression was determined to be the ideal and unique site for the FAST observatory. Construction of the FAST started on March 25, 2011 and completed on September 25, 2016.

Introduction

In April 1994, many astronomers decided to actively participate in the international large radio telescope project. Many types of topographical depressions such as mine pits, volcanic craters, meteor craters, karst depressions, and extremely large sinkholes were considered during the site selection process. By the end of 1995, a Kilometer-square Area Radio Synthesis Telescope (KARST) project was determined to be the next generation large arrays of radio telescope. The KARST project was presented during August 26-30 1996, at the 179th Symposium of the International Astronomical Union (IAU) held in Baltimore, USA (Peng and Nan, 1997).

The proposed KARST project was well received at the 179th IAU symposium and attracted great attention in the IAU community. In 1998, Chinese astronomers proposed a Five-hundred-meter Aperture Spherical radio Telescope (FAST) as a predecessor of the KARST project. Considering the size, spherical shape, bearing capacities, and ease of drainage of karst depressions, extremely large karst depressions were targeted areas for the FAST system. After careful investigation and characterization of more than 1000 large karst depressions, the Dawodang karst depression in Pingtang, Guizhou was selected to be the ideal and unique site for the FAST observatory.

Study Area and Site Characterization

The Dawodang karst depression is located in fengcong karst areas of Pingtang, Guizhou province of southwestern China. Fengcong karst is a major type of karst landscape, which is loosely correlated to cone karst (Waltham, 2008) or cockpit karst (Huang et al., 2014). Mature fengcong karst is dominated by U shaped depressions bounded by rolling hills.

Within a 6.2 by 4.6 km area, there are 64 karst depressions and the mean density is approximately 2.2 depression per km^2 (Figure 1). Characteristics of the Dawodang depression include 1) It is a U shaped depression so that the surrounding hills would block external electromagnetic signals (Figure 2 & 3); 2) Excavation

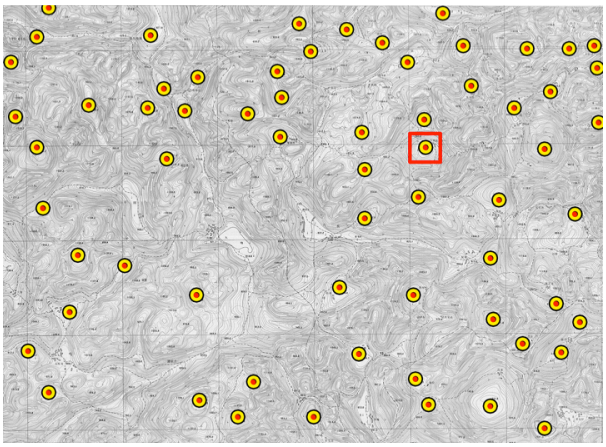

Figure 1. *The Distribution of karst depressions in the 6.2 by 4.6 km Liushui area. Dawodang depression is highlighted by the red box.*

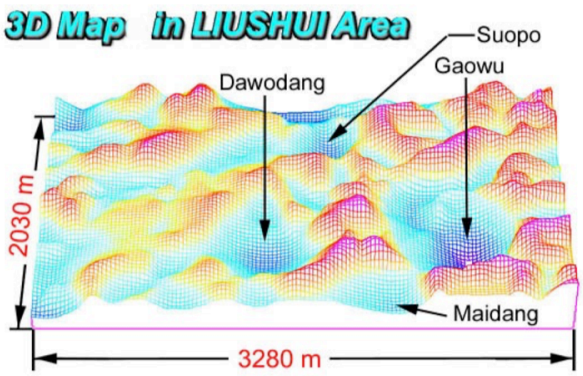

Figure 2. *Topographical contour of the Dawodang and the surrounding Liushui area.*

Figure 3. *Photo of Dawodang depression before FAST construction (May 25, 2009).*

of the site is minimal for a 500-meter diameter radio telescope; 3) The site is located in a remotely rural area without urban development which would ideally result in low background electromagnetic radiation; 4) No major natural disasters such as earthquakes, landslides, floods existed in the site and issues of unstable rocks and internal floods can be resolved through engineering design and practice; 5) Dawodang is about 7.5 km from the Guizhou highway S312 and 185 km from Guiyang, the capital city of Guizhou with an international airport and high-speed rail way stations; and 6) The Guizhou government and local residents are very supportive of the FAST project. Construction of the FAST started on March 25, 2011 and was completed on September 25, 2016 (Figure 4 & 5).

Conclusions

The selection process for the FAST Observatory lasted 12 years and ended up in an ideal and unique location, the Dawodang depression. Dawodang is a typical U shaped

Figure 4. *Aerial view of the Dawodang depression during the construction of FAST, image was taken by a DJI drone (Mar 31, 2012).*

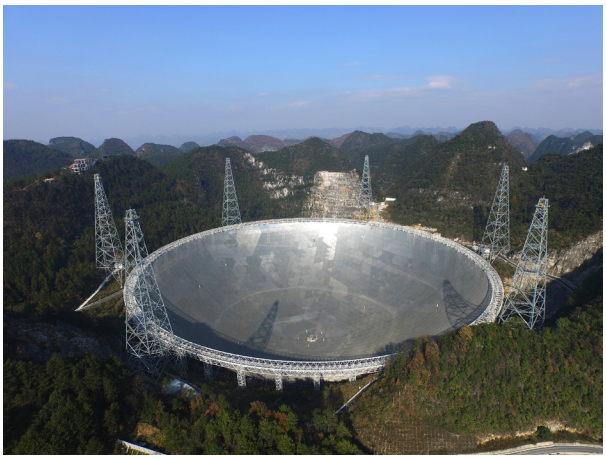

Figure 5. *Bird's eye view of FAST (December 31, 2016).*

karst depression. The FAST Observatory was a great example of utilizing a large fengcong karst depression for a main scientific observatory.

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