Progress on Chinese Spectral Radioheliograph –CSRH Construction

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Abstract

The Chinese Spectral Radioheliograph (CSRH) with 40 antennas of 4.5 m covering 400 MHz – 2 GHz (CSRH-I) and 60 antennas of 2 m covering 2-15 GHz (CSRH-II) has been supported and is under construction in a radio quiet region in Inner Mongolia of China. The array of CSRH-I has been assembled and is tested now. The array of CSRH-II will be established during 2011-2013. The progress about the project is introduced.

1. Introduction

The project of the Chinese Spectral Radioheliograph (CSRH) has been supported as National Major Scientific Research Facility Program of China and is under construction now, which will open new observational windows on flares and CMEs at radio wavelengths [1]. The site survey for the CSRH array was completed at Mingantu town (in Inner Mongolia of China) in 2008. The project was approved to start construction in the autumn of 2008. This instrument is designed to operate at multiple frequencies in the decimetric to centimeter wave range (0.40-15.00GHz) with high spatial-spectral-temporal resolutions [2]. By the end of 2010, CSRH-I in 400 MHz -2 GHz with 40 antennas of 4.5 m was installed and is under assembly and testing. CSRH-I will be put into operation in 2011, and CSRH-II in frequency range of 2 – 15 GHz will be constructed in 2011-2013.

2. Description of the Chinese Spectral Radioheliograph

Table 1 shows the specification of CSRH and the system block diagram for CSRH-I in dm-wave range is shown in Figure 1.

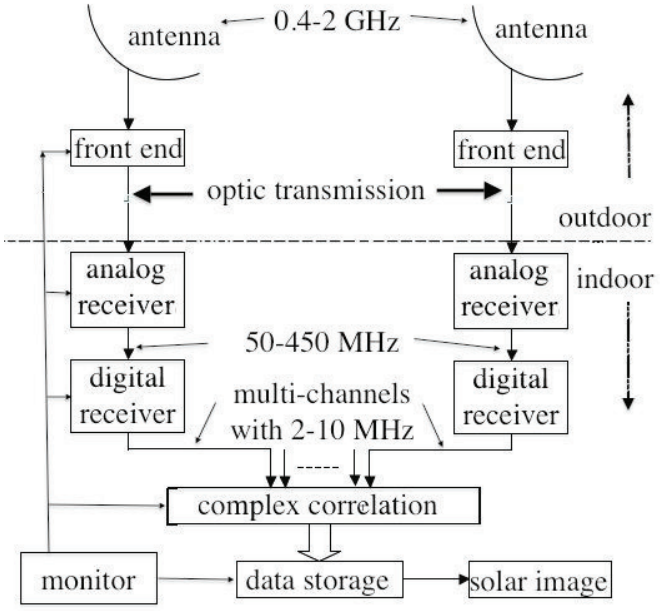

Figure 1 The system block diagram for CSRH-I.

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Table 1 The specifications of CSRH

Frequency range	0.4–15 GHz (λ: 75–2 cm)
Frequency resolution	64 chan (I: 0.4–2 GHz) 32 chan (II: 2–15 GHz)
Spatial resolution	1.3"–50"
Temporal resolution	25 ms (0.4–2 GHz) ~200 ms (2-15 GHz)
Dynamic range	25 db (snapshot)
Polarizations	Dual circular L, R
Spiral array with 3 arms	I: 40 × 4.5 m antennas II: 60 × 2 m antennas
Max baseline	3 km
Field of view	0.6º–7º

From Figure 1 it can be seen that the solar radio emission in 0.4-2 GHz is detected by each CSRH antenna with the broadband feed and outdoor devices including LNA and optic transmitter. The signal with 400 MHz bandwidth, which covers the whole 1.6 GHz bandwidth by scanning 4 times, is then transmitted through optic fibers to indoor devices including optic receiver and analogous receivers with an output in 50-450 MHz range. It is then followed by digital receiver with 1 Gsps A/D converter to receive 400 MHz analogous signal and the digital receiver outputs 16 channels simultaneously for the complex correlations with 2-10 MHz bandwidth for each channel. The time delay compensation and fringe stopping are considered in the digital correlations [3]. The whole correlation procedure is controlled by a monitoring subsystem.

3. Progress of CSRH Construction

We have adopted a spiral array for CSRH-I and CSRH-II. Figure 2 shows the computer design for CSRH-I array and the field construction of CSRH-I when deploying the optic cables. By the end of 2010, 40 antennas of 4.5 meter diameter were erected at the CSRH site. Both the outdoor and indoor devices are presently under assembling and testing. Figure 3 shows the antennas at the central part which were monitored synchronously to point to the Sun and the indoor devices to mount the analogous and digital receivers, digital correlators, and monitor subsystem, etc. The empty space is for the digital correlators which are still under development and not mounted locally yet.

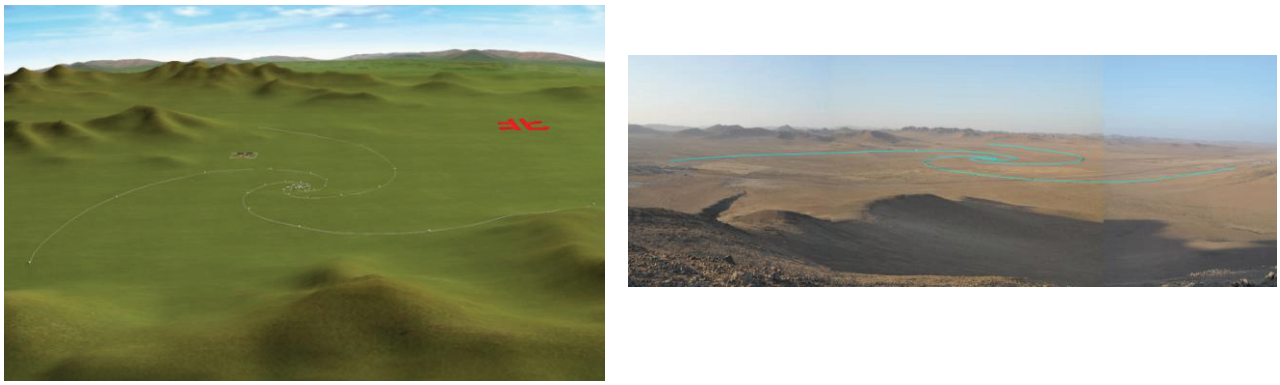

Figure 2 CSRH-I array (left) and the field construction of CSRH-I when deploying the optic cables (right).

While the whole CSRH system is under construction, we have carried out a number of experiments with some of CSRH elements to receive the signals from a geostationary satellite (E123.5) and GPS satellite in L-band when antennas were pointing at a fixed direction, and from the Sun when antennas were tracking. The residuals of the phase closures for every tri-antenna composition were about 2 degrees for both geostationary and GPS satellites [4]. The 5-element sub-system of CSRH-I for its first time, while testing the system, observed a solar radio burst which was associated with a C1.5 class X-ray flare at 07:59-08:20 UT on Nov. 12, 2010. Figure 4 shows the results which agree with other observations. These experiments verify the system design and demonstrate the system performance.

Figure 3 (left) CSRH-I central part antennas; (right) analogous receivers and monitor subsystems.

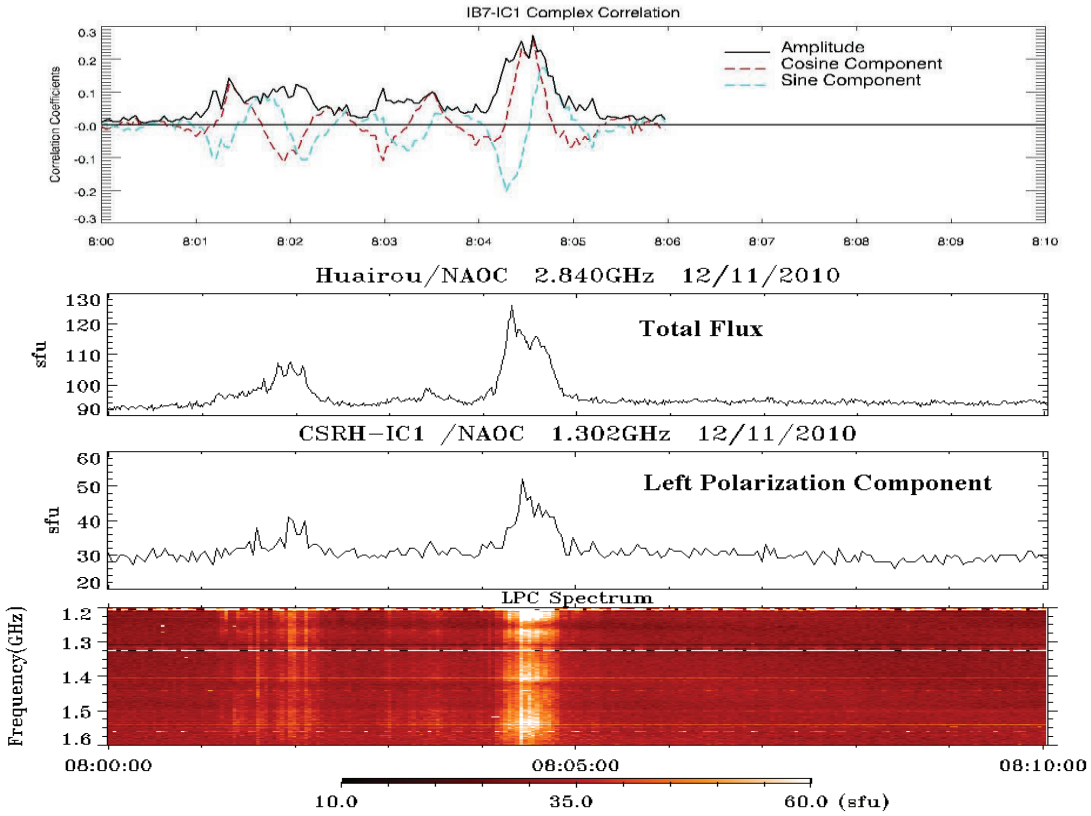

Figure 4 First observation of a solar radio burst by 5-element sub-system of CSRH-I in 1.2-1.6 GHz band and the comparison with 2.84 GHz flux profile obtained from Huairou solar radio spectrometer on 12 Nov 2010.

4. Summary

In summary, radio imaging spectroscopy is in its infancy and will open new observational windows on flares and CMEs. For CSRH construction, the radio quiet zone protection is established. The CSRH-I in 400 MHz – 2 GHz has been established and it is qualitatively progressing well whereas quantitatively being under way. The CSRH-II in 2-15 GHz will be constructed in 2013.

5. Acknowledgments

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6. References

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