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Calibration and data analysis for Chinese Spectral Radioheliograph

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Abstract. The Chinese Spectral Radioheliograph (CSRH) is under construction in Mingantu station of NAOC in China. Now, CSRH-I which includes antenna, receiver and correlator in decimetric wave range has been established. This paper introduced calibration on CSRH and present some results of data processing.

Keywords. Chinese Spectral Radioheliograph, Calibration

1. Introduction

The Chinese Spectral RadioHeliograph (CSRH) will be a solar-dedicated radio interferometric array that will be optimized to carry out imaging spectroscopy of the Sun, to produce high spatial resolution (maximum 1.3 arcsec), high time resolution and high frequency resolution images of the Sun simultaneously at a wide range of frequencies (Yan *et al.* 2009). CSRH is consists of two arrays which are CSRH-I (0.4-2GHz) and CSRH-II (2G-15GHz). The maximal baseline is about 3km and the minimal baseline about 8m in CSRH-I. The 3-arm spiral-shaped antenna array located in Mingantu Observing station of NAOC.CSRH-I began construction in 2009, and all instruments including 40 4.5-meters antenna and receivers have been installed successfully . CSRH-II has already mounted all antennas,now.

2. Calibraion

2.1. *Delay Measurement*

It is important that the amplitude and the phase must be accurately measured to image the solar. We have measured the system noise and gain carefully by using K-factor method. The each optical fiber from antenna to control room is not same length absolutely, although the length of each fiber is about 3400 meters. For delay measurement, we choose the sun and Cygnus-A as calibrated source, and then the amplitude of correlator output is equal to the maximal value by setting different delay compensation in digital receiver for every baseline among 40 antennas. Furthermore, the delay we measured minus the corresponding geometric delay, we can calculate the system delay which due to the difference fiber. Finally, the RMS of delay error is less than 1ns.

2.2. *Phase Closure*

Before observing the sun, observation of geostationary satellite and GPS satellite were carried out with 40 antenna at Mingantu observing station since May 2010. The cosine and sine fringes variation which we observed are good agreement with theoretical values.

The phase closure of geostationary satellites observation is less than 2.2 degrees within 12 hours, and it is less than 1.8 degrees for GPS satellite observation within 20 minutes. So, this results shown the receivers and correlator worked well.

3. Observation

The first burst, associated with a C1.5 class X-ray flare, observed by 5-element system was recorded at 07:59-08:20(UT) on Nov. 12th, 2010. Figure 1 shown the fringe observed by antenna IB7 and IC1. The total flux and spectrum from 1.2-1.6 GHz was also shown in panel (b), (c) and (d).

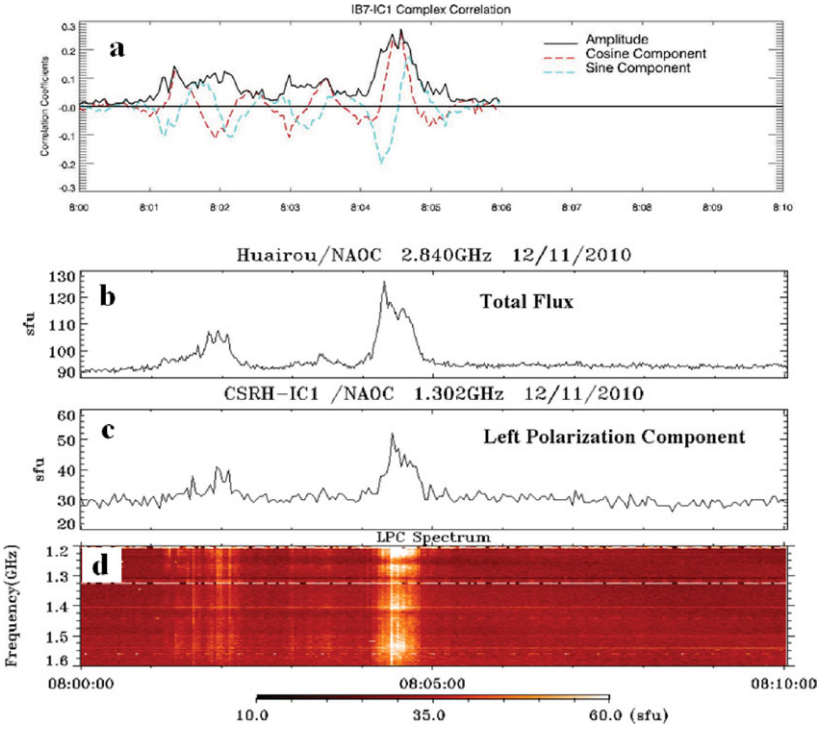

Figure 1. Panel a: Observed fringe included Cosine and Sine component with IB7-IC1 baseline. Panel b: Total flux profile observed by 2840M spectrometer in Huairou station. Panel c: Left polarization component profile observed by antenna IC1. Panel d: LPC spectrum observed by antenna IC1.

4. Conclusion

All instruments of CSRH-I have been already established in Mingantu Station. Some simulations and measurements have been carried out to test the whole system.For calibration, we are taking Cygnus-A and quiet sun as the radio source to calibrate the antenna, receiver and correlator. It is expected that the first image of sun will be obtained soon.

Reference

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