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Research Article

Effect of Parasitic Element on 408 MHz Antenna for Radio Astronomy Application

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Antenna is one of the important subsystem components in a radio telescope system. In this paper, analysis on the effect of parasitic element on 408 MHz antenna in a radio telescope system is presented. Higher gain up to 10.24 dBi with reduction on beamwidth size has been achieved by optimizing the position of parasitic element relative to the driven element. The proposed antenna is suitable to be utilized in a transient radio telescope array.

1. Introduction

Observation at radio wavelength has become a great scientific and applied importance in the field of astronomy. Many new types of astronomical object have been discovered by radio astronomical methods, including quasars, pulsars, and cosmic microwave background (CMB). This development has intrigued deep exploration in the field of radio astrophysics and computation and in the radio astronomical instrumentation.

In the field of instrumentation, the antenna becomes one of the vital and most explored fields of research [1–3]. As for radio astronomy application, antennas also have been developed in various manners based on the objectives of the observation. It plays an important role in determining the sky coverage (field of view) and angular resolution, as well as affecting the overall sensitivity of the radio telescope. Most of the radio telescope system employs a dish antenna as it inherits a very high angular resolution and gain [4]. However, for low-frequency observation (decimeter, meter, and decameter wavelength), the size of the dish antenna becomes impractically large, leading to complex construction and maintenance problems as well as high cost factor. Hence, dipole-based antenna has become a more suitable option for long-wave radio astronomy observation. Radio JOVE by NASA [5], the low frequency array (LOFAR) [6], and the eight-meter-wavelength transient array (ETA) radio telescope at Pisgah Astronomical Research Institute (PARI) [7, 8] are among the radio telescope systems which utilized dipole-based antenna.

One of the common methods in utilizing the dipole-based antenna is by constructing it in inverted-V-shape, as it provides low mismatch at the terminal point for 50 ohms transmission line and wide beamwidth (sky coverage) [6–8]. It is utilized in large array system where high angular resolution can be obtained by applying the aperture synthesis technique and hence is suitable to substitute the large dish antenna. Another method is by utilizing parasitic element to increase the gain of the antenna [9, 10] and hence it increases the sensitivity of the radio telescope system. This method is suitable when the sky coverage is less important than the sensitivity. In this paper, effect of parasitic element on a 408 MHz antenna is presented. The objective of this paper is to show the improvement on beamwidth which can