

Study of Microwave Radiation from the Electron Beam at the Telescope Array Site

Daisuke IKEDA¹, Romain GAÏOR², Keiichi MASE³, Bokkyun SHIN⁴, Krijn De VRIES⁵, Tokonatsu YAMAMOTO⁶, Aya ISHIHARA³, Takao KUWABARA³, Shigeru YOSHIDA³, Tatsunobu SHIBATA⁷, Izumi S. OHTA⁶, Shoichi OGIO⁴, Masaki FUKUSHIMA¹, Hiroyuki SAGAWA¹, John N. MATTHEWS⁸, Gordon B. THOMSON⁸, Kael HANSON⁹, Thomas MEURES⁹ and Aongus Ó MURCHADHA⁹

¹*Institute for Cosmic Ray Research, University of Tokyo, Chiba 277-8582, Japan*

²*Laboratoire de Physique Nucléaire et de Hautes Energies (LPNHE), Universites Paris 6 et Paris 7, CNRS-IN2P3, Paris, France*

³*Chiba University, Chiba 263-8522, Japan*

⁴*Osaka City University, Osaka 558-8585, Japan*

⁵*Vrije Universiteit Brussel, dienst ELEM, Pleinlaan 2, B-1050 Brussels, Belgium*

⁶*Konan University, Kobe 658-8501, Japan*

⁷*High Energy Accelerator Research Organization (KEK), Tsukuba, Ibaraki 305-0801, Japan*

⁸*University of Utah, Salt Lake City, Utah 85112, USA*

⁹*University of Wisconsin, Madison, WI 53706, USA.*

E-mail: ikeda@icrr.u-tokyo.ac.jp

(Received April 17, 2017)

The Telescope Array (TA) experiment installed the electron accelerator in order to calibrate the fluorescence detector by shooting 40 MeV electrons into the atmosphere. This accelerator also works to investigate the radio detection techniques used for the cosmic ray observations. Using this accelerator, four experimental groups have studied individual radio detection methods at different frequency bands ranging from 50 MHz to 12 GHz. All of these experiments have observed the microwave radiation from the electron beam itself. We have studied the radiation by combining all the measured results and constructed a model of this phenomena. Results of four experiments and model expectation are in good agreement within the systematic uncertainty.

KEYWORDS: radio emission, electron beam, accelerator

1. Introduction

The Telescope Array (TA) experiment [1], located in the west desert of Utah, US, installed the electron linear accelerator, so called Electron Light Source (ELS) [2]. The aim of this accelerator is for the absolute calibration of the Fluorescence Detector (FD). This accelerator, shooting the electrons to the atmosphere, also works to investigate the radio detection techniques used for the cosmic ray or neutrino observations. Four of the experimental groups have studied individual radio detection techniques at the different frequency bands ranging from 50 MHz to 12 GHz. All of these experiments have observed the microwave radiation. We have studied the radiation by combining all of measured results and constructed a model of this phenomena.

The configuration of the electron beam from the ELS is shown in Section 2. The details of four experiments are described in Section 3. The expectation from the constructed model and comparison with the experimental results are discussed in Section 4.