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Variation of Secondary Cosmic Gamma Ray Flux during Venus Transit on June 6, 2012 at Udaipur, India

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ABSTRACT We report the variation of secondary cosmic gamma ray flux during celestial event Venus transit on June 6, 2012at Udaipur. The collected data as a function of time using ground based NaI(Tl) scintillation detector were taken. The data analysis showed the decrease in secondary cosmic gamma ray flux on June 6, 2012 during the Venus transit of about2 % due to blocking of solar energetic particle (SEP) on the Earth.

KEYWORDS : Venus Transit, Obstruction of radiation by Venus, Solar energetic particle (SEP).

Introduction

Isotropic primary cosmic rays are high-energy charged particles that travel at nearly the speed of light and strike the earth from all directions. About 89% of these nuclei are of hydrogen (protons), 10% of helium, and about 1% of others heavier elements [1]. Cosmic ray has other classes of energetic particles that are associated with energetic events on the sun, also known as solar energetic particles (SEP) and are accelerated in interplanetary space. The galactic cosmic radiations (GCR) and solar energetic particles (SEP) reaching towards the earth atmosphere undergo collision with atoms of the upper atmosphere of the Earth, they produce a cascade of "secondary" particles that consist of pions, muons, neutrinos and gamma rays, as well as electrons and positrons. In this process produced gamma ray is known as secondary cosmic gamma ray flux (SCGR flux) which can be detected using appropriate detector on ground (Kodama, et al. 1983;Chilingarian, et al., 2010) [2, 3].

During transit of Planet Venus, it passes directly between the sun and the earth. Sun comes into view with the disk of the Venus. On June 6, 2012Venus transit was witnessed over Gulf, UAE, India, Nepal, Singapore and Malaysia at Sunrise. The present study was conducted on June6, 2012 in India at Udaipur, Rajasthan, where with the sunrise Venus transit was visible from 05:45:49 A.M. The Maximum Venus transit time period started from 07:02:42 A.M. and 3rd contact, 4th contact time was 10:05:22 A.M., 10:22:43 A.M. respectively.

During the solar eclipse the moon produces obstruction effect and during eclipse, most of the solar energetic particles (SEP) reaching towards the earth atmosphere are obstructed by the moon. This fact was observed by many scientists through experimental studies namely, Bhattcharya et al. (1997) [4] observed ~25% intensity drop of SCGR during the Solar eclipse of 24th October 1995, Kandemir G. et al. (2000) [5] observed the drop of 11% SCGR during the solar eclipse on 11th August 1999, Nayak. et al. (2010) [6] observed ~4% decrease in SCGR flux during solar eclipse on 1st August 2008, Bhaskar et al. (2011)[7] also reported drop of SCGR flux in about 21% eclipse on 15th January 2010 at Rameswaram, India. During solar eclipse, 4th January 2011 with help of scintillation counter at Udaipur, India we observed about 15% drop in SCGR flux [8].

During the Venus transit it may also produce the obstruction effect for SEP. The blocking of SEP flux during above solar eclipse studies led us to conduct an experimental study using scintillation counter during transit of the planet Venus.

Experimental Set-up and Observations

We used scintillation detector [8] of Model 802, make: Canberra Genie 2000 to detect SCGR produced by the SEP and GCR during transit of Venus. Photo multiplier tube (PMT) Model 2007P was coupled with NaI (Tl) crystal 50 mm thick and 44.5 mm in diameter. High tension voltage supply model 3102D of 1100 Volts DC was used. Using negative polarity spectroscopic amplifier Model 2022 negative signal of about 0.5 Volts was amplified to 5 Volts positive pulse then this signal was fed to multi channel analyzer for acquisition and analysis with multi channel Buffer of all 1024 energy channels. This counter system was used to collect the counts as a function of time. The scintillation detector was kept on the terrace of computer center of Mohan Lal Sukhadia University, Udaipur (India). The data files were stored in computer for every an hour duration from 6.05 A.M to 10.08 A.M. Maximum Venus transit time period was started from 07:02:42 A.M.

Analysis and Results

Figure-1 shows the total integrated counts over an hour of SCGR flux as a function of time of progress of the transit of Venus. During the course of time of the 6th June the Venus transit day the observed integrated counts were between 126280-128022 but at the maximum time of transit there was a drop of integrated counts to 125484 i.e. about 2 % decrease in the counts of SCGR flux. The result clearly shows the obstruction effect by Planet Venus during maximum Venus transit time period.

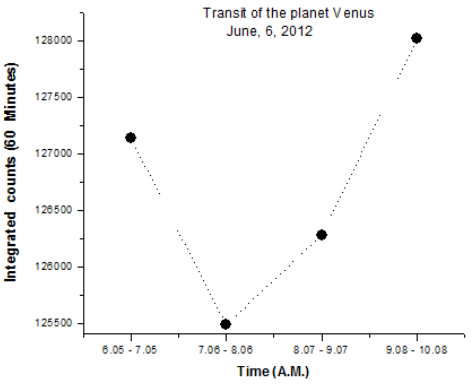

Figure 1

Discussions

The observed results of the present study for the variation in SCGR flux can be understood by the following argument:

The Venus produced partial obstruction to solar energetic particles (SEP) reaching towards the earth atmosphere. As the Venus transit progresses the obstruction effect by the Venus becomes significant and at the middle of the Venus transit time it blocks radiation flux causing drop in the counts of SCGR flux. The drop in SCGR flux observed by us was about 2% during long middle Venus transit time period. It was at low value in comparison to various solar eclipse experimental studies because Venus produced less obstruction effect due to its partial blocking of SEP.

Acknowledgments

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Figure Captions

Figure 1: Total integrated counts over the hour of SCGR flux as a function of time.

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