Enhancement of Secondary Radiation Flux Energy 3.63 % During Appearance of Full Moon on October 13, 2022 at Udaipur (Rajasthan), India

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ABSTRACT

We observed variation of secondary radiation flux energy (SRFE) at Udaipur (27^{o} 43' 12.00" N, 75^{o} 28' 48.01" E), Rajasthan, India during Full Moon in month of October, 2022. In this experimental study ground based NaI (Tl) Scintillation detector used. The data files were stored in computer for half hour duration around time 21.00 IST to 21.30 IST on October 6, 9, 10, 11, 12, 13, 14 and 15. The objective in this study is to observe secondary radiation flux energy during Full Moon. Analyzed data reveal significant enhancement of secondary radiation flux energy about 3.63 % on date of full Moon. We interpret such variation of SRFE on the basis of more reflection of solar radiation form surface of Full Moon.

Keywords: Cosmic radiation, Solar radiation, Reflected solar radiation, Secondary radiation flux energy.

1. Introduction

Experimentally explicated cosmic rays are inherent high-energy charged particles, experimental outcomes revels that these are nuclei of atoms ranging from the lightest to the heaviest elements in the periodic table and move through space at nearly the speed of light (Longair 1992; Chaisson *et al.* 1990; Mewaldt 2010) Primary cosmic radiation lies in the energy range from 10^{9}-10^{20}eV or more (Kudela 2009). Simpson 1983 gave information about cosmic radiation's chemical abundances in different energy ranges, compared solar system abundances and estimated abundances for the local interstellar medium. About 89% of these are protons, 10% of nuclei of helium, and about 1% of others heavier elements. Also high energy electrons, positrons, and other subatomic particles are present originate in outside the solar system, distributed throughout the Milky Way galaxy. The intensity of primary cosmic radiation flux above50 km from the surface of the Earth remains almost the same. Primary cosmic radiation produces denser ionization about 20 km from the Earth's surface, which is called "secondary" particles and called secondary cosmic radiation (Carl *et al.* 1936). These particles have X- rays, protons, alpha particles, pions, muons, electrons, neutrinos and neutrons. These particles increase rapidly as these moves downward in the atmosphere. After each interaction, the particles lose energy (Bhabha 1938a; Bhabha 1938b). In this way, secondary cosmic particles shower down through the atmosphere to the Earth's surface (Allkofer *et al.* 1984). Secondary radiation has three components (A) electromagnetic components (B) hadronic component and (C) masonic component (Walter Heinrich 1937; Nordheim 1937). The electromagnetic component has electrons and gamma particles. Hadronic component has low energy protons and neutrons. In contrast, masonic components have pions, muons. Therefore, penetrating primary cosmic radiation produced a secondary shower (Heitler 1938). This secondary radiation flux can be detected using appropriate detector on the ground (Kodama 1983; Chilingarian et *al.* 2010). A galaxy, a star, or a cluster of galaxies produces gravitational lensing effect (Mellier 1998; Narayan & Bartelmann 1996). A. S. Eddington and collaborators proved this phenomenon in a famous experiment during total solar eclipse in 1919. To observe secondary radiation flux, many scientist groups conducted experimental studies during normal days and on days of special celestial events such as Solar eclipse, Lunar eclipse, the appearance of a comet in the sky, phases of the Moon, the closest approach of celestial objects, transit of celestial objects etc. with the help of the efficient counter system.

Solar eclipse studies carried out to observe radiation flux (Bhattacharya *et al.* 1997; Kandemir *et al.* 2000; Bhaskara *et al.* 2011; Pareek *et al.* 2013). Lunar eclipses experimental studies were conducted by (Pareek *et al.* 2013; Raghav *et al.*2011; Rao *et al.* 1967). Using scintillation counter experimental study of the comet was conducted by (Pareek *et al.* 2014) in the energy range of 10 keV to 5 MeV. Analyzed data showed an unusual variation of secondary cosmic radiation flux at the energy about 1.127 MeV, 2.29 MeV and 3.66 MeV. Pareek *et al.* 2012 conducted an experimental study for celestial event transit of Venus 6^{th}June, 2012 at Udaipur, India. After analyzing it was observed 2% decrement in secondary solar radiation gamma ray flux. In September 2000 the lunar phases ground-based experimental study was conducted by Pareek *et al.* 2014 using a Scintillation counter. During the passes of the Moon through the background of the Capricornus constellation, an abrupt change in the energy spectra was noticed on 9^{th} and10^{th} September 2000 due to the gravitational lensing effect. Pareek *et al.* 2022 conducted an experimental study for the transit of the Sun across Constellations Libra, Virgo. The analyzed result showed a variation of Secondary Gamma Radiation Flux in Months November 2018 and September 2019 respectively at Udaipur, India. Also, for transit of the sun across constellation Libra in October and November 2020 at Udaipur Pareek *et al.* 2021 conducted an experimental study and observed the same result of variation of secondary gamma radiation flux.

Pareek *et al.* 2022 conducted experimental studies for transit of Moon in different constellations. Analyzed data showed variation of secondary radiation flux during these events. Another experimental study of change of Moon position in sky was carried and showed the variation of secondary gamma radiation flux in the month November, 2020 at Udaipur (India) (Pareek 2022).

To unveil the hidden secrets of high energy astronomy, technical advances, over more than half century, have been achieved so that we could able to pinpoint how astronomical observations and physical concepts interact. For this purpose, a large number of experimental studies carried out to collect good quality data of CR (Cosmic radiation) and SEP (Solar energetic particles) with the help of advanced technologies by astronomers, for different celestial events occurring at various points of time. However due to these events, it is found that the characteristics of GCR and SEP are modulated and manifested in the ground based observation for the terrestrial secondary radiation (SR) flux. These SR signals carrying the signatures of modulated GCR and SEP are measured by efficient detectors. In this experimental study, we want to see the effect on secondary flux due to appearance of Full Moon at Udaipur India.

2. Methodology

Experimental Set-up and Observations:

Scintillation detector Model SD 152 F flat type (Fig. 1) (make: Nucleonix) was employed to detect secondary radiation flux (SR) produced by the SEP and CR. The secondary radiation flux was incident on a NaI (Tl) of 2" x 2" diameter optically coupled with photo multiplier tube (PMT). This PMT is connected with USB interface with multi-channel analyzer (MC 1000) having 1024 channels built-in high voltage and shaping amplifier. The entire integrated assembly was used to collect secondary radiation flux and the detector pointed in the line of site of the Moon. This counter system was used to collect the counts as a function of time. The scintillation detector was kept on the terrace of Astronomy Laboratory of Department of Physics, Bhupal Nobles' University Udaipur (Rajasthan) India. The data files were stored in computer for half hour duration around time 21.00 IST to 21.30 IST on October 6, 9, 10, 11, 12, 13, 14 and 15.

3. Results and Discussions

The dates of observation were October 6, 9, 10, 11, 12, 13, 14 and 15. As depicted in Fig.s. 2 and 3 the panels of SR flux data files between energy and counts were taken around time from 21.00 IST to 21.30 IST.

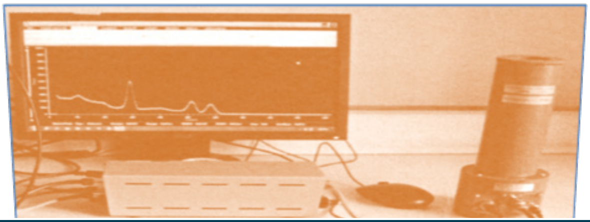

Fig. 1: Scintillation Counter Systam.

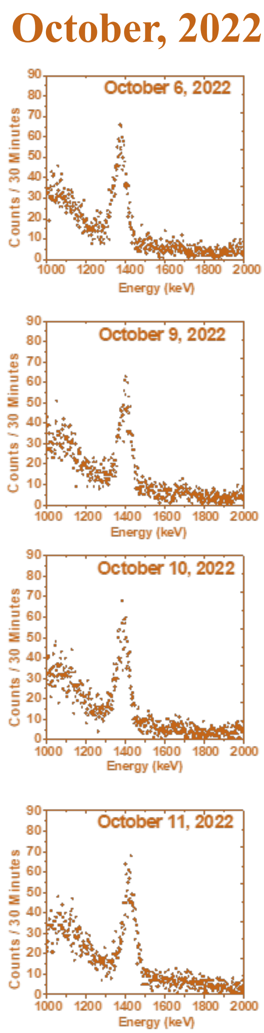

Fig. 2: Panels of secondary radiation flux energy and counts

October, 2022

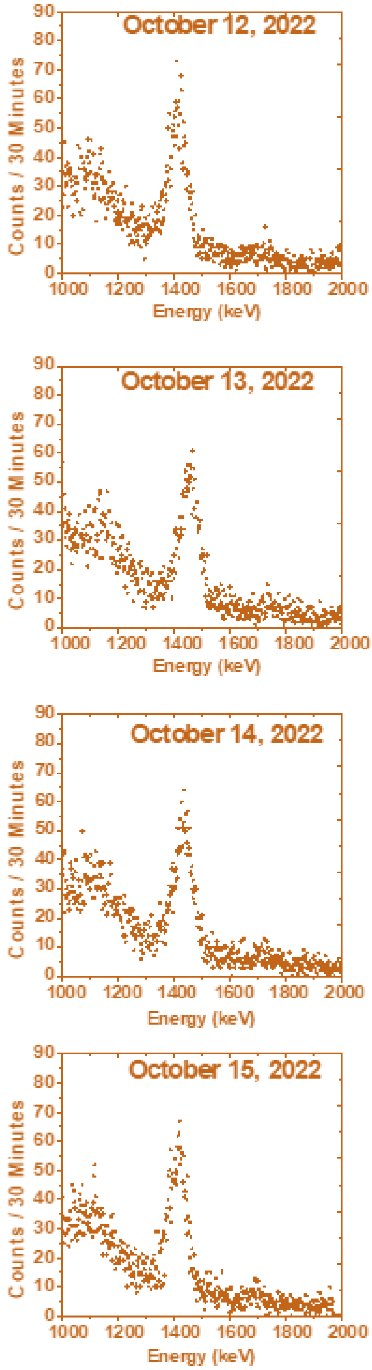

Fig. 3: Panels of secondary radiation flux energy and counts

Fig 2 and 3 show the existence of specific peaks. We used Lorentz peak fit concept in order to understand the characteristics and energy variation of SR flux peaks in the energy range from 1300 keV to 1600 keV as shown in below Fig.s. 4 and 5.

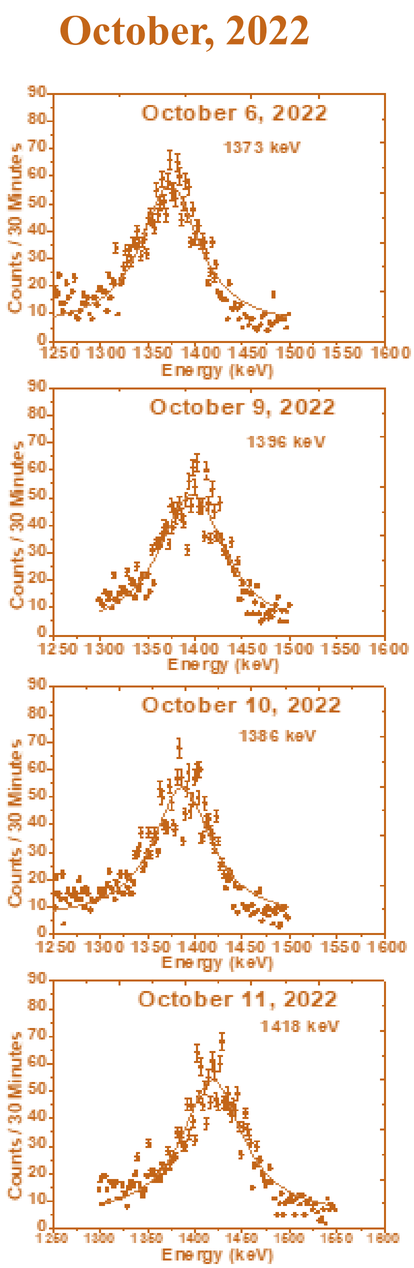

Fig. 4: Panel of energy peak of secondary radiation flux and counts

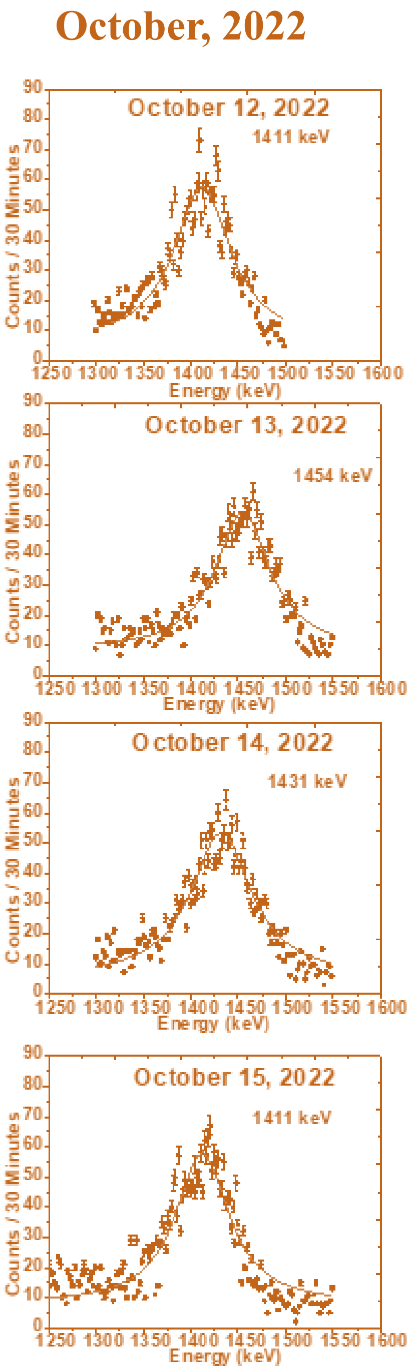

Fig. 5: Panel of energy peak of secondary radiation flux and counts

Using above panels of SR flux energy and counts files, we made Table 1 which represents secondary radiation flux energy with respect to dates in month of October, 2022 for half an hour.

Table 1 (Peak energy of secondary radiation flux)

Sr. No.	Date	Energy (keV)
October		
1	6	1373
2	9	1396
3	10	1386
4	11	1418
5	12	1411
6	13 (Full Moon)	1454
7	14	1431
8	15	1411

Using Table 1 we made following Fig. 6 between date and energy in keV for month of October, 2022

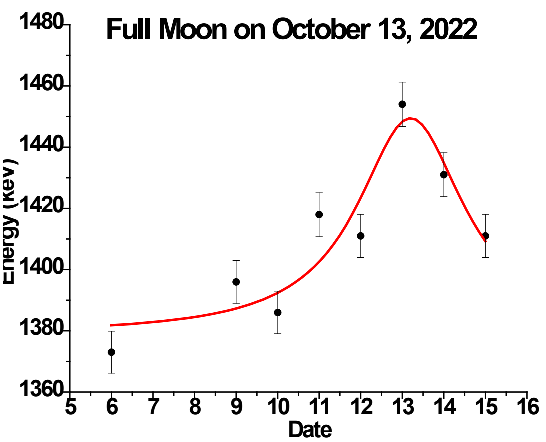

Fig. 6: Secondary radiation flux energy with date

Above Fig. 6 and Table 1 represent that in Month of October (2022) secondary radiation flux energy were less on comparison to October 13, 2022 (Full Moon). On October 13, 2022 highest energy 1454 keV we observed. In this study from Fig. 6 and Table 1, we conclude that on date October 13, 2022 there was significant enhancement of secondary radiation flux energy i.e. during appearance of Full Moon. Observed energy during Normal dates were: on October 6 - 1373 keV, 9–1396 keV, 10 - 1386 keV, 11 – 1418 keV, 12 – 1411 keV, 14 – 1431 keV and 15- 1411 keV. When we average all normal dates secondary radiation flux energy then it is equal to 1403 keV.

To see the enhancement in secondary radiation flux energy on the October 13, 2022 we used the following formula:

$$\text{\% of Enhancement of Energy} = \frac{\text{Energy on October 13, 2022} - \text{Average of energy on normal dates}}{\text{Average of energy on normal dates}} \times 100$$

Using above formula, we observed about 3.63% Enhancement in secondary radiation flux energy on October 13, 2022.

4. Conclusion

I conducted three experimental studies related to Moon to observe secondary radiation flux and energy. The first experimental study was Phases of Moon in month of September, 2000 (Pareek *et al.* 2014). In this experimental I observed variation of secondary radiation flux energy during different Phase of Moon. Another study was carried out transit of Moon in different constellations, results of this experimental study showed variation of secondary radiation flux during transit of Moon in different constellations (Pareek *et al.* 2022). Third study was conducted change of position of Moon in sky. Results of this experimental study showed variation of secondary radiation flux due to change of position of Moon in sky. From November 1 to 7 the integrated counts of secondary gamma radiation were regularly increasing. On date November 7 we observed highest counts. The probable reason is, as changes of position of Moon in sky and approaching towards the detector more reflected solar radiation reached. Therefore formation of secondary shower was more (Pareek 2022).

Getting inspired on previous experimental studies related to Moon, this experimental study was conducted for astronomical event Full Moon to observe secondary radiation flux energy.

The probable reason for this unique and first-time finding is as follows:

(A) During of the appearance of Full Moon more intense reflected solar radiation entered in the atmosphere of Earth. Due to this more secondary radiation flux energy formed in the atmosphere as we observed on surface of Earth during Full moon.

Significant enhancement of secondary radiation flux energy about 3.63% we observed on date October 13, 2022. Such unique enhancement we can understand with help of above reason. The Moon is reflector of Solar Radiation and at time appearance of Full Moon more intense radiation reflected from Moon surface. This experimental study gave conclusion that during Full Moon event on surface of Earth significant enhancement of secondary radiation flux energy we observed.

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