TRANSIT OF SUN ACROSS CONSTELLATIONS CAPRICORNS, AQUARIUS AND VARIATION OF SECONDARY GAMMA RADIATION FLUX IN MONTH OF FEBRUARY, 2021 AT UDAIPUR, INDIA.

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Abstract
We conducted an experimental study at Udaipur (27^0 43' 12.00" N, 75^0 28' 48.01" E), Rajasthan, India during transit of Sun across constellations Capricorns and Aquarius in month of February, 2021 using ground based NaI (Tl) Scintillation detector. Data files were stored in computer for half hour duration from time 17.00 IST to 17.30 IST on the dates February 9, 11, 12, 13, 15, 16, 17 and 19. After analyzing data we observed significant variation of secondary gamma radiation flux (SGR). We interpret such variation of SGR flux counts on the basis of transit of Sun across constellations Capricorns, Aquarius. Combine gravitational lensing and gravitational pull effect on background radiation due to constellations, Sun and celestial objects and radiation from constellations.

Key Words: *Cosmic radiation, solar radiation, secondary gamma radiation, combines gravitational lensing and gravitational pull, radiation from constellations.*

Introduction

The electromagnetic radiation has composition of about 89% nuclei are protons, 10% nuclei of helium, and 1% of others heavier elements (Lithium, Beryllium and Boron) is called cosmic radiation [1, 2, 3]. Cosmic radiation lies in the energy range of 10^9- 10^{20} eV or more [4].In different energy range Simpson (1983) [5] gave information about chemical abundances of cosmic radiation. Above 50 km from the surface of the Earth intensity of primary cosmic radiation flux remains almost same but about 20 km from surface of the Earth Primary cosmic radiation produces denser ionization. Denser ionization produced in the Earth atmosphere is called secondary cosmic radiation [6] having X- rays, protons, alpha particles, pions, muons, electrons, neutrinos and neutrons. When such secondary particles moves downward in atmosphere of the Earth, loses energy [7, 8]. Therefore there is formation of secondary cosmic particles shower [9]. In secondary radiation there is an electromagnetic component[10, 11, 12]. Electromagnetic component produced secondary shower contains electrons, gamma particles [13]. Secondary radiation flux can be detected using appropriate detector on ground [14, 15]. Gravitational lensing is that phenomenon when the electromagnetic radiation passing near a massive object then due to gravitational field of the object it bends towards massive object. The object could a galaxy, a star, or a cluster of galaxies [16, 17, 18].

Celestial events and variation of radiation flux

It is very interesting to observe secondary radiation flux during different celestial events such as Solar eclipses, Lunar eclipses, appearance of comet in sky, phases of moon, closest approach of celestial objects, transit of celestial objects etc. Many scientist groups conducted experimental studies to observe secondary flux during celestial events. Bhattacharya et al [19], Kandemir G. et al [20], Nayak. et al. [21],Bhaskar et al [22], Pareek et al [23] conducted experimental studies during solar eclipses.

For the celestial event lunar eclipses experimental studies were conducted by Pareek et al. [24], Raghav et al. [25], J.N. Ananda Rao et al. [26], Pareek et al. [27], Pareek et al. [28] Experimental study during celestial event of transit of Venus June 6, 2012 at Udaipur India was conducted by Pareek et al [29] observed 2 %. decrement in secondary solar radiation gamma ray flux. To understand information about the GCR, SR modulation at the time of new Moon, Full Moon and different phases of the Moon with different background of constellation in the sky in the month September, 2000 Pareek et al. [30] conducted experimental study. Analysed results showed abrupt change in energy spectra on 9^{th} and 10^{th} September 2000, when Moon was in background of Capricorns

constellation. Pareek et al [31] conducted an experimental study for transit of the Sun across Constellations Libra, Virgo and observed variation of Secondary Gamma Radiation Flux in Month November, 2018 and September, 2019 respectively at Udaipur, India. Pareek et al [32] conducted an experimental study for transit of the Sun across constellation Libra in the month of October and November, 2020 at Udaipur and observed the variation of secondary gamma radiation flux

In month of October, 2020 at Udaipur, India to observe variation of secondary gamma radiation flux during closest approach of Mars towards Earth, Mars at opposition and transit of Moon across different constellations, planets Pareek et al [33] conducted experimental using scintillation counter.

During appearance of Comet Hyakutake in the month of March, 1996 using scintillation counter, Pareek et al. [34] conducted experimental study. Analyzed results showed variation of secondary cosmic radiation flux in energy spectrum of specific energies of about1.127 MeV, 2.29 MeV and 3.66 MeV.

With the fact that during different celestial events happening in sky, modulate terrestrial secondary flux of cosmic and solar radiation, we attempted to see effect of transit of Sun across constellations Capricorns, Aquarius in month of February, 2021 on secondary gamma radiation flux at Udaipur India.

Experimental Set-up and Observations

In this experimental study we used Scintillation detector of (SD 152 F) flat type with Size of the NaI (Tl) crystal of 2" x 2"ofNucleonix make (Figure 1). This is optically coupled with photo multiplier tube (MC 1000) having 1024 channels. The integral line was connected to 1k multi-channel analyzer of Nucleonix make with usb interface built in high voltage and shaping amplifier. Using gamma ray software Anuspect data files were collected in computer. This Scintillation counter system kept open to collect the counts as a function of time on the roof of Astronomy Laboratory of Department of Physics, Bhupal Nobles' University Udaipur (Rajasthan) India. For this experimental study the data files were stored in computer for half hour duration from time 17.00 IST to 17.30 IST on the dates February 9, 11, 12, 13, 15, 16, 17 and 19.

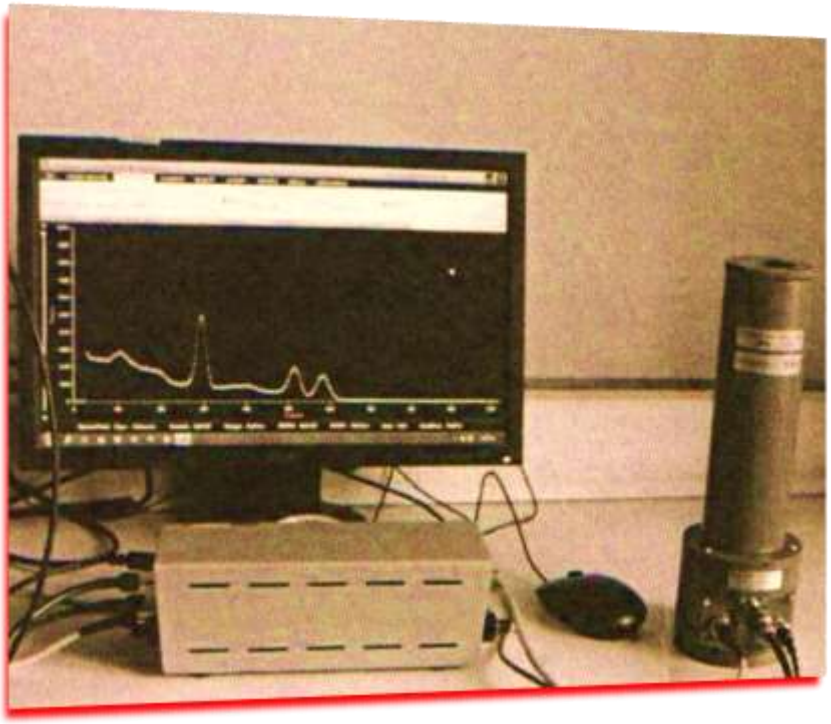

Figure 1 (Scintillation Counter System)

Analysis and Results

As depicted in figure- 2 the panels of SGR flux integrated data files between channel and integrated counts for half hour duration between time 17.00 IST to 17.30 IST on the dates February 9, 11, 12, 13, 15, 16, 17 and 19.

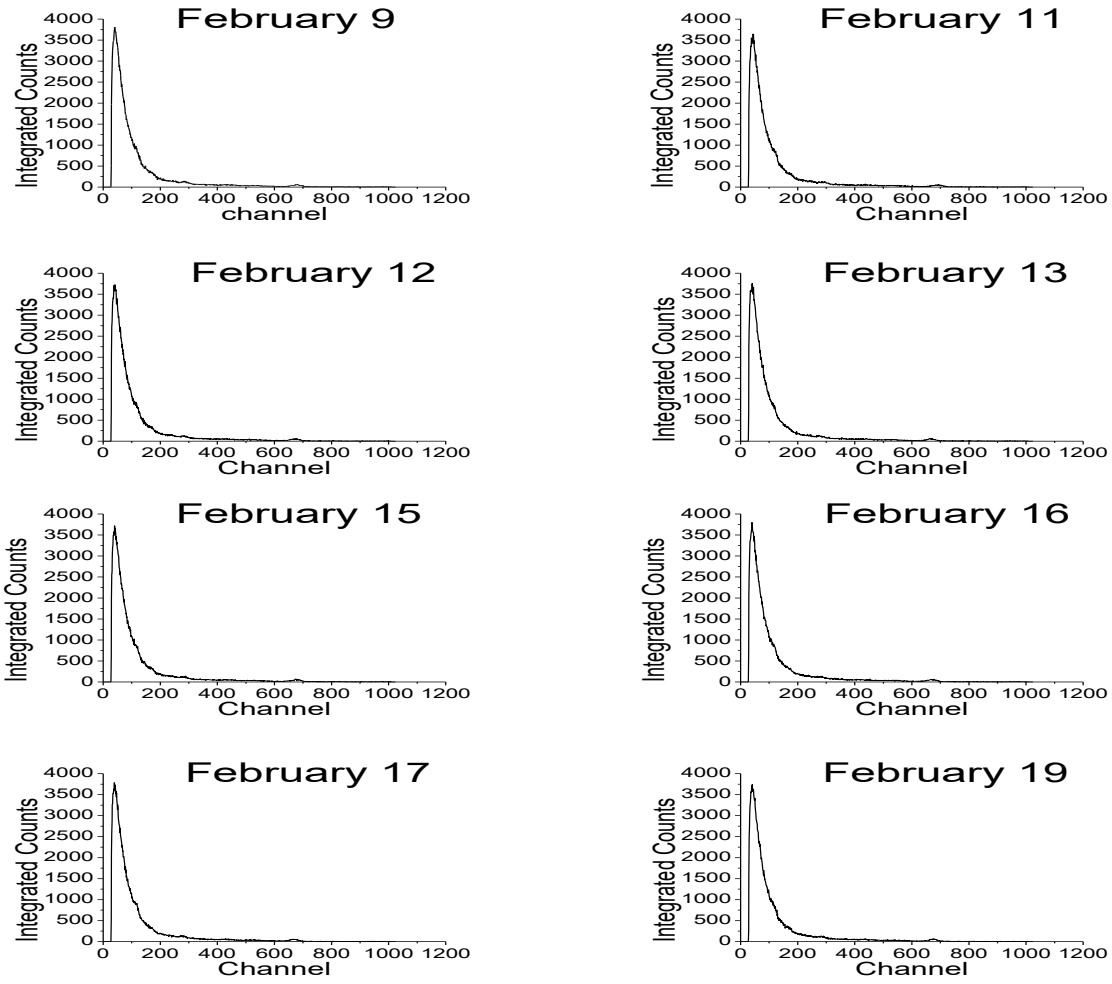

Figure- 2 (Panels of SGR flux integrated data files)

Using Figure 2 we made the table 1 which represents integrated counts of secondary gamma radiation flux with respect to dates February 9, 11, 12, 13, 15, 16, 17 and 19.

Table 1

Sr. No.	Date	Integrated Counts
1	9	259592
2	11	252172
3	12	250853
4	13	249366
5	15	247411
6	16	252979
7	17	252019
8	19	253000

Using figure 2 and table 1 of SGR flux integrated data files, we made figure 3 which represents integrated counts of secondary gamma radiation flux with date for the month of February, 2021.

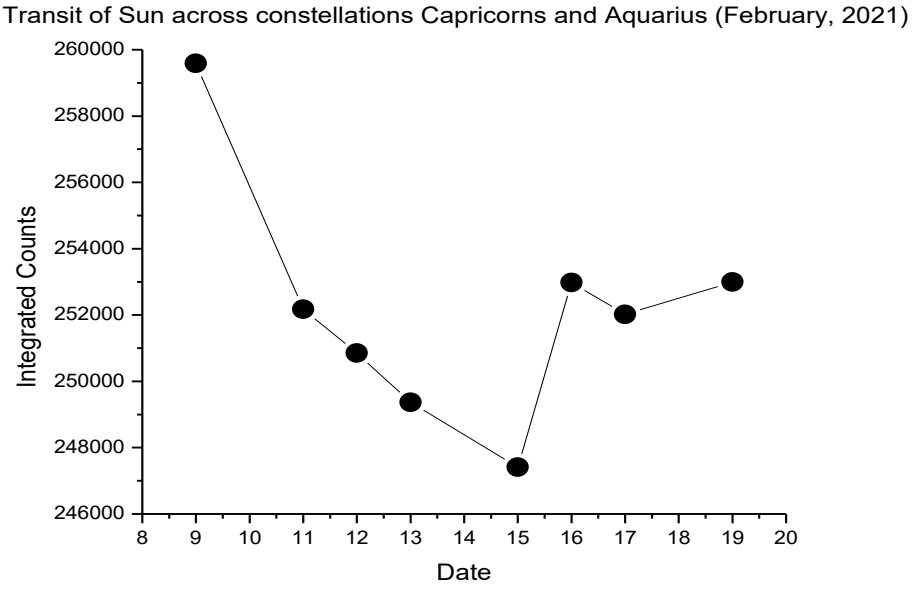

Figure 3 (Iintegrated counts of secondary gamma radiation flux)

Discussions

The probable reasons in this present experimental study for the variation of SGR flux counts in the month February, 2021 are as follows:

(1) Table 1 and figure 3 clearly showed that on February, 9 there were highest counts in this experimental study. On this date the Sun, planet Jupiter, planet Saturn, Planet Venus were in the constellation Capricorns. Planets Mercury was close to constellation Capricorns. Therefore on this date due combined gravitational lensing and gravitational pull by the Sun, constellation Capricorns and planets on background radiation, more radiation bent. Also on this date radiation from constellation Capricorns was more. These more radiation interact with atmosphere of the Earth hence formation of secondary radiation were more.

(2) After February, 9 the Sun started to shift away from this constellation Capricorns and we observed decrease in counts on the comparison with February, 9.

This is due to gravitational lensing, gravitational pulling effect started to decrease and less secondary radiation formed in the atmosphere of Earth.

(3) Table 1 and Figure 3 showed from date February, 16 integrated counts started to increase because the Sun approached towards constellation Aquarius. Therefore again combined gravitational lensing, gravitational pulling effect by Sun and constellation Aquarius and radiation from constellation Aquarius caused increased in secondary gamma radiation flux.

This experimental study is unique and first time we reported variation of secondary gamma radiation flux on surface of the Earth during Transit of Sun across constellation Capricorns, constellation Aquarius and presence of planets in the constellation Capricorns.

Conclusions

Change of secondary radiation flux on the surface of the Earth during Transit of Sun across constellation Capricorns, constellation Aquarius and presence of planets in the constellation Capricorns is another signature. In my experimental studies we observed such variation [31], [32].Also, we observed variation of secondary flux during transit of Sun in constellation Sagittarius. This research paper is accepted for publication in Nepal Journal of science and technology and will publish in NJST Vol 20 (1).

In the experimental studies [31] analyzed data showed variation of secondary flux during transit of Sun across constellations Libra in month November, 2018 and Virgo in month September, 2019 at Udaipur. In month November, 2018 on 13 November the Sun was in the Libra constellation and on another dates the Sun was shifted away therefore we observed less secondary radiation flux. In the Month September, 2019 from 4 September

onwards the sun was approaching towards Virgo constellation and we observed increase in secondary radiation flux.

Also, in another experimental study [32] in the month November 2020 the Sun was approaching towards Libra Constellation and on November 12 the Sun was in the constellation Libra. On this date we observed highest secondary flux.

Another study was conducted in the month of January, 2021 and on January 8 the Sun was in constellation Sagittarius and we observed the highest secondary flux. This research paper is accepted for publication in Nepal Journal of science and technology and will publish in NJST Vol 20 (1).

Results of above experimental research studies encouraged to observe such variation due to transit of Sun across another constellations therefore an experimental study was further conduced to observe such variation during Transit of Sun across constellation Capricorns, constellation Aquarius and presence of planets in the constellation Capricorns in the month February, 2021 at Udaipur, India. In this study we observed variation of secondary radiation flux, because on February, 9 combined gravitational lensing and gravitational pull by the Sun, constellation Capricorns and planets on background radiation more therefore more radiation bent. Also on this date radiation from constellation Capricorns was more. Further from February, 16 integrated counts started to increase because the Sun approached towards constellation Aquarius. This experimental study gave the conclusion that during Transit of Sun across constellation Capricorns, constellation Aquarius and presence of planets in the constellation Capricorns on the surface of the Earth secondary gamma radiation flux varies.

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References

1) *Longair M.S., (1992) High energy Astrophysics 1 second edition Pub. Cambridge University press,*
2) *Chaisson, Eric and Mcmillan, (1999) Steve, Astronmy today, 3rd Edition, Prentice Hall*
3) *Mewaldt, R. A., (2010), cosmic rays. California institute of technology.http://www.srl.caltech.edu/personnel/dick/cos_encyc.html.*
4) *Kudela, K., (2009) On energetic particles in space.Actaphysicaslovaca 59,537-652*
5) *Simpson, J. (1983). Elemental and isotopic composition of galactic cosmic rays, annual reviews of nuclear and particle science, 33, 323-381.*
6) *Carl D. Anderson and Seth H. Neddermeyer, (1936) Cloud Chamber Observations of Cosmic Rays at 4300 Meters Elevation and Near Sea-Level, Physical Review 50, 263.*
7) *Bhabha (1938 a) Nuclear forces, heavy electrons and the β-decay. Proc.Roy.Soc.Lond.A 166 (1938) 501*
8) *Bhabha, (1938b) Nuclear forces, On the theory of heavy electrons and nuclear forces, Nature 141 117 DOI: 10.1038/141117a0*
9) *Allkofer, O. C. and Grieder, P. K. F. (1984) Cosmic Rays on Earth.https://inis.iaea.org/search/search.aspx?orig_q=RN:15054748*
10) *Walter Heinrich Heitler, (1937) On the analysis of cosmic rays, Proceeding of the Royal Society A, , 161,261. https://doi.org/10.1098/rspa.1937.0145*
11) *L. W. Nordheim, (1937) On the Absorption of Cosmic-Ray Electrons in the Atmosphere, Physical Review, 51, 1110. https://doi.org/10.1103/PhysRev.51.1110*
12) *Pfotzer (1936) Messungen der Ultrastrahlung in der Stratosphäremiteiner Dreifachkoinzidenzapparatur, Z. Phys. 102, 23, 41.*
13) *W. Heitler, (1938) Showers produced by the penetrating cosmic radiation, Royal Society, Vol. 166, Issue 927..Page(s): 529-543. https://doi.org/10.1098/rspa.1938.0108*
14) *Kodama M., (1983) Ground Albedo Neutrons Produced by Cosmic Radiations, Physical Society of Japan, Journal, 52, 1503-1504*
15) *A. Chilingarian, A. Daryan, K. Arakelyan, A. Hovhannisyan, B. Mailyan, L. Melkumyan, G. Hovsepyan, S. Chilingaryan, A. Reymers, and L. Vanyan, (2010) Ground- based observations of thunderstorm-correlated fluxes of high-energy electrons, gamma rays, and neutrons, Physical Review D, 82(4), 043009*
16) *Mellier, Y. (1998) : Probing the universe with weak lensing. https://arxiv.org/abs/astro-ph/9812172*
17) *Ramesh Narayan, Matthias Bartelmann,(1996): Lectures on gravitational lensing. https://arxiv.org/abs/astro-ph/9606001*

18) *DevendraPareek, S.N.A. Jaaffrey, K.P. Talesra, Ravi Yadav, Sonia Ameta, (June, 2013) Experimental study of Variation of Secondary Cosmic Gamma Ray Flux and Energy during Partial Solar Eclipse of 4th January 2011 at Udaipur, India, Research journal of physical sciences, Vol. 1(5), pages 22-30,Nayak, Pranaba K, et al. (2010), AstroparticlePhysics, Volume 32, Pages 286 – 293.*

19) *AnkushBhaskara, AvadhutPurohit, M.Hemalatha, ChintamaniPai, Anil Raghav, ChetanGurada, S.Radha, VirendraYadav, Vishal Desai, AbhishekChitnis, PadmanabhSarpotdar, AnirudhaPatankar, (December 2011), A study of secondary cosmic ray flux variation during the annular eclipse of 15 January 2010 at Rameswaram, India, Astroparticle Physics, Volume 35, Issue 5, Pages 223-229,*