Abstract

The high-energy cosmic rays entering the Earth's atmosphere throw light upon many **~~different~~** aspects of Astroparticle **~~Physics~~** and Particle Physics. **~~The~~ This** work **~~presented in this symposium~~** outlines investigative learning about these **high-energy** primaries based on a 7 mini array DEASA in Agra, India. DEASA (Dayalbagh Educational Air Shower Array) con8 sists of eight plastic scintillators**,** each with an area of 1 square meter. This array covers an area of 260 square meters and is the first array in the northern part of our country. 10 **~~The~~ A** real-life application~~s~~ of the cosmic ray particles where the effect of cosmic rays in space has been studied and the best material has been found to protect the astronaut from the galactic cosmic rays. Poly materials were found to be the best material due to **the** large amount of hydrogen (H) and low atomic number (Z). It is observed that **the** equivalent dose is minimum (107 sieverts) for Polystyrene compared to the other materials. 15 Finally the high energy muons have been studied to image nuclear caskets called muon 16 tomography. In this study, a dry cask container has been simulated which contains the 17 UO2 rods and the muon scattering has been observed.

MINOR COMMENT: *The paragraph between lines 9-12 must be written clearly. It is confusing. Also, use the active voice in places and sentences describing your own results and findings. For example, here is a suggestion:* **We found poly materials are the best material to protect astronauts from galactic cosmic rays due to a large amount of hydrogen (H) and low atomic number (Z).** *Try to join the previous sentence to this one with coherence.*

~~It is~~ We observed that **the** equivalent dose is minimum (107 sieverts) for Polystyrene compared to the other materials. **Finally,** the **high-energy** muons have been studied to image nuclear caskets called muon tomography. In this study, a dry cask container been simulated which contains the UO2 rods and the muon scattering has been observed.

MINOR COMMENTS: *The marked paragraph between lines 25-26 must be written clearly. This is an abstract. It must be concise. The paragraph starting on line 23, must be continuous to line 22*

MAJOR COMMENT: ***The abstract seems to be a copy-paste of the same sentence or similar words in/from the main text. Please avoid the latter. Change the abstract somehow. The main idea is there but is not a copy-paste literally (e.g. compare with marked text in lines 102-104). Authors abstract must write the abstract in a pretty concise and short way. It must have a brief context, aim/goal/scope, results, and conclusions. No more. This work is a peer review article, so authors must write it as it is and with more care.***

1 Introduction

The cosmic rays **mainly** come from radioactive decay inside the stars, ~~**explosive supernovae's**~~, **supernovae**, **the** Sun and pulsars ~~**etc**~~ **(do not use wordy or etc. Use another word like mainly, mostly or similars.)**. The higher energy ones seem to be coming from **supermassive** black holes at the heart of galaxies. On reaching the Earth's atmosphere, they produce showers of particles ~~**which**~~ **that** pass through us almost 500 times ~~**in**~~ a minute. The cosmic flux is ~~**an important**~~ **a crucial** tool for calibrating particle detectors**, and** this study is **also** being done for DEASA detectors ~~**also**~~. The muons entering our detectors do not have a constant flux but slightly more in summer and lower in winter. This is connected to pions which have decayed into muons in the shower. In **summer,** the air warms and expands, leading to more gap**s** between air molecules allowing pions to ~~**reach**~~ further ~~**so as**~~ ~~**to**~~ decay into muons. In **winter,** the air is cold and dense resulting **in** higher collisions of pions leading to fewer decays into muons. The cosmic rays before entering the atmosphere are ~~**mostly**~~ **primarily energetic** galactic ~~**energetic**~~ particles coming from inside the galaxy **and more energetic** extragalactic ~~**with energetic**~~ **particles** from the active galactic nuclei, quasars or **gamma-ray** bursts. These energetic particles affect the human body in many different ways as **a** published study [1] says that the twins physiology, memory abilities and genes for one of the **twin's** on Earth and other on ISS for 340 days. The study confirms that **space-time** manipulates ~~**the**~~ genes, **and** affects the human immune system. The exposed person suffers from ~~loss in~~ mental reasoning and memory **loss, and** studies are going on for **long-term** ailments. One of the stickiest problems for NASA is how to shield **astronauts** from energetic cosmic rays and solar flares. The air shower developed by an energetic particle entering the atmosphere grows with depth into hadronic and electromagnetic particles at ~~**the**~~ sea level. These muons can look into the interiors of impenetrable structures in parallel to the x-ray imaging of our body. The difference ~~**being**~~ **is** that X-rays have to be produced in the laboratory**, and** muons are always available. This feature defines them as a good tool for **impenetrable** imaging ~~**the impenetrable**~~ structures like pyramids **and volcano** to nuclear reactor containers. Muons **travelling** through a structure will be stopped along the path or scattered depending on the thickness and density of the material. The plastic scintillator lights up when a charged particle passes through so we design the simulation with 46 a nuclear casket **surrounded** ~~**surrounding**~~ by two plastic scintillators. **Finally, this** muon imaging technique has been used to image the interiors of the nuclear reactors at **the** Fukushima Daiichi plant[2] ~~**also**~~.

MINOR COMMENT: *The marked paragraph between lines 51-53 must be written clearly. It is confuse, first authors are describing work [1] and then with a THE STUDY is not clear if still is [1] or the current work. Remark and clarify what [1] is saying, and what the current work is obtained.*

2 DEASA

The cosmic ray flux decreases rapidly with energy as E −2.7 around 1014 49 eV**. Hence**, is impossible to 50 have direct measurements. ~~**At these energies, the**~~ **The** secondaries produced at sea level **increase** with primary particle energy **at these energies**. The change in transverse momentum and scattering of the secondary particles with the atmospheric particles leads to their lateral spread on **the** ground. This process of almost parallel arrival of the secondary particles reaching **the** ground is called extensive air shower in which the spread is between 104m2 to 10km2. This phenomenon gave insight into: 1. Particle Physics from air shower spread. 2. The direction of secondaries arriving on **the** ground tells about **high-energy** particles. 3. The cosmic ray energy spectrum. 4. Mass of primary cosmic rays. DEASA is a mini array of eight plastic **scintillators,** each with an area of 1 square meter, **which** has been set up as shown in Figure 1. This array covers an area of 260 square meters and is the first array in the northern part of our country. The pulses from the eight detectors are ~~**being**~~ manually studied. The pulse amplitudes, **time** over **the threshold**, rise time, fall time**, and** full width half maximum are being observed to study correlations between them. The calibration of the 12 dynode **photomultiplier** tubes attached to each of the eight detectors has been completed and the flux measured is around 13500 counts per minute. Daily monitoring of the detectors is maintained in **the** log book.

3 SPACE STUDIES

~~**The**~~ **A** real-life **application** of the cosmic ray particles is the effect of cosmic rays in space to find out the best material to protect the astronaut from the solar energetic particles(SEP) and galactic cosmic rays(GCR) [3] **(COMMENT: CHECK LINES 32-38)**. The water phantom was irradiated with primary proton following a galactic cosmic ray energy spectrum with different shielding materials. The secondary particles are created with interactions between protons and the shield material in Geant4.

We found poly materials ~~**were found to be**~~ are the best material due to **a** large amount of hydrogen (H) and low atomic number (Z). **(COMMENT: CHECK LINES 32-38)**. High H leads to fragmentation of the heavy GCR particles into small fragments**, and** low Z produces **a** maximum number of secondaries. Poly materials are 16 percent more effective than **aluminum** in reducing the dose equivalent with only 1.5148 g/cm2 ~~**of material**~~. Polymeric materials are expected to play an important role in protecting ~~**the**~~ astronauts on future missions. It is observed that **the** equivalent dose is minimum (107 sievert) for Polystyrene as compared to the other materials.

4 MUON TOMOGRAPHY

The second study defines the application of muons to identify nuclear wastage using plastic scintillation detectors [4] in muon tomography. In this study, a dry cask container has been simulated**, which** contains the UO2 rods (varying in number)**, and ~~the~~ muon** scattering has been observed [4]. This shows that when the dry cask is filled with the rods, muons **are** scattered to the maximum angle**, and** if the dry cask is empty, the muon will pass through it straight **without** getting scattered. The scattering of energetic muons of range 3 GeV – 10 GeV from these containers with dimensions from Narora Nuclear plant, Uttar Pradesh(U.P.). The parameters measured are energy loss, radiation length**, and** scattering angle for **a** different number of rods gives us patterns **~~which~~ that** describe the inside of the containers without opening them. The radiation length is the average distance required for an electron to lose 1/e of its energy and **is** measured in cm. The multiple scattering of the muons is **~~mostly due~~ primarily due** to **the** Coulomb scattering of muons in the target with charge Z, calculated analytically. Muon with energy 3 GeV **~~looses~~ loses** 3.64 MeV/c energy in concrete**, and we found** the scattering angle **~~was found~~** to be 4.14 mrad **(COMMENT define or mention what is a mrad to put in context)**, **whereas** the radiation length was 10.91 cm. These calculations have been done for different energy muons scattered from Iron, Lead and Uranium targets in this paper.

5 Conclusion

These studies prove that **high-energy** quantum fields consciously assist us in applications beyond the accelerating sources **~~from which~~** they arrive and reach far beyond the **human-machine** interface. **Neutrinos**, although **~~being~~** nearly **massless,** give solutions to Dark matter, Dark energy in cosmology, muons being tiny particles **that** can scan structures like nuclear plants, submarines**, etc (COMMENT: Avoid to use etc. Use other words and be more specific).** Hadron fields have applications in medical physics**, such** as hadron therapy and carbon ion therapy for **~~the~~** cancer patients. The importance of cosmic ray studies at DEASA is that students can understand quantum sensors, the electronics for fast pulses**, and the analysis of count rates ~~count rates analysis~~** over the different seasons. Another **~~important~~ critical** aspect of these studies is the Monte Carlo simulations in Geant4 and CORSIKA. These codes give a **wide-angle** view to the user and applications in space physics, nuclear science**, and** many other areas.

Acknowledgments

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REFERENCES

The four references have different formats and using types. Use the accepted style for the journal and uniformize