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Health risk by Cosmic Radiation Exposure

Szu-Tung Chen, Xin Jie Duan, Cheng Yi Guo and Meet Agrawal
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1 Introduction

Cosmic radiation is high energy radiation with subatomic particle. They mainly come from the outside of solar system. Most of them are consist of protons(89%) and atomic nuclei(10%). Cosmic rays can produce showers of secondary particles that sometimes reach the surface of the earth[1].
In 1912, Victor Hess carried three enhanced-accuracy Wulf electrometers to an altitude of 5,300 metres in a free balloon flight. He detected that the ionization rate increased to about four times of the ground rate[2]. It is from that time, people have started to explore the mysterious radiation.

2 Health risks

Cosmic ray collisions in the body can be harmful because the pions from radiation will quickly decay into mu mesons, or muons, which penetrate to the ground. As they pass through our bodies, they produce ions and break chemical bonds[3]. They can also damage the DNA in our cells. Even a single cosmic ray has a large amount of energy. Cells may be destroyed or mutation of some disease like cancer or cataract may occur[4]. These radiations can do no significant harm for people on the ground.
Cosmic radiation is affected by atmosphere. For a single person on the ground, radiation exposure is only 0.3-0.4 [mSv/y] [5]. Fig.1 shows the average cosmic radiation exposure in 2008.

Source of exposure		Annual effective dose (mSv)	
		Average	Typical range
Cosmic radiation	Directly ionizing and photon component	0.28	
	Neutron component	0.10	
	Cosmogenic radionuclides	0.01	
	Total cosmic and cosmogenic	0.39	0.3–1.0[a]

Fig. 1 . Average Cosmic radiation exposure

Without enough thickness of atmosphere, it is said that the pilot of an aircraft probably absorbs as much radiation as a worker in a nuclear power plant. Since they work in upper atmosphere, they face much more radiation(around ten times) than people on the ground[6].

Some airlines choose to fly over poles, because it can save upto $35,000 to $40,000 per flight in fuel costs alone. But correspondingly, radiation of flights over the poles are 3 to 5 times higher than domestic flights closer to the equator[6]. Below is the image of Nowcast of Atmosphere Ionizing Radiation for Aviation Safety on Oct. 4, 2018

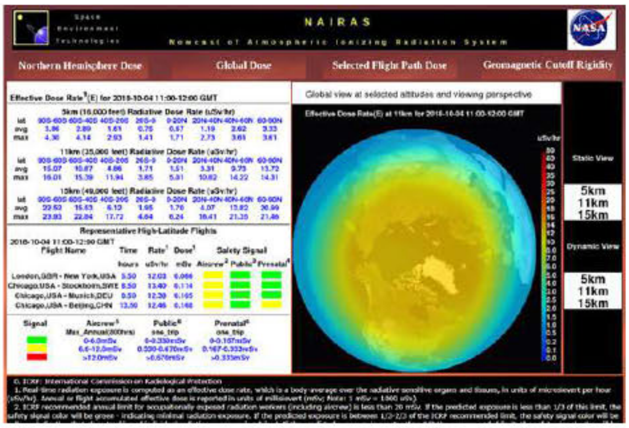

Fig. 2 . A NAIRAS model shows radiation levels over the northern hemisphere on Oct. 4, 2018 [7]

The situation become more serious with astronaut in deep space. They would have thousands of subatomic particles pass through his or her body every second[4]. One estimate from NASA reveals that about one third of the DNA in an astronaut's body would be cut by cosmic rays every year[3]. The structure of the fuselage can be coated with shielding materilas like composite built from Polyethylene(PE) and low-Z materials, which are convincingly proven effectives towards these radiations[8] . Learning how to protect humans from radiation exposure is an important step in future space exploration.

3 Mitigation of Health risks caused by cosmic radiation

The following sections will discuss methods to mitigate health risks caused by cosmic radiation from the perspectives of astronomers, flight passengers, and ordinary civilians.

3.1 Cosmic radiation protection - Astronomers

Astronomers have the greatest health risk caused by cosmic radiation as they receive the largest amount of radiation from the universe and it is much higher than anyone else on the earth[9]. Several methods are developed and employed to ensure the safety of astronomers. Inside the spacecraft, astronomers are protected by the radiation shield layer wrapped around the spaceship[10]. The radiation shield layers can be made of aluminum alloy, CFRP, or Gold Foil (most commonly used). These materials are proven to be effective in blocking radiation but they also have their own pros and cons[10]. CFRP is a relative light material in terms of weight and it can also provide space debris protection, but it is also the most expensive material[11]. Aluminum alloy provides the most effective shielding and it is inexpensive, but due to its heavy mass, it reduces the payload carried on the spaceship. Finally, gold foil is the lightest material, and it also provides reasonably good shielding effect, but another layer has to be added to protect it from the space debris[12].

3.2 Cosmic radiation protection - flight passengers

There are numerous methods available to protect the flight passengers from the high radiation at high altitudes of flight. First, the airline companies can upgrade their facilities by adding an additional layer made of soft aluminium foils in the blanket provided to passengers for long-haul flights[13]. Secondly, windshield can also be made from CFRP or other radiation shielding materials so that passengers can close the windshield during the flight to reduce the effect of radiation[13]. Finally, passenger can also purchase radiation protection clothes and wear them during the flight. The radiation protection clothes won't necessarily be complicated and technical, it can be simply made of two cottons with an layer of tinfoil in between[14].

3.3 Cosmic radiation protection - ordinary civilians

The above-discussed methods are for extreme conditions and these won't happen in our day-to-day life. Most of the earth's surface is shielded by the earth's natural magnetic field generated by the flowing liquid metal at the center of the earth. Ozone layers also provides protection from these radiations, especially UV radiation[15]. As a ordinary civilian, what one can do is, to protect the earth and the ozone layer, reduce the greenhouse gas emission and the carbon footprint[15].

4 Conclusion

In this paper we discussed the health risks caused by cosmic radiation and presented several methods to mitigate the effect of cosmic radiations. While gold foil and tinfoil are proven to be effective, light, and inexpensive material to shield from the radiation, it is also important to pay close attention to solar variation and changes in cosmic radiation and protect the ozone layer - a natural effective protection shield for all lives on earth.

Authenticity and Plagiarism

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