

Project Brief

Xin Cheng Liu

1 Project Title

Using nuclear tracks in solids to detect cosmic rays.

2 Project Description

Cosmic rays are high energy particles originating from supernovae or other astrophysical events and are constantly coming into contact with the Earth. 87% of primary cosmic rays are protons or hydrogen nuclei; 10% are helium nuclei and the 1% are heavier nuclei[5]. When primary cosmic rays interact with the Earth's atmosphere, they produce secondary cosmic rays that cascade down to produce three main components of secondary particles: electromagnetic, mesonic and nucleonic.

When these high energy particles interact with certain minerals/solids, they leave behind latent damage known as nuclear tracks. These tracks are microscopic and to reveal them, chemical or plasma etching is used to widen the tracks.

This process has been used on many extraterrestrial objects such as meteorites and helmets from Apollo missions, as they have a higher potential of coming in contact with the heavier primary cosmic rays, compared to terrestrial minerals. Such research can be found in [6], [1], [3] and [4].

However, this literature review is interested in taking this process and carrying it out terrestrially. Through placement of suitable solids for detecting cosmic rays at high altitudes, such as on mountains. We can probe the change in cosmic ray flux through nuclear track density at different altitudes.

Similar work has been carried out by [2], where they placed Solid State Nuclear Track Detectors (SSNTDs) at Darjeeling, India.

References

- [1] AB Aleksandrov, AV Bagulya, MS Vladimirov, LA Goncharova, AI Ivliev, GV Kalinina, LL Kashkarov, NS Konovalova, NM Okateva, NG Polukhina, et al. Meteorites as a natural detectors of very heavy galactic cosmic ray nuclei: some aspects of the experimental track studies. *Astronomical School's Report*, 7(2):145–149, 2011.
- [2] Basudhara Basu, Sibaji Raha, Swapan K Saha, Sukumar Biswas, Sandhya Dey, Atanu Maulik, Amal Mazumdar, Satyajit Saha, and Debapriyo Syam. Observation of a rare cosmic ray event at mountain altitude. *Astroparticle Physics*, 61:88–92, 2015.
- [3] RK Bull and SA Durrani. Cosmic ray tracks in the shalka meteorite. *Earth and Planetary Science Letters*, 32(1):35–39, 1976.
- [4] GM Comstock, RL Fleischer, WR Giard, HR Hart Jr, GE Nichols, and PB Price. Cosmic-ray tracks in plastics: The apollo helmet dosimetry experiment. *Science*, 172(3979):154–157, 1971.
- [5] Tibor J Dunai. *Cosmogenic nuclides: principles, concepts and applications in the earth surface sciences*. Cambridge University Press, 2010.
- [6] RL Fleischer, PB Price, RM Walker, M Maurette, and G Morgan. Tracks of heavy primary cosmic rays in meteorites. *Journal of Geophysical Research*, 72(1):355–366, 1967.