An exploration of micrometeorites on the rooftops of Dublin

Research Proposal

Introduction

Between 60 - 100 metric tons of cosmic dust falls to earth each day. Most of that dust is in the form of micrometeorites- small particles of meteoroids, measuring between 100-500 micrometres in length, that survive the Earth's atmosphere. Even though scientists have been finding large amounts of micrometeorites in polar ice and deep-sea sediments for decades, it was only recently that scientists began to find micrometeorites in various urban environments. Although micrometeorites have been found in various urban cities across the world, they still remain to be found in Ireland.

The goal of this research project is to search for micrometeorites across the rooftops of Dublin. Rooftops are the most likely place to find micrometeorites in an urban environment as they are unobstructed from the sky and have less foot traffic than other possible sample collection sites. This project has the potential to find new micrometeorites in Ireland, an area where micrometeorites have never been searched for before and contribute to the growing field of knowledge of urban micrometeorites.

I first came across the topic of urban micrometeorites through an article I read about them back when I was in high school. At the time there wasn't much research available about urban micrometeorites as it was still a newly developing area. I had wanted to conduct my own research and look for micrometeorites on my own roof after learning about them, however I didn't have the equipment needed to be able to do so. The Laidlaw programme would finally be able to equip me with the resources to carry out this project. Although this project isn't revolutionary, it could enable us to better understand the type of cosmic dust that falls on earth every single day including their origins and composition.

Methodology

The proposed project will be broken up into three stages:

1) The first stage is the collection of samples. As most micrometeorites are magnetic in nature, the samples will be collected using strong magnets. The magnets will be attached to a trolley device for ease of collection. Samples will be collected from various flat rooftops across Dublin. Several locations have been proposed for this following discussion with my supervisor. These include- Multi-level car parks, Dunsink observatory, the advanced microscopy laboratory, Trinity halls, and more. The permissions to gain access to these locations from the relevant authorities shall be gathered in the weeks following up to the project. Samples will also be collected by placing strong magnets for an extended period of time (around a week) at the ends of rain gutters of various buildings, and flushing them out either naturally by rain or manually, allowing the magnet to collect samples from the large build up of particles that reside inside. This stage should take around 2-3 weeks.

2) The second stage is the processing of the samples. This involves the cleaning and separation of the samples using a micrometre sieve. The samples are then identified and isolated using a normal optical microscope. The samples will be selected based on shape and appearance. This stage will take around 1 week.

3) The third and final stage is the imaging of the sample. This is done through the use of the scanning electron microscope at Trinity's advanced microscopy lab under the guidance of my supervisor- Dr. Lewys Jones. The scanning electron microscope (SEM) allows the samples to be imaged in significant detail allowing the surface topography of the samples to be seen. It is also able to find the elemental composition of the sample. Using the information provided by the SEM, the samples can be cross referenced with indexes and literature on micrometeorites collected by other scientists to identify whether the sample is actually a micrometeorite or a terrestrial imposter. This stage would take around 1-2 weeks.

The project should be feasible within the 6 week period as a generous amount of time has been allocated towards each stage.

Materials

The materials required for this project are-
- Strong magnets such as Neodymium magnets for sample collection
- Trolley device for sample collection
- specimen containers for isolating potential samples.
- optical microscope for manual selection of potential samples
- A 300-400 micrometre sieve
- The use of the scanning electron microscope at Trinity's advanced microscopy lab (approved for use by Dr. Jones)

All of the materials required for this project are fairly straightforward to obtain, and should not be much of a problem.

The permissions needed from the managers of the buildings the samples will be collected from will be gathered before the project starts.

As the methods for this research project are based on field sample collection and laboratory work, it would be challenging to complete if the Covid-19 situation gets worse and more restrictions are introduced, as all the work must be done in person. Although with the way the current situation is progressing, that shouldn't be too much of a concern.

The methodology and various details of the project have been extensively discussed and evaluated with my supervisor – Dr. Lewys Jones, who specialises in the field of ultramicroscopy.

References and Resources

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