Motivation

Based on Dr. J. Lilensten’s bell-jar design and as part of the Planeterella European network, we report here a revised design of a Planeterella, which consists in a uniquely designed single-structure glass-aluminium vacuum chamber of cubic shape built ‘in-house’ at Aalto University.

With code name Terrella Cubica, the aim is to support the current space physics cures of the Aalto University Department of Electrical Engineering, by demonstrating plasma phenomena (auroral ovals, ring currents, etc.) usually only witnessed by instruments onboard space missions.

The ingredients of the experiment: From Birkeland’s Terrella...

In 1902, the Norwegian physicist Kristian Birkeland started in Christiania (Oslo) a series of vacuum experiments to reproduce in the laboratory the auroral mechanisms he had theorized: he called them Terrella, “little Earth”, in honour of W. Gilbert’s magnetism experiments.

The experiment is composed of:
- Vacuum chamber capable of reaching ionospheric-like pressures (~ 10⁻² mbar)
- Aluminium magnetised spheres, with dipolar magnets (1 T), to mimic Earth and other planets
- High-voltage power supply to mimic the electron flow (~ 1 kV, few mA).

When these spheres are placed in a partial vacuum, an electric discharge is introduced between the anode and cathode, simulating electrons precipitating along magnetic field lines in the rarefied gas, hence creating auroral ovals in the Southern and Northern hemispheres.

... to the Planeterella as a teaching tool for space plasma physics

First created at Grenoble University (France), the modern Planeterella experiment has since been remade 17 times in universities in Europe and the US. It draws from Birkeland’s heritage, with many practical modifications that make it portable and accessible to Universities and public institutions. The main enhancement of the experiment is the use of several spheres to recreate Space Weather phenomena (Sun-planet or “exotic” star-exoplanet interactions).

All vacuum chambers are bell-shaped and standardised.

Please visit us at:
http://planeterella.osug.fr/?lang=en

The Planeterella is organised as an international network bound by a Gentleman’s agreement. Thanks to its success & several awards (EuroPlanNet, etc.) it has been seen and discussed by more than 20,000 people across the network.

Aalto’s Terrella Cubica, the first Nordic Planeterella

Stemming from the original cubic-shaped plasma chamber of Birkeland, we have built at Aalto University a new prototype within the Planeterella agreement, called Terrella Cubica (see below).

The experiment has been entirely created on site at the University as a single aluminium structure. The small pieces (spheres, pedestals) as well as the base plate were created from off-the-shelf raw materials by machining and by 3-D printers. Neodymium magnets of 1 Tesla intensity are used in the current setup.

Tests are under way at Aalto University. The experiment will be used to demonstrate basic phenomena encountered in planetary space plasmas such as the Lorentz force, the Debye length, the formation of ring currents or of upper atmosphere VIS/UV emissions.

The Aalto Terrella Cubica from 3-D design (left), building (middle) and first vacuum test with discharge (right).

Further reading


