Cosmic Ray Tracks by the new type of Cloud Chambers

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Abstract

We have fabricated two different types of cloud chambers: a diffusion cloud chamber and a Wilson cloud chamber. These chambers were filled with pure air and the tracks formed in them by cosmic rays were investigated. Surprisingly, cosmic ray tracks were observed in air containing few aerosol particles. This finding is highly significant and may be useful in future studies of the relationship between solar activity and global cloudiness.

Whether cosmic rays affect the global climate is an important unresolved question in geophysics. This question was first posed in a paper by Friis-Christensen and Svensmark published in 1997. In subsequent papers, Svensmark et al. found a correlation between global cloudiness and the intensity of cosmic rays.

Cosmic ray physicists have no difficulty understanding the correlation between the intensity of cosmic rays and cloudiness, since they use cloud chambers to detect cosmic rays, which produce tracks in the chambers by ionization. However, the intensity of cosmic rays appears to be too low to account for number of water droplets in global clouds. Ion pairs induced by cosmic rays probably play only a minor role in accelerating the formation of water droplets. Even if cosmic rays were able to accelerate the formation of a small number of water droplets by ionization, the clouds produced would mask the light of the Sun, thereby reducing the global temperature. Thus, it might be possible to find a reasonable explanation for the correlation found by Friis-Christensen and Svensmark.

However, the role of the ions created by cosmic rays is not well understood. There may be other routes through which ions have function as cloud condensation nuclei (CCN) and form water droplets. Do ions accelerate the formation process of CCN? Or do ions increase in size by attracting water particles by themselves, independently of Aitkin particles (AP) and/or Aerosol Particles? This is a very critical point for understanding the Maunder minimum phenomena. In order to discover the answer to this question, we conducted an experiment using small cloud chambers.

We prepared two types of cloud chambers: a diffusion cloud chamber and a Wilson cloud chamber. While these cloud chambers are similar to conventional cloud chambers, they differed in that the gas inlet and outlet was located on the outside of the chambers. Figures 1 shows a photograph of the diffusion cloud chamber. First, we evacuated the cloud chamber by the vacuum pump. Then we flew a purified air in the chamber. The purified air was manufactured by the Sumitomo Seika Chemicals Co. which had very low levels of APs in them (less than one AP per liter according to the manufacturer). On the contrary, there are high quantities of APs in the air, for example, 300,000 aerosols with the size > 0.3μm/liter, according to our measurement.

Results: surprisingly, cosmic ray tracks were observed in the semi-purified air in the same way that they were observed in the contaminated gas that contained a high concentration of APs. We are currently unable to explain this observation. *It appears that ion pairs generated large droplets without the assistance of APs.* Is there a previously unconsidered third route to make CCN? Do ions form water droplets by themselves? Our experimental results suggest that this is possible.