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Recording of mysterious meteor sounds

Joined by the International Leonid Watch - Croatia (ILWC) project, a group of scientists presented the first instrumental detection of elusive electrophonic meteor sounds. In November 1998, the researchers from the Croatian Physical Society and the University of Kentucky organized an expedition to Mongolia to observe the anticipated Leonid meteor shower and shed some light on the phenomenon. The complete data analysis revealed two electrophonic sounds that provided several important clues about the nature of this longstanding astronomical mystery.

In the year 1676, Geminian Montanari from Italy realized that the normal sounds produced by a bright fireball require several minutes to reach the ground. The same is true when thunder lags behind distant lighting. However, the mystery was born when he noticed that some people claimed they heard sounds simultaneously with the meteor.

It was not until 1980 that the electrophonic sounds had their revival in the work by Colin S. L. Keay. Intrigued by these sounds, he proposed that meteors could produce very low frequency (VLF) electromagnetic waves. These radio waves travel with the speed of light, thus reach an observer almost simultaneously with the appearance of the meteor. Then they make a sound by simply vibrating an ordinary object.

However, something was missing in this picture. The Leonid meteors are very fragile and burn out too high in the atmosphere, contradicting the Keay's physical model of VLF meteor emission. Nevertheless, a spectacular Leonid storm of 1833 yielded a list of electrophonic sound reports. These reports and anticipated large number of meteors indicated that the 1998 Leonids were a good target for the ILWC project.

The expedition site was far from populated area to avoid radio and audio noise. Environmental conditions were harsh, with temperatures as low as -30°C (-22°F). The meteor shower appeared and numerous bright meteors illuminated the snow covered Mongolian plane. The experiment included a video camera, VLF radio receivers, and microphones acoustically isolated from the observers.

Two fireballs produced a short duration “pop”-like sound, with one of them captured on video. The sounds resemble deep “pops” reported in 1833, but the analysis of all collected data revealed surprises. Damir Kovačić from the Cognitive Neuroscience Sector

at SISSA, Trieste, Italy, coordinated the sound detection experiment. “First of all, finally we have a strong indication that our electrophones were indeed produced by the electromagnetic radiation”, he says, “but it is rather of much lower frequency than expected.”

The picture had become even more blurred when the theoretical analysis was applied to the data. “There are two major theories, including the one by Keay, about the physical process of radio emission from meteors. Both of them failed to explain the data”, says Dejan Vinković, a member of the team and coordinator of the Global Electrophonic Fireball Survey (GEFS) at the University of Kentucky. “Basically, we are back to the drawing board, where we have to start thinking about refining the theory for Leonids.”

There are some important clues, though. “It is interesting to notice that both electrophonic sounds were created when the meteors were crossing the border of the nighttime ionosphere, a layer of charged particles”, says the project leader Slaven Garaj from the Swiss Federal Institute of Technology Lausanne. “Also, the energy of meteor may not be sufficient to invoke large electric fields needed to produce electrophonic sounds. Thus, a strong coupling of a meteor with the ionosphere has to be taken in account in any future theory.”

The paper about these results will appear in the Journal of Geophysical Research. Other members of the team are Goran Zgrablić and Neven Grbac (University of Zagreb, Croatia), Silvija Gradečak (Swiss Federal Institute of Technology Lausanne), Nikola Biliškov and Željko Andreić (Rudjer Bosković Institute, Croatia).

After the expedition to Mongolia, the team initiated the GEFS project with the goal of collecting witness reports of electrophonic sounds and coordinating future experiments. There are many new reports about electrophonic sounds from the recent 2001 Leonids this November. If you have heard an electrophonic sound, please send a report to the GEFS project at the web-address: www.gefsproject.org.

Images, videos and additional information are available at the project’s web site: fizika.org/ilwcro/results/

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