Electron-gun simulations explain the mechanisms of high-energy cosmic rays

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A new study published in *EPJ D* provides a rudimentary model for simulating cosmic rays' collisions with planets by looking at the model of electrons detached from a negative ion using photons. In this work, Chinese physicists have for the first time demonstrated that they can control the dynamics of negative ion detachment via photons, or photodetachment, on a moving surface.

When cosmic rays collide with planets or debris, they lose energy. Scientists use the collision of electrons with a moving surface to simulate this process. A new study published in *EPJ D* provides a rudimentary model for simulating cosmic rays' collisions with planets by looking at the model of electrons detached from a negative ion by photons. In this work, Chinese physicists have for the first time demonstrated that they can control the dynamics of negative ion detachment via photons, or photodetachment, on a moving surface. De-hua Wang from Ludong University, Yantai, China, and colleagues have developed mathematical equations and computer simulations showing that the chance of such photodetachment occurring depends on the electron's energy and the speed of the moving surface. For this purpose, negative ions, such as chloride (Cl-) or hydrogen (H-) ions, are considered a good source of electrons, as they are made up of one electron loosely bound by a short-ranged energy potential to the neutral atom. Such ions can be made into electron guns under a strong electric field capable of scraping electrons away—thus helping to model electrically charged cosmic rays.

These electron guns generate interference patterns. Indeed, this is

triggered by the detached electron wave returning back to the ion's nucleus due to the effect of the external fields interfering with the new electron wave. As the speed of the moving surface reaches a certain threshold, its effect on the chances of photodetachment taking place becomes significant.

The authors also found that the moving surface's effect on the photodetachment of Chloride (Cl-) ions is less pronounced compared to hydrogen (H-) ions.

More information: De-hua Wang et al, Photodetachment dynamics of negative ions near a moving surface, *The European Physical Journal D* (2019). DOI: 10.1140/epjd/e2018-90415-1

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