New electricity grids possible with computer simulations

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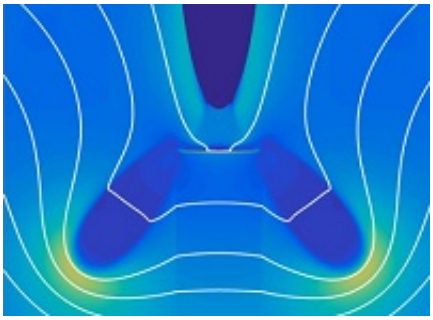

Detail of a simulation of a pulsed positive discharge near a dielectric rod, made by Anna Dubinova. Credit: CWI

Renewable energy requires new electricity grids, sometimes over entire continents, because 'green energy' is often generated in remote locations. A general problem in such networks is that, although electrically conductive parts are separated from their environment by insulators, sparks often occur on the surface of insulators, causing permanent damage to the equipment. Until now, this was not well understood.

Anna Dubinova, Ph.D. student at the Centrum Wiskunde & Informatica (CWI) research institute in Amsterdam, the Netherlands, developed new mathematical models and techniques to predict the behavior of these sparks. She defended her Ph.D. thesis, "Modeling of streamer discharges near dielectrics" on 1 September 2016 at Eindhoven University of Technology. With the results, the architecture of high-voltage networks

can be fundamentally renewed and improved.

The researcher says, "There was not much known about these 'creeping sparks'—for instance, when they occur and how the discharge starts moving. Sometimes, a spark will run over a surface, even if its path length is much longer than directly through the air. Thanks to our models, it is now clear how behaviour depends on the geometry, the type of gas and the type of insulator. A major insulator in the industry is SF6, a strong greenhouse gas. Alternatives can now be chosen in a more balanced way." The results are not only applicable to high-voltage technology, but also on the beginning of lightning. "Hailstones are also insulators. Along with Casper Rutjes and others, I developed models that describe how lightning starts in a thundercloud—it is a combination of sharp hail (graupel) and cosmic particles." This news made it to the international press in 2015.

The research was funded by Technology Foundation STW and ABB Corporate Research. The mathematical modelling was carried out by the Ph.D. student and a postdoc researcher in the Multiscale Dynamics research group of 'lightning professor' Ute Ebert. In addition, two Ph.D. students at Eindhoven University of Technology have studied the phenomena experimentally. Several companies are interested in the applications of the new insights, e.g., for high-voltage equipment or high intensity discharge lamps for outdoor use, in shops and cars.

More information: Creeping sparks project: www.nwo.nl/onderzoek-en-result … ecten/i/40/8240.html

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