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Wrath of Grapes Redux

YouTubers have gone grape crazy. In a plethora of Internet videos, kitchen scientists have cut a grape almost in half—leaving just a strip of skin connecting the two sides—and stuck it in the microwave. In seconds, sparks erupt [1].

As I wrote in a previous column [2], [3], the quote comes from an article in *Science* [1], which even included a link to an impressive video demonstration of the phenomenon, accompanied by rousing music. However, for a long time, a proper scientific explanation for this crowd-pleaser was missing. That changed in 2019 with the publication of an article [4] in *Proceedings of the National Academy of Sciences* (*PNAS*). Canadian physicists Khattak, Bianucci, and Slepkov claimed to have cracked the problem:

> This work ties the source of the plasma to microwave photonic hotspots at the junction of aqueous dielectric spherical dimers. We use a combination of thermal-imaging techniques and computer simulations to show that grape-sized fruit and hydrogel beads form resonant cavities that concentrate electromagnetic fields to extreme subwavelength regions. This is enabled by the large dielectric susceptibility of water at microwave frequencies. Furthermore, the absorptive properties of water are key to washing out complex internal modes and for allowing the evanescent hotspot build-up. [4]

Now, a team of physicists from Taiwan has proposed a different mechanism in a *Physics of Plasmas* article to explain the sparks in the narrow gap between the two grape halves.

The *PNAS* article generated much public interest worldwide and was listed among the *PNAS* "top 10 stories of 2019" [5]. However, not everyone was convinced. Now, a team of physicists from Taiwan has proposed a different mechanism in a *Physics of Plasmas* article [6] to explain the sparks in the narrow gap between the two grape halves. Prof. Chu and his colleagues find the mechanism to be electrical in nature (a ± polarization charge buildup across the gap). As Chu wrote to me in an email,

> The "electromagnetic hotspot" proposed in the *PNAS* paper and the "electrical hotspot" in our study have entirely different physical origins, so it's relatively simple to check which one has really caused the sparks. For example, the former would produce a radiation pressure to repel the two grapes, while the latter would produce an electrical force to attract them. As shown in our video (https://youtu.be/ACWP9_vc2aY), the attractive force between the grapes convincingly establishes the validity of the electrical origin.

I am reminded of Mark Twain, who wrote, at the end of chapter 28 of Huckleberry Finn [7], ". . . and you pays your money and you takes your choice!"

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