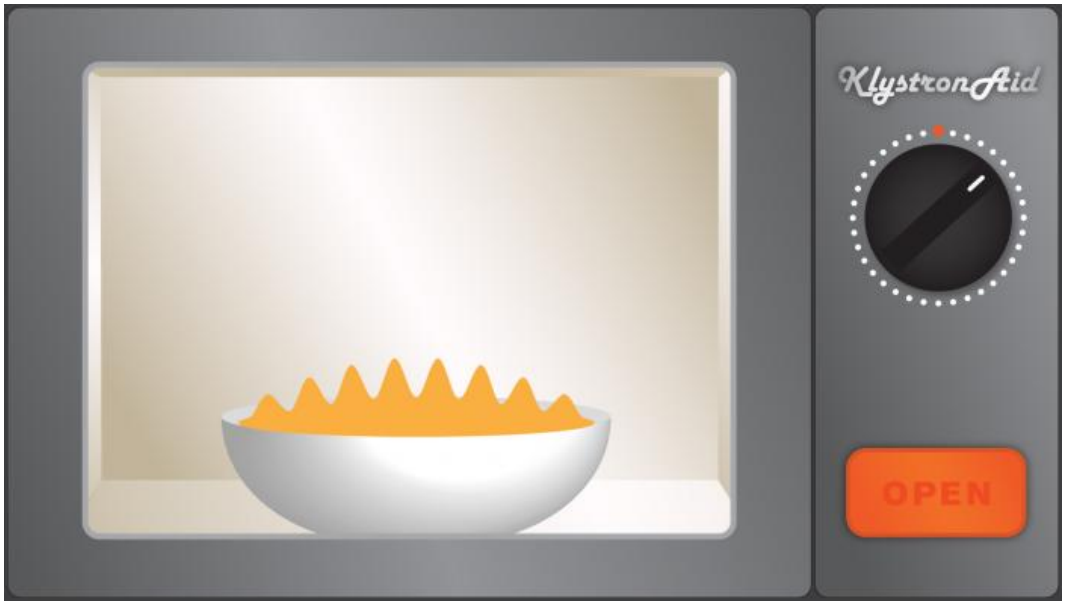


**explain it in 60 seconds**

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# Klystron

Klystrons are at the heart of particle accelerators, radar, cancer treatments and some radio telescopes.

**By Diane Rezendes Khirallah**

Klystrons are what make linear accelerators—as well as radar, cancer treatments and some radio telescopes—work. Invented at Stanford University about 75 years ago, klystrons convert electricity into radio and microwave energy, a far more powerful version of what's generated by your kitchen microwave oven.

Klystrons do this by sending a low-power wave of energy at a stream of electrons. The electrons that interact with the crests of the wave are pushed forward and accelerated. Meanwhile, the electrons that interact with the trough of the wave are pulled back and slowed down. The result is an electron beam broken up into a series of discrete bunches, each playing follow-the-leader with the bunch in front of it. This process is repeated in a series of vacuum cavities within the klystron, each one compressing the bunches further and increasing the empty space between them. Much as air blown into a pipe organ creates vibrations that flow into the surrounding air as sound waves, the bunched electrons cause the klystron's output cavity to resonate, "ringing" out high-energy micro- or radio- waves.

At SLAC National Accelerator Laboratory's linear accelerator, which is powered by about 240 klystrons, this process results in microwaves with 64 million watts of power. The energetic microwaves travel through a copper pipe to the accelerator, where they boost the energy of electrons that are bound for experiments.

Think about that the next time you're heating lunch in the microwave.

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