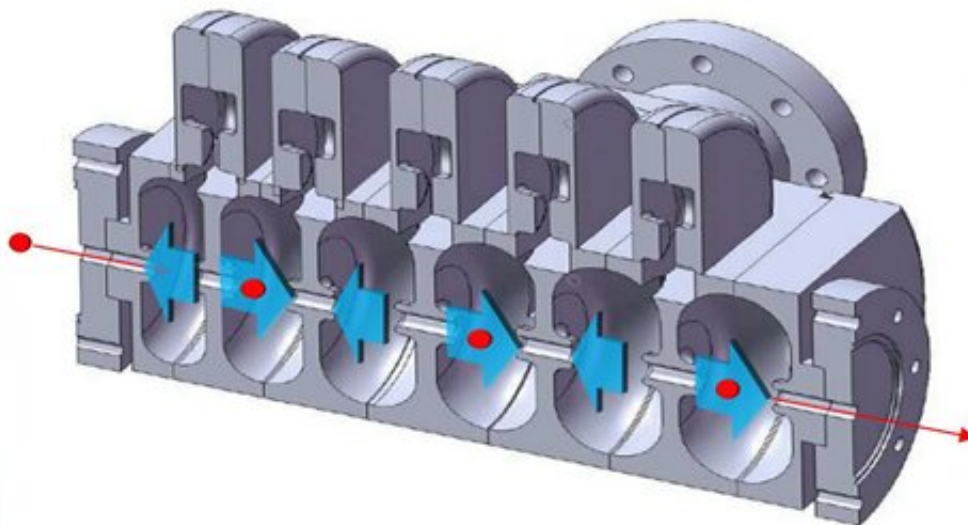


Small high-voltage transmission electron microscope built in Japan

October 16 2019, by Bob Yirka



Credit: T. Sannomiya et al., *Phys. Rev. Lett.* (2019)

A team of researchers affiliated with several institutions in Japan has built a high-voltage transmission electron microscope small enough to reside in a university lab. In their paper published in the journal *Physical Review Letters*, the group describes building the first-of-its-kind microscope and how well it works.

High-voltage transmission electron microscopes (TEMs) use special characteristics of electrons, such as their wave-like properties, to create images of things as small as single hydrogen atoms. Up until now, such TEMs have been quite large due to the need to use electron accelerators.

This has limited their general use. In this new effort, the researchers report a way to shrink the size of a TEM without sacrificing its usefulness.

The team achieved this feat by using [radio-frequency](#) (RF) cavities to speed up electrons enough to create beams. This allowed them to overcome the lack of coherence that had ended other efforts aimed at making a small TEM. The researchers used a series of RF cavities to control the coherence of the [beam](#)—and the beam was created using a conventional TEM accelerator.

After passing through two RF cavity splicers, the beam was snipped into synchronized pulses. The resulting pulsed beam was then sent to a more powerful RF cavity that aimed the beam at the desired sample. The beam then passed through yet another RF [cavity](#) that decelerated the electrons to the desired speed, focusing them. The team reports that the resulting [microscope](#) was easily small enough to fit in their lab, much smaller than conventional TEMs, which can take up a whole building. They report also that the microscope is capable of accelerating electrons to 550 kV, which is approximately half that of building-sized TEMs.

The researchers demonstrated the abilities of their new microscope by creating images of nanometer-sized samples. They report that their work on the microscope is not complete—they hope to improve its capabilities using cavities made from superconducting materials, which they believe could accelerate beams to higher voltages. Such an improvement, they note, should allow them to make the microscope even smaller.

More information: Takumi Sannomiya et al. Transmission Electron Microscope Using a Linear Accelerator, *Physical Review Letters* (2019). [DOI: 10.1103/PhysRevLett.123.150801](https://doi.org/10.1103/PhysRevLett.123.150801)

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