

Creating a non-radiating source of electromagnetism

September 7 2021, by Bob Yirka

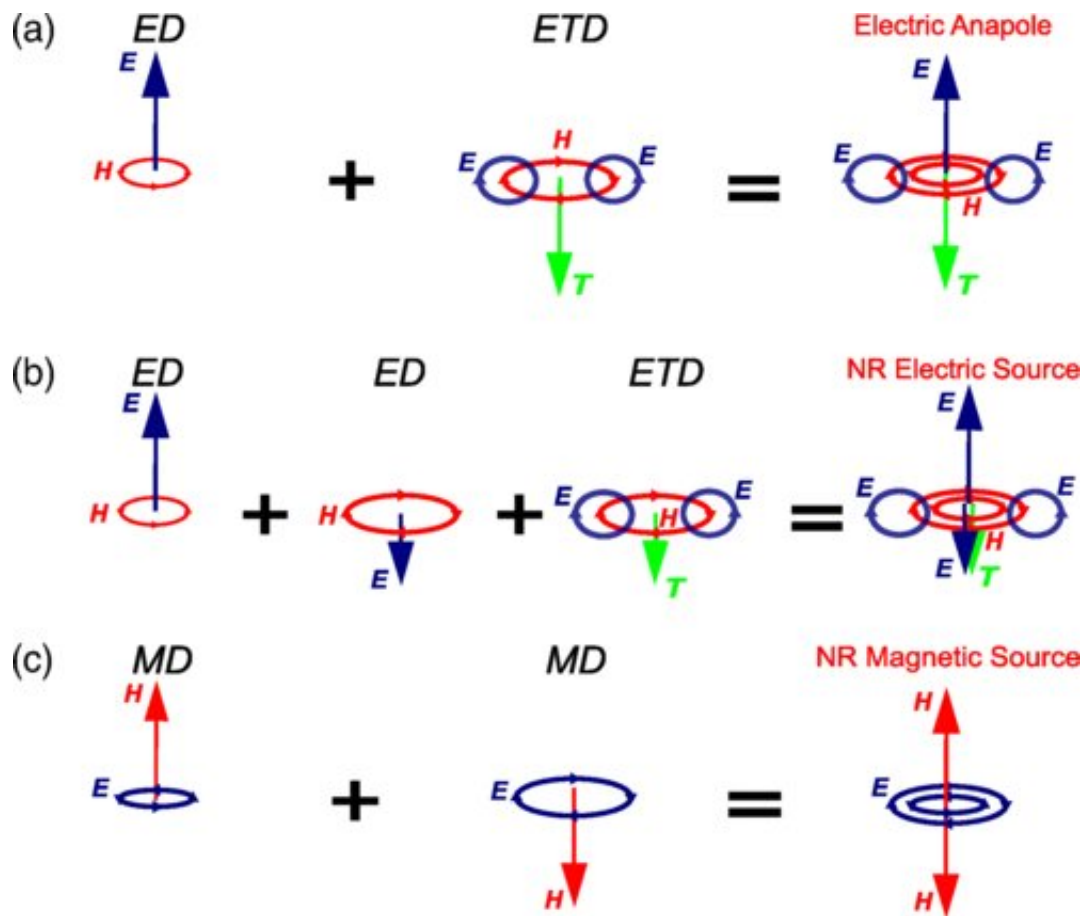


Figure 1. The conceptual approaches to realize (a) electric anapole, (b) NR electric source, and (c) NR magnetic source. Credit: DOI: 10.1103/PhysRevLett.127.096804

An international team of researchers has developed a way to create non-

radiating sources of electromagnetism. In their paper published in the journal *Physical Review Letters*, the group describes their technique and how well it worked when they tested a model based on their ideas.

For many years, physicists have grappled with the idea of "meta-atoms," macroscopic objects that have alternating current that prevents the emission of electromagnetic energy. In 1957, Yakov Zel'dovich came up with the idea of anapole states, where parity violations in [electric current](#) would produce electric moments with no poles. Since that time, some astrophysicists have suggested that such states could explain how dark matter remains hidden.

In this new effort, the researchers have envisioned a system that allows for observing anapole states, then modeling them and then creating a demonstration device. The device consisted of a simple radiating antenna placed inside a hollow dielectric disk with high permittivity—a setup that allowed the disk to be smaller than the wavelength of the emitted radiation. The researchers note that the design of the device was such that the [electromagnetic radiation](#) emitted from the antenna would interfere in a destructive way with waves produced in the dielectric disk, where they would cancel each other out. The team next modeled the simple setup on a computer that allowed for simulating the behavior of the electromagnetism. They found that by changing the frequency of the antenna, they could tune it to the point of canceling the waves produced by the disk. Next, the team used the results from their simulations to create an actual device for testing.

Due to constraints in their lab, the team was forced to create a device based on microwaves rather than [radio frequencies](#)—they placed an 18-mm antenna inside of a 6.4-mm disk and put them into an anechoic chamber. They used another [antenna](#) to measure emissions from the device after it was turned on. They found the device able to support total suppression of far-field radiation. The researchers suggest their [device](#)

could pave the way toward the development of new kinds of wireless power transfer devices.

More information: Esmael Zanganeh et al, Anapole Meta-Atoms: Nonradiating Electric and Magnetic Sources, *Physical Review Letters* (2021). [DOI: 10.1103/PhysRevLett.127.096804](https://doi.org/10.1103/PhysRevLett.127.096804)

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