# Physicists find a new way to slow the speed of light

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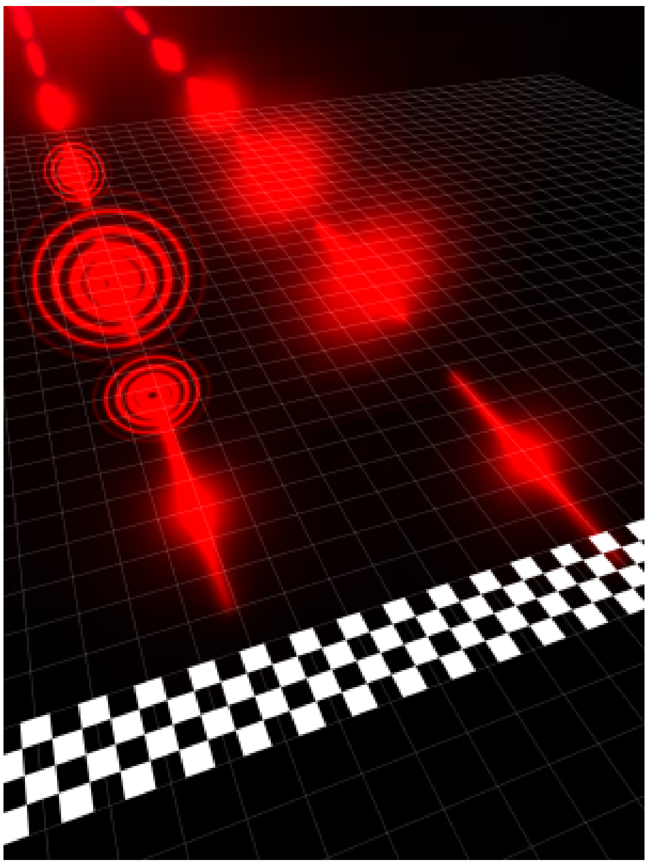

(Phys.org)—A team of physicists working at the University of Glasgow has found a way to slow the speed of light that does not involve running it through a medium such as glass or water. Instead, as they explain in their paper published in the journal *Science*, they caused a change in the speed by first running it through a mask, which changed its shape.

Everyone knows that the speed of light in a vacuum is constant, but now it appears that there is a way to indirectly alter its speed—by running it through a special mask. Doing so apparently causes a change to the shape of the photon, making it move through a vacuum slower than an unaltered photon.

The researchers built what they called a racetrack—setting up a dual course for firing photons and detecting when they struck a detector a meter away. The first group of photons was fired in the normal way, while the second group was fired through a filter to shape it into either a Gaussian or Bessel beam. The photons from both groups were launched at the same time but the unshaped photons beat the shape-altered photons to the finish line by approximately 0.001 percent. There were two reasons for that. The first was that moving through the filter slowed the photons, much as would happen were they to pass through other mediums such as water or glass. The second reason was more complex, because it demonstrated that the speed of the photons was slower than normal *after* passing through the filter—light is supposed to speed back up to its normal constant after passing through a medium. The experiment showed that light can be caused to travel slower than *c*, by changing its shape.

The researchers explain this result by noting that they were using group velocity to measure the light's speed—a measurement of the group's envelope speed. The mask, they explain, caused some of the photons in the group to move at a slight angle to the other's causing a slowdown for the group as a whole. Thus, their results are not going to upend one of the basic tenets of modern physics, it is more likely that future researchers will have to make sure lab or astronomical observations are not being impacted by shape changes that occur naturally.

**More information:** Spatially structured photons that travel in free space slower than the speed of light, *Science*, DOI: 10.1126/science.aaa3035

**ABSTRACT**
That the speed of light in free space is constant is a cornerstone of modern physics. However, light beams have finite transverse size, which leads to a modification of their wavevectors resulting in a change to their phase and group velocities. We study the group velocity of single photons by measuring a change in their arrival time that results from changing the beam's transverse spatial structure. Using time-correlated photon pairs we show a reduction of the group velocity of photons in both a Bessel beam and photons in a focused Gaussian beam. In both cases, the delay is several micrometers over a propagation distance of the order of 1 m. Our work highlights that, even in free space, the invariance of the speed of light only applies to plane waves.

Read the University of Glasgow press release.