New type of light interaction with atoms allows for manipulating cloud shape

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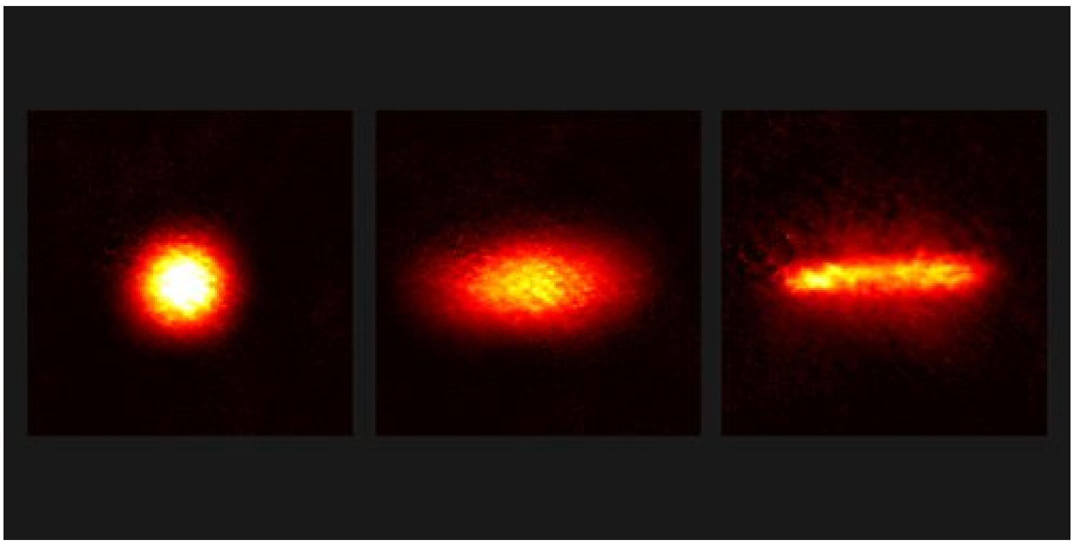

Credit: *Physical Review Letters* (2017). DOI: 10.1103/PhysRevLett.119.163201

A team of researchers at the Weizmann Institute of Science in Israel has found a new way to manipulate atoms using light. In their paper published in *Physical Review Letters*, the team describes the new technique and possible uses for it.

Up until now, scientists have used two main techniques to manipulate atoms with light. The first involves firing a laser at a single atom to change its momentum. The other has been to cause an atom to "feel" an electric field force associated with a beam of light. Now, researchers have developed a third technique—one that involves firing a laser at an atom cloud.

The experiments involved creating a spherical cloud consisting of nothing but millions of cold rubidium-87 atoms. The researchers then fired a pulse of infrared light at the cloud (the frequency was described as "far detuned" from rubidium-87 transitions) and found the cloud responded by behaving similarly to a lens, deflecting the light and causing the cloud to become longer and thinner—the light beam essentially squished the sphere into a new shape. The researchers note that the parameters of the beam they fired at the cloud had been idealized to reduce the force between the light's electric field and the individual rubidium atoms.

The researchers suggest the change in cloud shape resulted from the collective effect of the laser acting on all of the atoms in the cloud—conservation of momentum caused the atoms to respond to a force pushing against them in a direction opposite the deflection. The team has invented a term to describe the overall effect: electrostriction. They note that they ran their experiments on booth Bose-Einstein condensates and clouds at higher temperatures.

Because it is a global optical force, the researchers note, it could be easily modified to allow for easy tuning of interactions with lasers—an improvement over the current cumbersome method. They suggest their technique might prove useful in future cold atom experiments because it allows inducing interparticle interactions that can be easily turned.

More information: Noam Matzliah et al. Observation of Optomechanical Strain in a Cold Atomic Cloud, *Physical Review Letters* (2017). DOI: 10.1103/PhysRevLett.119.163201