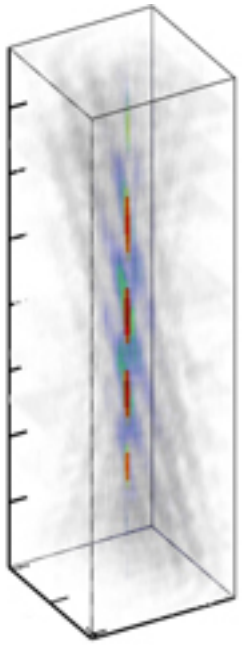
Physicists create tractor beam for microscopic particles



New York University (NYU) physicists have created a tractor beam capable of pulling particles micrometers in size. This so-called optical conveyor tractor beam, reported in *Physical Review Letters*, has a range of potential applications, from microfluidics in the near term to far-out applications like collecting dust samples from comet tails.

"This is science fiction made real," says NYU Physics Professor David Grier, one of the paper's co-authors. "This tractor beam moves objects back to its source, just like those in so many sci-fi movies, but with very small pieces."

The creation builds upon an earlier Grier creation: optical solenoid, or spiraled, beams, which can be used to confine and pull small objects—a couple micrometers in size—over a range of 8 um. By contrast, the conveyor tractor beam has demonstrated moving particles distances of 30 to 40 um. Together, they are the only working tractor beams in the world.

"The field of tractor beams is really in its infancy," adds David Ruffner, an NYU doctoral student and the paper's other co-author. "There is great potential for advances."

The work applies Newton's third law of motion: For every action, there is an equal and opposite reaction. In this case, the action is the scattering of the beam off the particle and the reaction is the motion of the particle. In principle, this is akin to shooting a watermelon seed using your thumb and forefinger—if you grasp the seed in the right location, you can shoot the seed toward you rather than away. In this case, the beam of light functions as fingers. However, Grier and Ruffner’s creation

uses only a single light beam, whose internal properties allow it to surround and squeeze particles in hauling them back to the light's source.

While the researchers are now working on ways to increase the weight the beam can hold as well as the distances it can move objects, it may have immediate applications. For instance it could transport biological cells in three dimensions toward arrays of chemical sensors in a microfluidic device, which controls fluids under a millimeter in scale.

A more ambitious long term application would be sending these beams into comets to pull out dust samples in space probe missions. This would be an improvement over current methods such as those used by NASA's rover Curiosity, which recently landed on Mars. Curiosity relies on a mechanical arm, which has several moving parts and, therefore, is susceptible to breaking. A beam of light, by contrast, has no mechanical properties, eliminating the possibility of structural damage. Moreover, the beam would pull in, rather than scoop up, particles, thereby preserving their make-up in ways current methods cannot achieve.

Source: New York University [1]

Links:
[1] http://www.nyu.edu/about/news-publications/news/2012/11/14/physicists-create-tractor-beam-for-microscopic-particles-.html