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Science - Reuters - updated 12:18 PM ET May 5

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Thursday May 3 5:52 PM ET

A 'Star Trek' Tractor Beam at Microscopic Level

By Will Dunham

WASHINGTON (Reuters) - It's the equivalent of the fictional tractor beam depicted in ``Star Trek'' moving things around in space without touching them -- only at the microscopic level.

Scientists at the University of St. Andrews in Fife, Scotland, said on Thursday they have developed a technique using specialized lasers to spin around even the most delicate microscopic objects, such as chromosomes, without making physical contact. The system could have a variety of futuristic applications in powering micro-machines and assisting in biomedical studies.

``It is a massive advance in the field," researcher Kishan Dholakia, lead author of the research appearing in the journal Science, said in an interview.

Building on so-called optical tweezer technology, the St. Andrews team invented a way to spin objects by focusing two laser beams to create a spiral pattern. Beams of light pack a very small force that can be harnessed at the microscopic level.

Dholakia said the technique could be used to drive tiny motors, mixers, centrifuges and other rotating parts in cheap, tiny, automated technologies of the future.

He also said it could be used to rotate biological structures in living cells as part of the process of developing new medicines. By manipulating a cell's chromosomes with the laser technique, scientists could study how the genome gets divided during cell division -- a process that causes serious genetic disorders when it does not go right.

``Star Trek,' Only Smaller

Dholakia compared the effect to the fictional tractor beam depicted in the ``Star Trek'' television shows and films, which is used to pull objects into a spaceship without touching them.

``It's that type of effect, but obviously on a microscopic scale. Physicists cannot grab and move large (objects). Light has momentum, but it's very

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small," he said.

Optical tweezer technology already allowed scientists to move microscopic objects back and forth and up and down by trapping them in a tightly focused laser beam. Scientists use this to insert genes into cells and assist with in vitro fertilization. But the value was limited because objects could not be spun around for a more complete manipulation.

"It's a bit like a jigsaw puzzle," Dholakia said. "If you take a jigsaw puzzle and you're assembling it, it's OK to move the pieces backward and forward and left and right. But if I have the ability to move that piece around, it can slot much more easily into the puzzle."

Dholakia and colleagues Lynn Paterson and Michael MacDonald have demonstrated their technique with glass beads just one micron across (a human hair is 100 microns thick) and a tiny glass rod, which could be used to stir small amounts of liquid. They also rotated a hamster chromosome, demonstrating the potential for studying other structures inside a cell.

Dholakia said the technique may have applications no one has yet considered. "One doesn't know where this is going to go," he added.

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