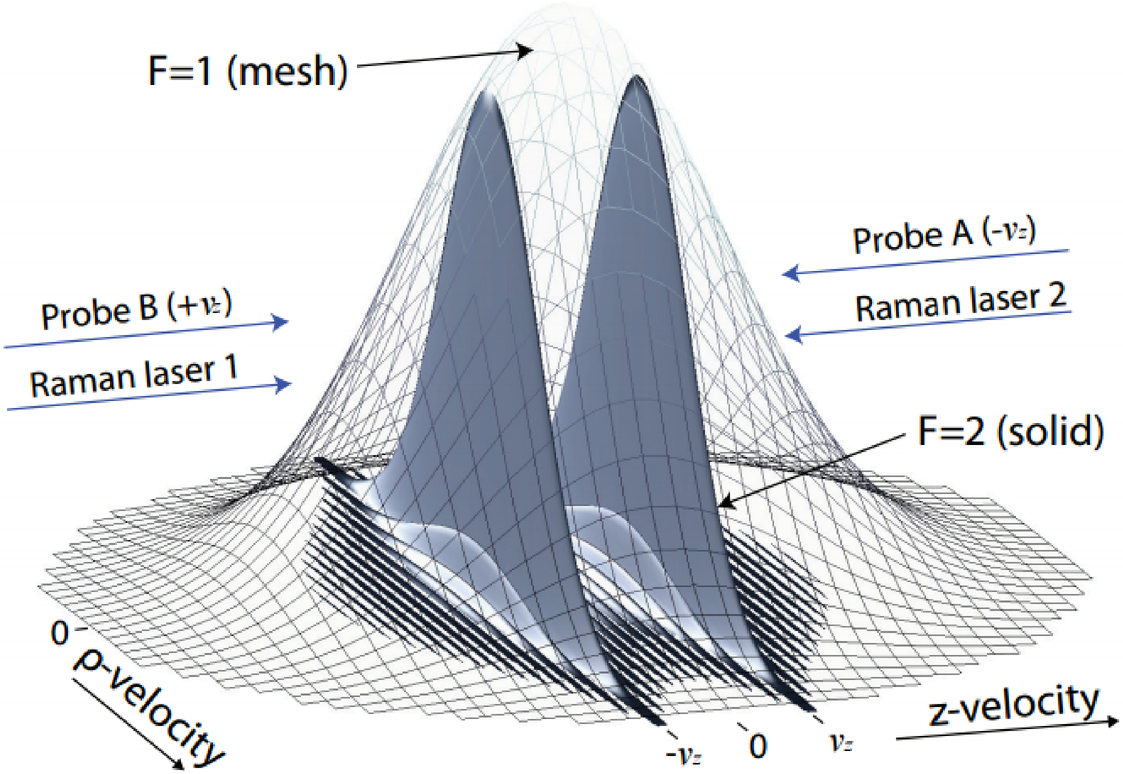
An atom interferometer that works without super cold temperatures

May 3 2017, by Bob Yirka



Vapor interferometer concept–not to scale. Credit: arXiv:1610.02451 [physics.atom-ph]

(Phys.org)—A team of researchers at Sandia Labs in the U.S. has developed a type of atom interferometer that does not require super-cooled temperatures. In their paper published the journal *Physical*

Review Letters, the group describes the approach they used to overcome the main hurdles to warm interferometry and the ways in which their new device can be used. Carlos Garrido Alzar with Sorbonne Université offers a commentary piece on the work done by team in the same journal issue and offers a descriptive analogy of the device they created.

There are two kinds of interferometers—optical and atom. Both are precise measuring devices that operate by measuring interference fringes that are produced when a beam is cut in half and both halves are allowed to proceed for a short distance before being recombined—thus recording the information generated due to interference, such as from gravity. To date, atom interferometers have required very cold temperatures to operate—the cold slows the range of velocities of a collection of atoms to increase the signal that occurs at the machines' output. It also helps to keep the atoms under study close to one another, which improves precision. Atom interferometers do their measuring by using laser beams to split the beam under study. In this new effort, the researchers have come up with a new kind of atom interferometer that works without the need for very cold temperatures.

As the researchers note, the development of the new interferometer required overcoming two main obstacles—the first was to greatly reduce spin flipping due to collisions with the chamber walls. The team got around this by developing a special coating for the chamber that dramatically reduces such flipping. The second problem involved developing a way to align the weak laser that detects interference fringes and the strong laser used as the interferometer. They solved this problem by using two counter-propagating probe beams to measure signal differences. The result was an atom interferometer that was not as sensitive as those that require extreme cold, but one that can acquire data faster, can be ported more easily, and is able to measure a wider range of accelerations.

Garrido Alzar describes the difference between the cold and warm approach as the difference between a device that operates much like as laser versus one that works using light from a regular white light bulb.

More information: G. W. Biedermann et al. Atom Interferometry in a Warm Vapor, *Physical Review Letters* (2017). DOI: 10.1103/PhysRevLett.118.163601 . On *Arxiv*: arxiv.org/abs/1610.02451

ABSTRACT

We demonstrate matter-wave interference in a warm vapor of rubidium atoms. Established approaches to light-pulse atom interferometry rely on laser cooling to concentrate a large ensemble of atoms into a velocity class resonant with the atom optical light pulse. In our experiment, we show that clear interference signals may be obtained without laser cooling. This effect relies on the Doppler selectivity of the atom interferometer resonance. This interferometer may be configured to measure accelerations, and we demonstrate that multiple interferometers may be operated simultaneously by addressing multiple velocity classes.

Citation: An atom interferometer that works without super cold temperatures (2017, May 3) retrieved 20 April 2024 from https://phys.org/news/2017-05-atom-interferometer-super-cold-temperatures.html