Molecules chilled below Doppler limit

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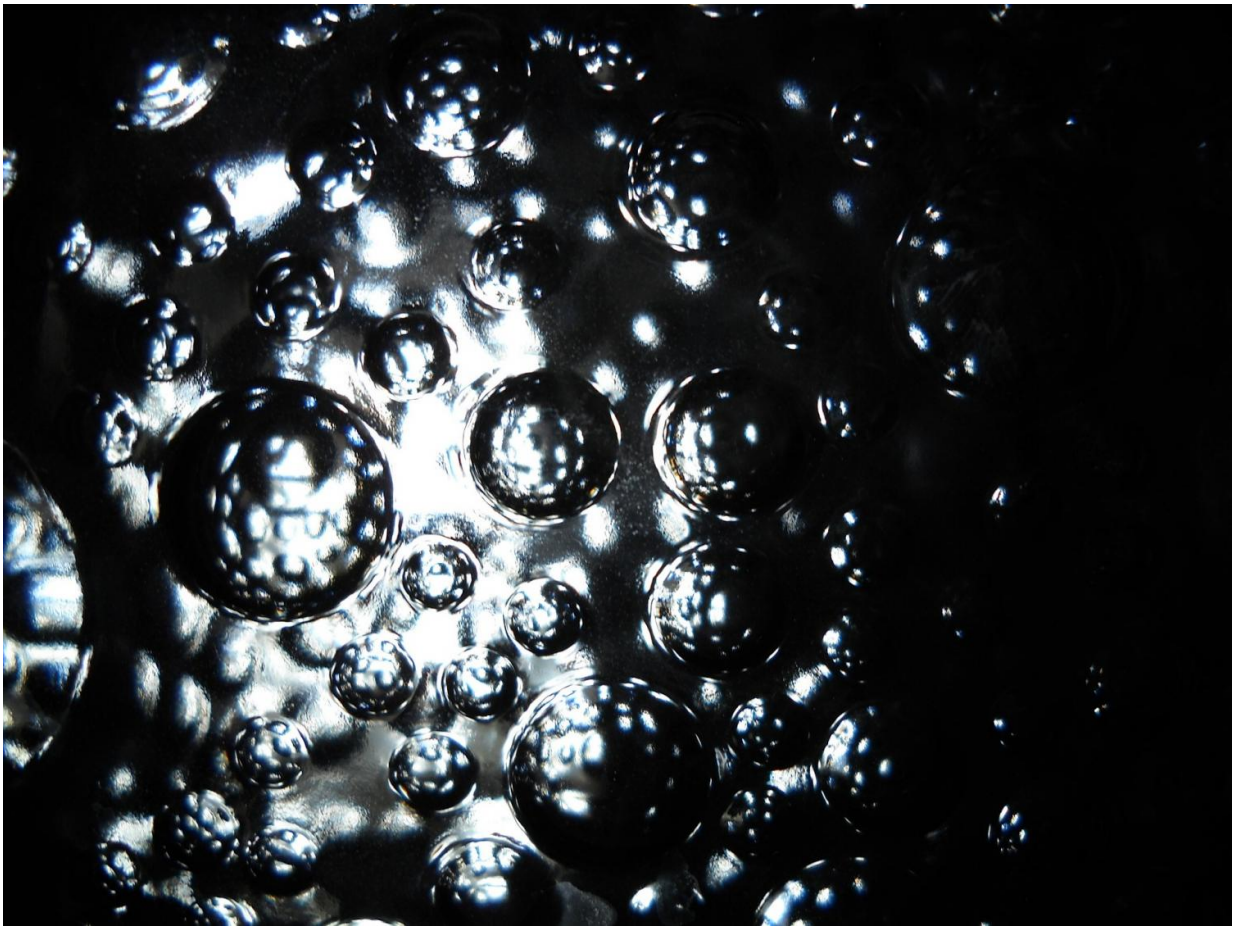

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A team of researchers working at the Centre for Cold Matter, Blackett Laboratory, Imperial College London, has found a way to chill molecules much closer to absolute zero. In their paper published in the journal

Nature Physics, the team describes the two-step technique they used to achieve the feat and offer some ideas on how it might be used by others in the near future.

Scientist learned to chill atoms to near absolute zero some time ago, and have come as close as 50 trillionths of a degree in more recent times. But doing the same with molecules has remained elusive, until now. In this new effort, the researchers found that combining two traditional methods of cooling could be used to cool molecules to temperatures much closer to absolute zero than current methods, which typically bring molecules to just hundredths of degrees above absolute zero.

The researchers worked with calcium monofluoride molecules, using magnets to hold them in place and lasers to cool them by slowing them down—a technique that has been used widely in the past. To chill the molecules further (beyond the Doppler limit) the team used an adapted form of Sisyphus cooling, in which two lasers are fired directly at one another, creating an electromagnetic field. The field caused a constant exertion on the molecules, pulling energy from them, which cooled them. Using the combined methods, the researchers report that they were able to cool the molecules down to within 50 millionths of a degree above absolute zero.

When scientists learned to chill atoms to similar temperatures, a flurry of subsequent research efforts sought to take advantage of a new way to study atomic properties. With a similar technique now at hand for molecules, it is likely that a similar research flurry will occur. Molecules at such a cold temperature have less movement, which should make them easier to study. It should also slow reactions, making it easier to see what actually occurs. It is also possible that researchers could learn more about the fundamentals of molecules, especially regarding simultaneous molecular particle interactions.

More information: S. Truppe et al. Molecules cooled below the Doppler limit, *Nature Physics* (2017). DOI: 10.1038/nphys4241