Dancing molecules “trapped”

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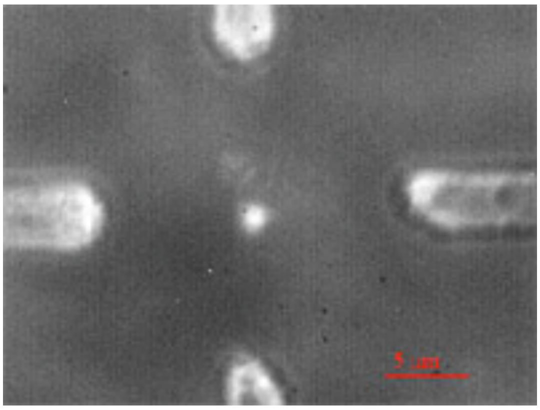
Courtesy American Institute of Physics and World Science staff



Biology is chock full of art. For decades, scientists have probed some of the tiniest structures of life’s basic building molecular blocks, such as DNA or proteins, rendering full-color ball-and-stick models of them that fill the pages of journals and adorn the trophy cases of biology departments everywhere.

While these representations reveal some of the most intricate molecular details of life, they often fall short in depicting how a single molecule moves.

Just as the perfect picture of a horse cannot convey the fluidity of it gallop, so does a frozen picture of DNA fail in describing its intricate dance.

“These are wet, warm, squishy things,” said Adam Cohen of Harvard University. They jiggle, they flap, they twist, they turn, and they randomly “walk” about.

Studying how a single molecule moves is hard, however, because of these very motions. Like a horse, if you set a single molecule free, it will wander away. You can tie it down, ensuring that it no longer wanders, but then you can’t necessarily observe how it moves.

Now, thanks to a machine built by Cohen and colleagues at Harvard, it may be possible to confine a single molecule and study its motions at the same time. Cohen presented his findings this week in Boston at the annual symposium and exhibition of the American Vacuum Society, a part of the American Institute of Physics.

The machine basically uses a variable electric field to trap a single molecule under a microscope, Cohen said. It does this by tracking the molecule’s motion and then rapidly applying tiny electric pulses to counter this motion and zap the molecule back into place. Cohen described how he and his colleagues can use this machine to look at things like virus particles or single pieces of DNA.

Cohen reported that his group recently made a movie by capturing 60,000 high-speed frames of a DNA molecule dancing. The studies show the nature of the molecule’s internal forces, said Cohen, and these properties give information about how DNA interacts in a biological setting.

Image; A particle two ten-thousandths of a milli-meter wide trapped in Cohen's device, called the Anti-Brownian Electrokinetic trap. (Image courtesy A. Cohen)