Scilight

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# Creating a microsphere ‘molecule’ in a magneto-gravitational trap

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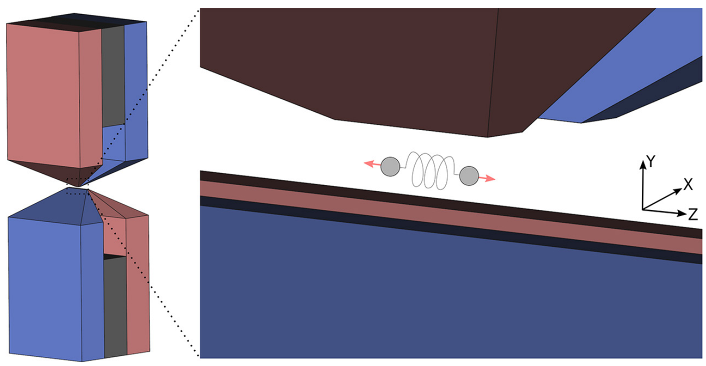
**A quadrupole magnet arrangement with an inherent asymmetry traps two charged silica microspheres, creating a model of a diatomic molecule.**




Particles levitated in vacuum have been used as models for testing a variety of physical phenomena. Previous research has shown that such model systems can be constructed using different trapping technologies. In an article from AIP Publishing’s Applied Physics Letters, physicists have shown that charged microspheres, levitated and trapped between the poles of a quadrupole magnet in a gravitational field, behave as a type of diatomic “molecule.”

The trap was created by sandwiching two SmCo permanent magnets between four ferromagnetic pole pieces in a quadrupole arrangement. The magnets were oriented such that the resulting quadrupole-field geometry lies in transverse-vertical (X-Y) planes. An asymmetry in the pole pieces along the axial (Z) direction adds an upward curve to the quadrupole field, with gravity serving to confine particles in the axial direction.

Small silica microspheres are placed into the trap, and a DC voltage is applied to the poles to selectively trap negatively-charged spheres. Slowly increasing the voltage drives all but two of the spheres out of the trap. The charge on the remaining spheres is then tuned to the desired value by exposing them to either ionizing radiation or UV light.

The resulting two-particle system exhibits motion normally associated with diatomic molecules. One mode is translational motion, in which the center-of-mass moves but the distance between the spheres remains fixed. The other mode is a vibration, in which the distance between the spheres oscillates.

The investigators were able to address and control the translational and vibrational modes of the resulting “molecule” using a system of lasers and filters. They showed that the two modes could be individually manipulated, highlighting the unique experimental possibilities for this type of trapping system.

**Source:** “A microsphere molecule: The interaction of two charged microspheres in a magneto-gravitational trap,” by Bradley R. Slezak and Brian D’Urso, *Applied Physics Letters* (2019). The article can be accessed at https://doi.org/10.1063/1.5097615.