Using a new kind of electron microscopy to measure weak van der Waals interactions

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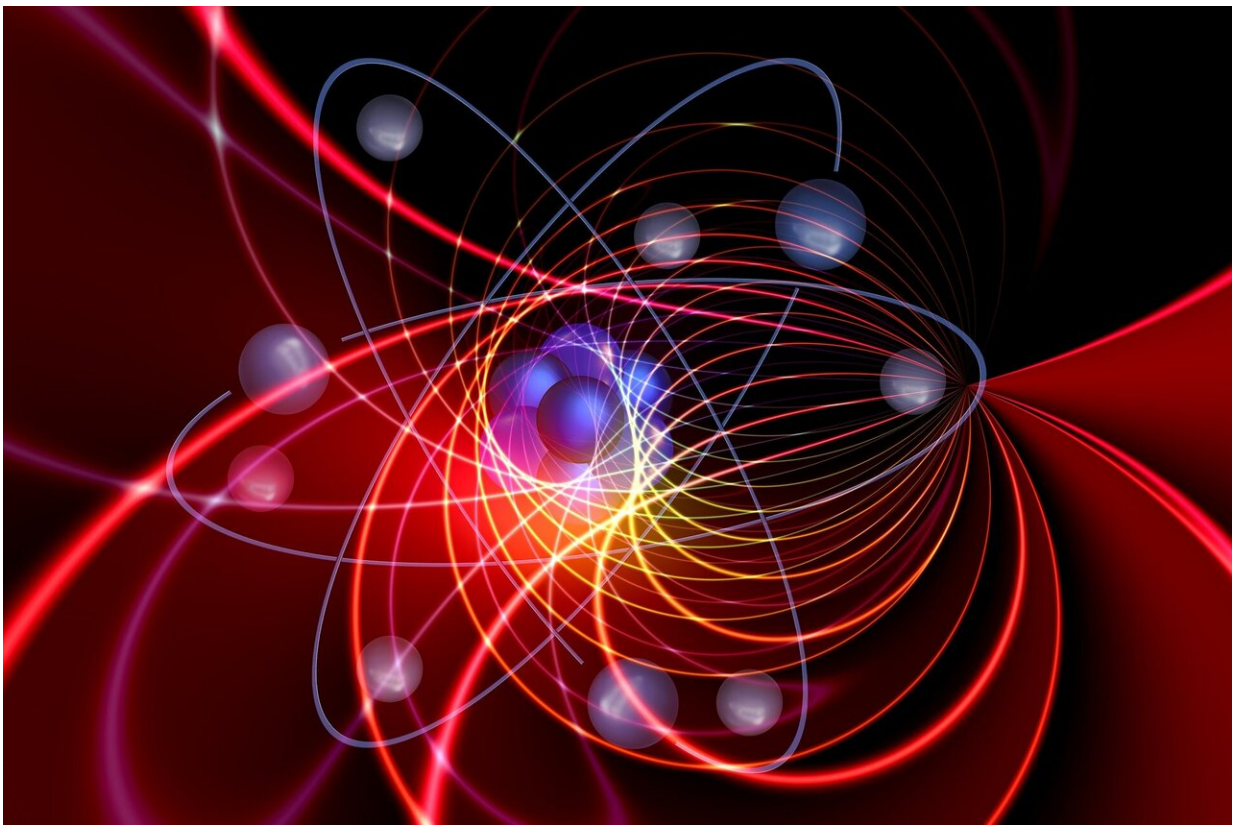

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A team of researchers from China, the Netherland and Saudi Arabia has used a new kind of electron microscopy to measure weak van der Waals interactions. In their paper published in the journal *Nature*, the group

describes creating what they describe as a molecular compass to measure weak van der Waals interactions using a new type of electron microscopy developed in the Netherlands.

Van der Waals forces are electrostatic forces between uncharged molecules—they arise due to the interaction between electric dipole moments—measuring them typically requires the use of highly sophisticated equipment. In this new effort, the researchers have developed a new way to measure their interactions using less sophisticated equipment.

The work was made possible by the development of a new kind of electron microscope created recently by a team in the Netherlands. Officially called integrated differential phase contrast scanning transmission electron microscopy, the new technology produces images at the atomic level using image data, which gives results with higher signal-to-noise ratios. This means that smaller doses of electrons can be used than with other electron microscopes.

To measure van der Waals interactions, the researchers used ZSM-5, a type of zeolite that has rings of oxygen atoms and silicon that link around holes in lattice sheets. They stacked several of the sheets, aligning them in a way that created small channels. The team then placed para-xylene molecules into the channels using a centrifuge. Next, they used the para-xylene molecules as a pointer in a type of compass. They noted that shifting of the molecules relative to the oxygen and silicon atoms indicated changes in weak van der Waals interactions. They measured these shifts using the imaging capabilities of the new electron microscope.

The researchers tested their technique by comparing orientation changes in the para-xylene pointers with changes in the shape of the rings. They suggest their technique could be used to optimize applications such as

those involved in converting alcohol to petrol.

More information: Boyuan Shen et al. A single-molecule van der Waals compass, *Nature* (2021). DOI: 10.1038/s41586-021-03429-y