Promising discovery could lead to a better, cheaper solar cell

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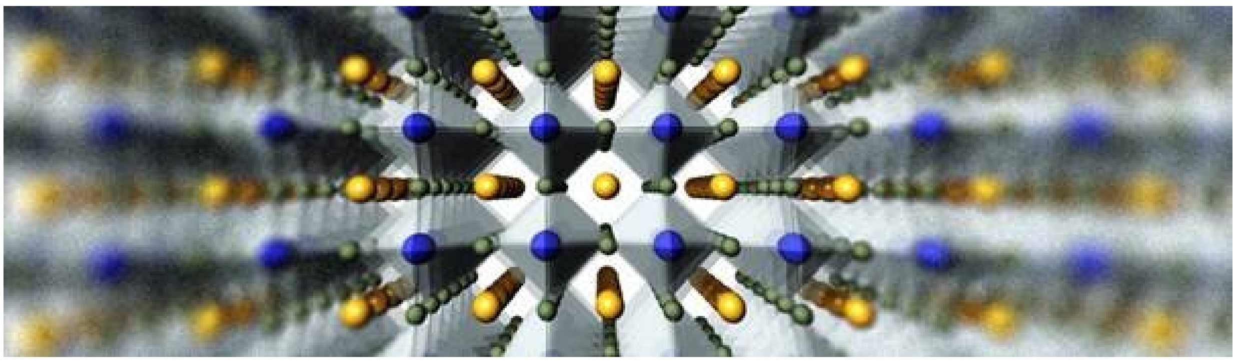

Credit: McGill University

McGill University researchers have gained tantalizing new insights into the properties of perovskites, one of the world's most promising materials in the quest to produce a more efficient, robust and cheaper solar cell.

In a study published today in *Nature Communications*, the researchers used a multi-dimensional electronic spectrometer (MDES) – a unique instrument hand-built at McGill—to observe the behaviour of electrons in cesium lead iodide perovskite nanocrystals. The MDES that made these observations possible is capable of measuring the behaviour of electrons over extraordinarily short periods of time—down to 10 femtoseconds, or 10 millionths of a billionth of a second. Perovskites are seemingly solid crystals that first drew attention in 2014 for their unusual promise in future solar cells that might be cheaper or more defect tolerant.

A most exciting discovery

"It's the most exciting result that I have been a part of since starting in science in 1995," said senior author and McGill chemistry professor Patanjali Kambhampati of the discovery of perovskite's liquid-solid duality. "Instead of searching for perfection in defect-free silicon microelectronics, here we have a defective thing that's defect-tolerant. And now we know a bit more about why that is."

Solids acting like liquids

As the researchers looked more closely at the crystals using the MDES, what they saw was something that challenges our conventional understanding of the difference between liquids and solids.

"Since childhood we have learned to discern solids from liquids based on intuition: we know solids have a fixed shape, whereas liquids take the shape of their container," said Hélène Seiler, lead author of the research and a former Ph.D. student in the Department of Chemistry at McGill who is currently at the Department of Physical Chemistry, Fritz-Haber-Institut at the Max-Planck Institute. "But when we look at what the electrons in this material are actually doing in response to light, we see that they behave like they typically do in a liquid. Clearly, they are not in a liquid—they are in a crystal—but their response to light is really liquid-like. The main difference between a solid and a liquid is that a liquid has atoms or molecules dancing about, whereas a solid has the atoms or molecules is more fixed in space as on a grid."

More information: Hélène Seiler et al. Two-dimensional electronic spectroscopy reveals liquid-like lineshape dynamics in CsPbI3 perovskite nanocrystals, *Nature Communications* (2019). DOI: 10.1038/s41467-019-12830-1

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