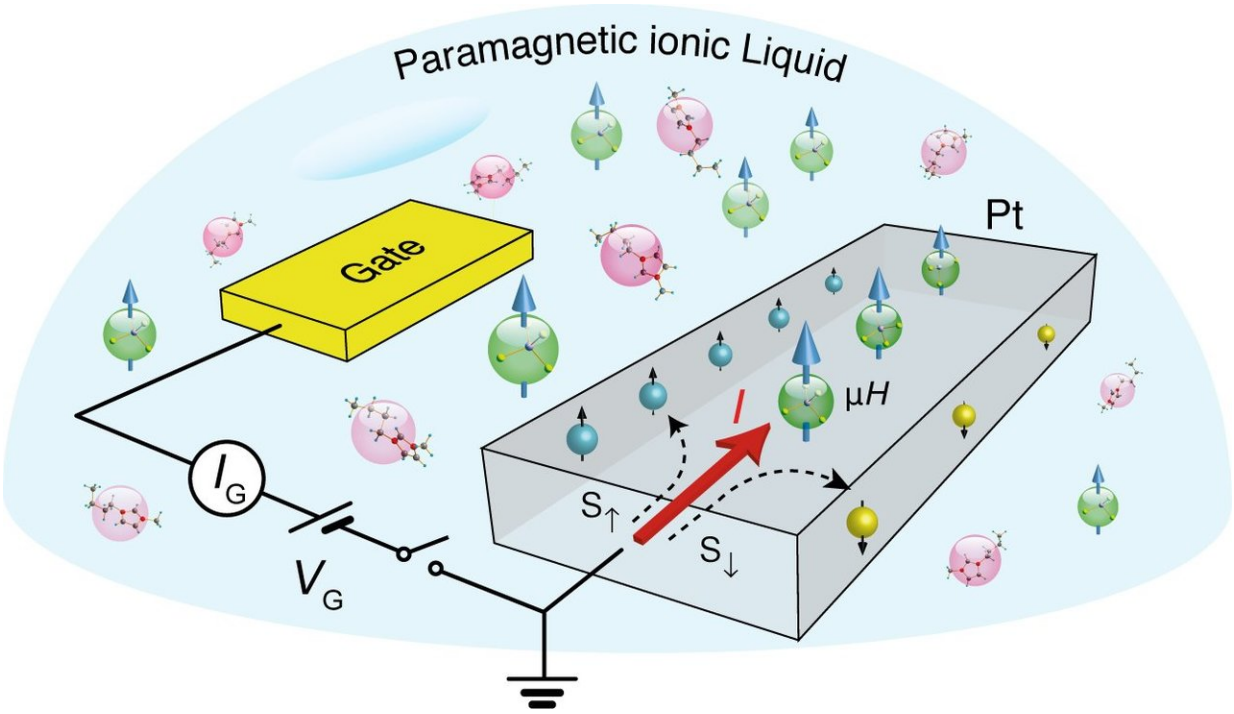
Creating a 2-D platinum magnet

April 6 2018



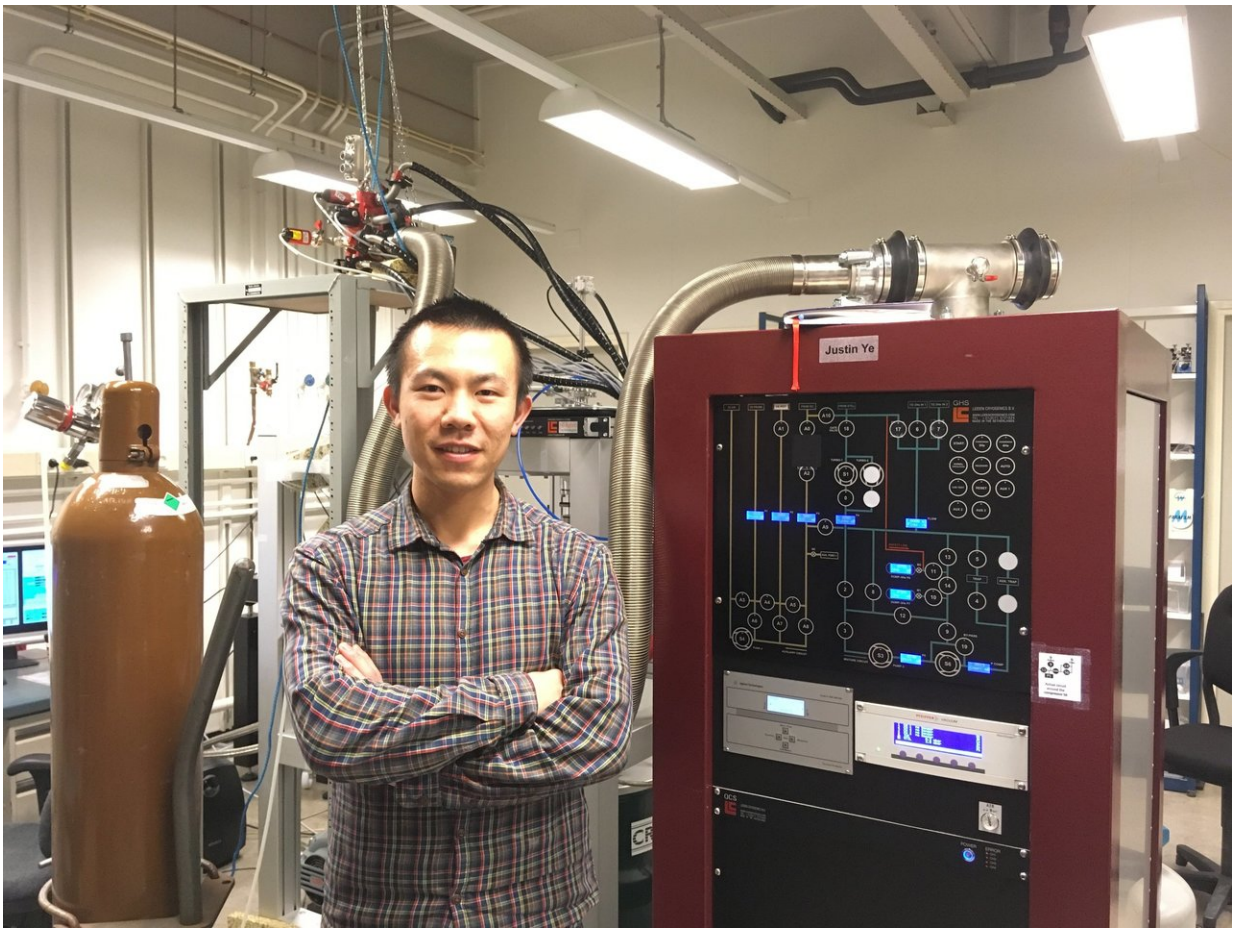
Schematic of Platinum transistor with paramagnetic ionic liquid gate. Credit: L. Liang

University of Groningen physicists have induced magnetism in platinum with an electric field created by a paramagnetic ionic liquid. As only the surface of the platinum is affected, this creates a switchable 2-D ferromagnet. The study was published in *Science Advances* on 6 April.

Although platinum is an excellent conductor, it has no magnetic

properties. However, University of Groningen scientists have induced ferromagnetic states on the surface of a thin film of platinum. "You can tune magnets electrically by changing the number of carriers inside, which is one of the key ideas in spintronics. But so far, no one could generate magnets like that," says Associate Professor Justin Ye, chair of the Device Physics of Complex Materials group at the University of Groningen.

Lei Liang, a postdoc in Ye's research group and first author of the paper, built a device to induce ferromagnetism in non-magnetic platinum using a field effect generated by gating through an ionic medium called ionic liquid. Ye says, "The key, here, is that we used a paramagnetic ionic liquid, a new type of ionic liquid we synthesized ourselves." If an electric field is applied, the ions move to the surface of the platinum, carrying both charge and magnetic moment. Both affect the surface layer of the platinum film, creating an atomically thin layer of magnetic platinum.



Dr. Lei Liang, first author of the study. Credit: Lei Liang (use with credit)

"We were able to show that this is really a 2-D magnet, and the magnetic state can extend to the room temperature," says Ye. "It is amazing that we could still add new properties to such a well-known material." Recently, many 2-D magnets have been isolated from layered compounds, but most are insulators, and are only magnetic at very low temperatures. Making them in a conductor could be useful in spintronics, a promising new type of electronics based on the magnetic moment (or spin) of electrons. The new discovery means that magnetism can be switched on and off in a conductor, which could lead to the

development of devices that can simultaneously control charge and spin.

More information: L. Liang; Q. Chen; J. Lu; W. Talsma; J. Shan; G.R. Blake; T.T.M. Palstra; J. Ye: Inducing ferromagnetism and Kondo effect in platinum by paramagnetic ionic gating. *Science Advances* 6 April 2018. , DOI: 10.1126/sciadv.aar2030