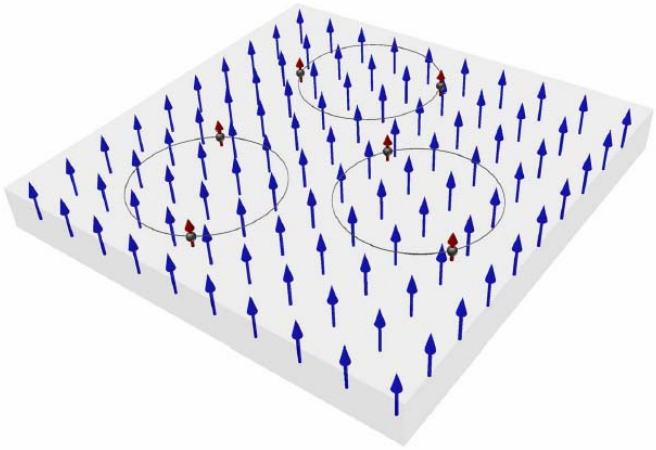
Rebel superconductor UCoGe feeds off ferromagnetism

The idea of an eternal electrical current flowing without loss through a superconductor has captivated the imagination of scientists and public alike since the early 1900's. In our publication, we give this august field a new spin, by uncovering a rebellious superconductor that breaks all the rules by happily superconducting while also being ferromagnetic.

Many metals choose to become superconducting at low temperatures. However, there is a group of recalcitrants - the ferromagnets - which stubbornly ignore the siren calls of superconductivity. Imagine taking a look inside a ferromagnet (such as those featured on the door of your household refrigerators): one will see that the electrons of the atoms inside the crystal have organized themselves such that their spins - like little compass needles - all point the same way, thus creating a magnetic field. This spin arrangement is pure poison to superconductivity, as the latter demands that the electrons of the system pair up with their spins pointing in *opposite* directions: exactly what the ferromagnet doesn't want to do.

Our research has just unearthed a rebel in the ranks of the superconductors - in the form of an alloy of uranium, cobalt and germanium - in which superconductivity and ferromagnetism are good friends, instead of mortal enemies. When we cool this material to a few degrees above absolute zero it becomes ferromagnetic. Cool it further, and it goes superconducting, remarkably, while *remaining* a magnet.

This apparent contradiction can only be understood if the electrons in the superconducting pairs break the rules by ganging up with *parallel* spins (dubbed triplet pairing), which grants immunity to the magnetic field of the ferromagnet. The sly superconductors suspected of using this trick are few and far between, and before now can only been found under extreme conditions of ultra-low temperatures, high pressure and/or magnetic fields. Our new member of the gang is highly accessible, signing in under normal pressure conditions at a temperature four times higher than the nearest competitor. Therefore, finally opens the door to the complete and profound investigation of the fascinating and mysterious quantum phenomenon of triplet superconductivity.



<u>Life inside the superconductor UCoGe.</u> Rebellious super-conducting pairs with a parallel spin arrangement (red) dance happily in a lattice of parallel, ferromagnetic spins (blue).