New Spin Source Could Offer Insight Into Gravity

March 6 2007, By Miranda Marquit

“We have a situation in physics where we understand very well the quantum forces,” Clive Speake tells *PhysOrg.com*. “But gravity, as we understand it, is a problem.”

Speake is a scientist at the University of Birmingham in the United Kingdom, and he is interested in solving some of the problems with gravity: “We know that the weak nuclear force and electromagnetic force can be worked into a unified theory. But there is a problem with the picture when you can’t put gravity with the other forces. And right now we can’t.”

Speake and his University of Birmingham colleagues, Giles Hammond, Christian Trenkel and Antonio Pulido Patón, are working toward learning more about gravity by using a new spin source geometry used in a new device more sensitive to forces at close distances. Their recent experiment is reported in *Physical Review Letters*, in a piece titled “New Constraints on Short-Range Forces Coupling Mass to Intrinsic Spin.”

Many scientists today are working on unified theories, including String Theory, to explain universal forces. And, while many forces fit nicely into the Standard Model of particle physics, the characteristics of gravity, which are not very well understood, present a problem.

“Theorists keep coming up with news ideas, and many of them push the experimental limits of knowledge,” Speake says. “So we need better instruments in order to rule out — or even validate — some of these

theories." He continues: "At smaller scales, the gravitational interaction is much more difficult. You need a more sensitive apparatus and special techniques to measure forces between objects at very short distances."

And with their new instrument, the spherical superconducting torsion balance, Speake thinks that he and his peers may have developed just the thing. "The SSTB has properties beyond a regular torsion balance," Speake explains. "The classical Cavendish torsion balance is hard to control when the distance between the masses is very small."

Speake and his colleagues created a torsion balance that makes use of a float levitated by magnetic pressure caused by the current in superconducting coil. Their search for short range forces coupling mass to intrinsic spin also uses a new configuration of spin source: "The spin source itself looks like magnetic shielding," Speake says, "an external magnetic field polarizes electrons in the shielding tube so that all the spins add up and point in the same direction. The sum of all the spins cancels out the field on the inside of the tube."

"The way things are at the moment," explains Speake, "our success in the new upper limit is mainly due to the design of the new spin source. We've not yet reached the sensitivity of regular torsion balances; the new spin source is why we have new limits."

Speake remains optimistic, however. "We don't have the sensitivity that we would like, so we are continuing to develop our device. We want to take this further, measuring the force between macro surfaces only a micron apart. We feel that we can exploit this new device to reach that goal."

permission of PhysOrg.com.