Using vortex motion to detect inhomogeneous superconductivity in crystalline organic superconductors

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We will present new results investigating the exotic, inhomogeneous correlated electron state called the FFLO state, named after the authors Fulde, Ferrell, Larkin, and Ovchinnikov who predicted it in 1964. This inhomogeneous superconducting state exists at high magnetic fields when the orbital (vortices) destruction of superconductivity is suppressed, and the Cooper pairs are then broken when the Zeeman energy difference of the up and down electrons is equal to the superconducting energy gap. We will show how vortex motion can be used as a sensitive probe to detect the FFLO state. A particularly interesting aspect of this system occurs at an angle just slightly different than parallel when the composite bosons (Cooper pairs) that create the first vortices occupy only a few discreet Landau levels. This bosonic Landau level system is rare, in contrast to fermionic Landau level systems (such as quantum oscillations in metals) that are commonly studied. Finally, we will show how our recently launched Organic Superconducting Database (osd.clarku.edu) can be used to identify new materials where the FFLO state can be found. Using the database in this investigation will serve as an example to show how an extensive materials database could be helpful in many different aspects of correlated electron studies of crystalline organic materials.