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Nematic order in $Sr_3Ru_2O_7$ and triplet superconductivity in Sr_2RuO_4

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In an externally applied magnetic field, ultra-pure crystals of the bilayer ruthenate compound $Sr_3Ru_2O_7$ undergo a metamagnetic transition at a temperature which can be tuned towards zero as a function of the angle between B and the crystalline c-axis. This "metamagnetic quantum critical point", however, is enveloped by a nematic fluid phase with order one resistive anisotropy in the ab plane. In this talk, I will discuss the microscopic origins of metamagnetism and the accompanying nematic order in this system. I propose that both can be understood within the framework of an orbital-ordering tendency of the material and present a phase diagram which accounts for much of the experimentally observed phenomena. By contrast, the closely related monolayer compound, Sr_2RuO_4, is a spin-triplet superconductor; it does not exhibit metamagnetism or nematic order. This drastic difference in the physical properties of the two materials - despite their structural similarity - points towards a possible microscopic mechanism of triplet superconductivity in Sr_2RuO_4. I will conclude the talk with a discussion of our recent progress in understanding the microscopic origins of superconductivity in Sr_2RuO_4.