TITLE: Topological Solitons in Chiral Quantum Matter

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There are profound links between superconductivity and forms of magnetism in low dimensions. Typically, investigation of these links is restricted to bulk single crystals with exotic structures and/or compositions. Tuning of the electronic properties involve the application of strong magnetic fields or destructively high pressures to macroscopic samples, with no obvious pathway to technological upscaling. Modern capabilities, however, now allow studies in atomically controlled structures, opening pathways to explore quantum orders, but also to exploit their potential for energy and information handling. I will discuss the creation of the first material-platform in which superconductivity and magnetism interact through topological solitons, demonstrating the viability of using spin topology to influence a superconductor at selective length scales. This architecture opens pathways towards fluxonics and chiral superconductivity, and adaptable recipes for quantum processes including non-perturbative, non-contact Majorana braiding. Time permitting, I will also talk about complementary studies on magnetic solitons developing quantized helicity excitations with well-separated energy levels and distinct out-of-plane magnetizations, offering a new class of primitive building blocks for realizing quantum logic elements.