

# Unusual quasiparticle pairing in stacked atomic layers

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Interactions between particles in quantum many-body systems can lead to collective behavior. In a condensed matter system consisting of weakly interacting particles, a propagating particle interacting with its surroundings can be viewed as a 'dressed' quasiparticle with renormalized mass and other dynamic properties. Heterogeneous interfaces between two dissimilar materials are an essential building block for modern semiconductor devices. The 2-dimensional (2D) van der Waals (vdW) materials and their heterostructures provide a new opportunity to produce atomically sharp interfaces in the ultimate quantum limit for the electronic and optoelectronic processes. In this talk, we will discuss several research efforts to realize unusual quasiparticle pairing mesoscopic devices based on stacked vdW interfaces between 2-dimensional materials. The topics include semiconducting exciton condensations, paired composite fermions, spin-polarized cooper pairs and non-abelian anions in induced superconductivity in quantum Hall edge states.