van der Waals Solids under Compressive Strain

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This presentation explores how ultrahigh compressive strain transforms van der Waals (vdW) solids such as graphene, transition metal dichalcogenides (TMDs), and their heterostructures. Under extreme compression, these materials exhibit lattice transitions, structural distortions, metallization, bandgap modulation, and enhanced electronic correlations—effects amplified by the strain sensitivity of vdW bonds compared to covalent networks. Using MoS_2, WS_2, graphene–graphite, and chemically doped TMDs as case studies, I will demonstrate how compression can systematically tune structural, phononic, and electronic states relevant to optical, electrical and thermal transport properties of the vdW solids. These findings open new pathways for engineering strain-responsive 2D materials with potential in next-generation devices.