

Coherent dynamics in model 2D structures

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Abstract

We demonstrate Rabi splitting of the 1s exciton resonance in monolayer MoSe₂ and (Ga,In)As quantum wells under cryogenic, near-resonant excitation. Using time-resolved pump-probe spectroscopy, we resolve the dynamics of strong light-matter coupling in both systems. A microscopic theory based on exciton Bloch equations confirms the experimental findings. In (Ga,In)As quantum wells, we observe linear Rabi splitting, pronounced Rabi oscillations, and coherent optical gain, owing to weaker Coulomb interactions. In contrast, MoSe₂ shows sublinear splitting without oscillations or gain, dominated by strong excitonic correlations and biexcitonic effects. These results highlight how many-body physics governs the Rabi response in 2D materials and offer insights for future coherent optoelectronic applications.