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Extraction of many-body excitation configurations from nonlinear absorption in semiconductor quantum wells RYAN SMITH, ANDREW FUNK, JARED WAHLSTRAND, JILA, National Institute of Standards and Technology and University of Colorado, RICHARD MIRIN, National Institute of Standards and Technology, STEVEN CUNDIFF, JILA, National Institute of Standards and Technology and University of Colorado, JOHANNES STEINER, MARTIN SCHAFER, MACK KIRA, STEPHAN KOCH, Department of Physics and Material Sciences Center, Philipps-University Marburg — We extract detailed electronic many-body configurations by analyzing quantitatively measured, time-resolved nonlinear absorption spectra of resonantly excited GaAs quantum wells with our fully consistent microscopic theory. Nonlinear spectral changes observed in the probe absorption are attributed by our theory to a unique mixture of the effects of electron-hole plasma, exciton populations, and polarization. Studies of these effects include quantitative comparison of co-linear- and co-circular-polarization pump-probe excitation schemes that reveal the consequences of spin-selection rules on scattering. For co-circular excitation conditions, we observe strong transient gain. We attribute this gain to the transfer of pump-induced coherences to the probe. Unexpectedly, we also find that true exciton populations do not significantly contribute to spectral broadening or shifting; rather, the nonlinear modifications are dominated by the excited carrier densities.

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