College of Optical Sciences
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Electromagnetically-induced transparency via biexcitons in semiconductor quantum wells

I. Rumyantsev, N.H. Kwong, R. Takayama and R. Binder

College of Optical Sciences and Department of Physics
The University of Arizona

M.C. Phillips and H. Wang

Department of Physics
University of Oregon

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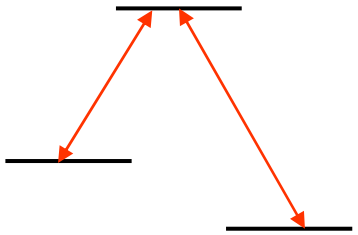
Nonlinear optical effects in atomic 3-level systems

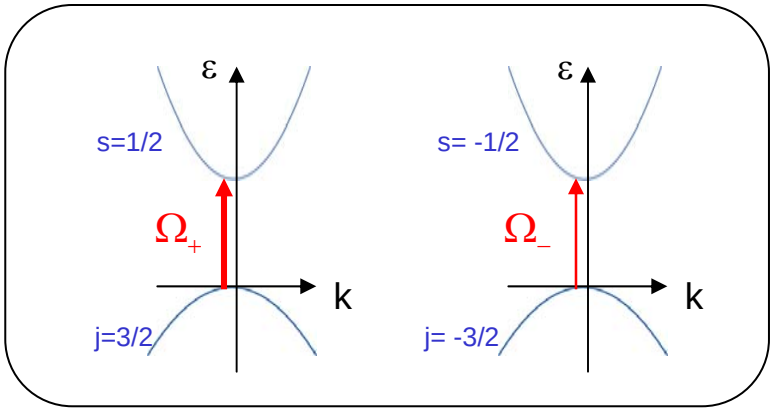


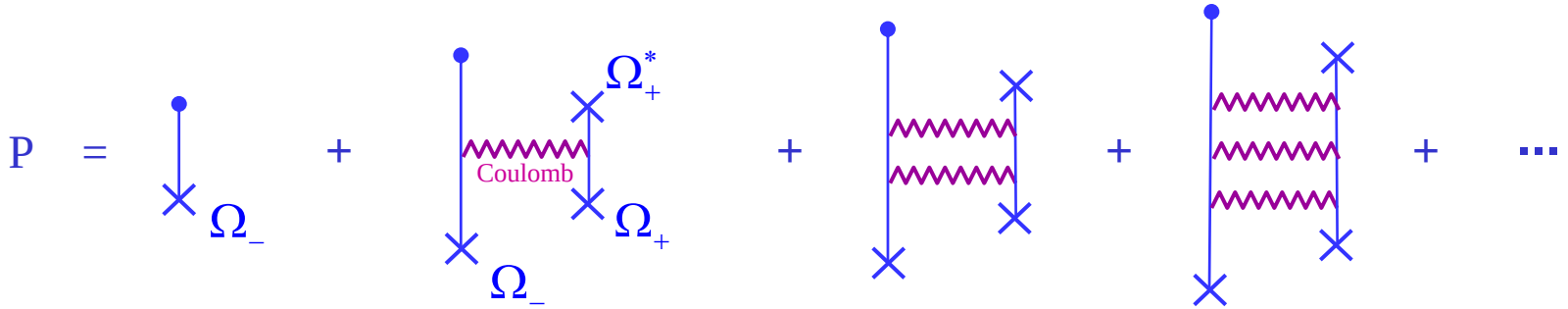
- electromagnetically-induced transparency (EIT)
- lasing without inversion
- adiabatic population transfer
- ultraslow light

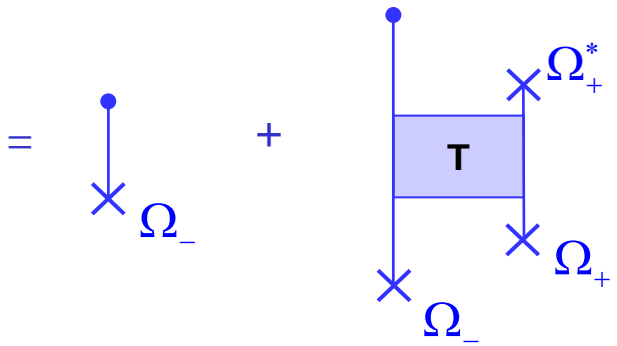
Analogous coherence effects in semiconductors?

- hh, lh valence band, conduction band (Arizona, Iowa, …)
- 3 conduction subband (London, …)
- hh valence band, 2 conduction subbands (Chicago, Texas, …)
- ground state, spin +/- excitons (Oregon, …)
- ground state, exciton, biexciton (Oregon, Arizona, …)

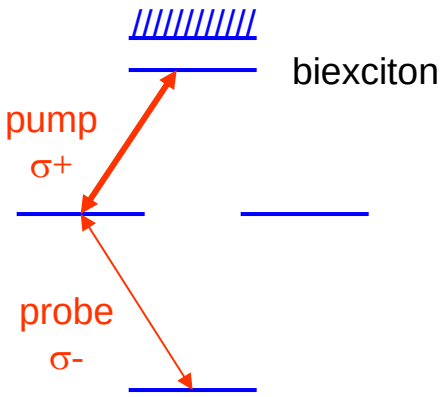
Interference up to 3rd order: excitons



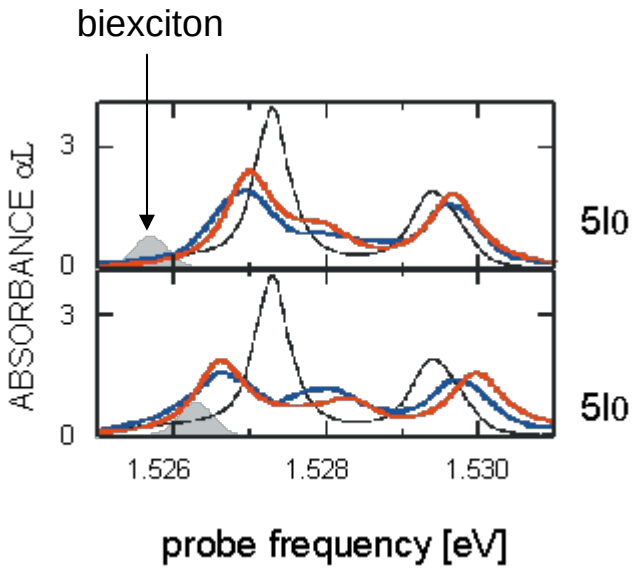




excitonic polarization

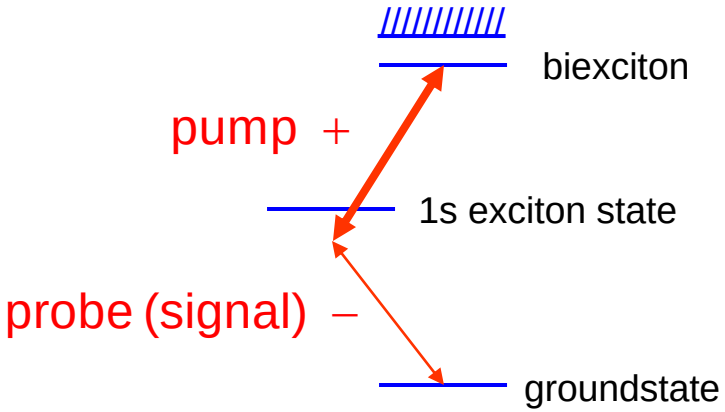


linear spectrum
nonlinear, experiment
nonlinear, theory



- Clear EIT dip in both experiment and theory, transmission increase by factor of 22 (13dB)
- Full recovery after control pulse gone (control duration 6 ps)

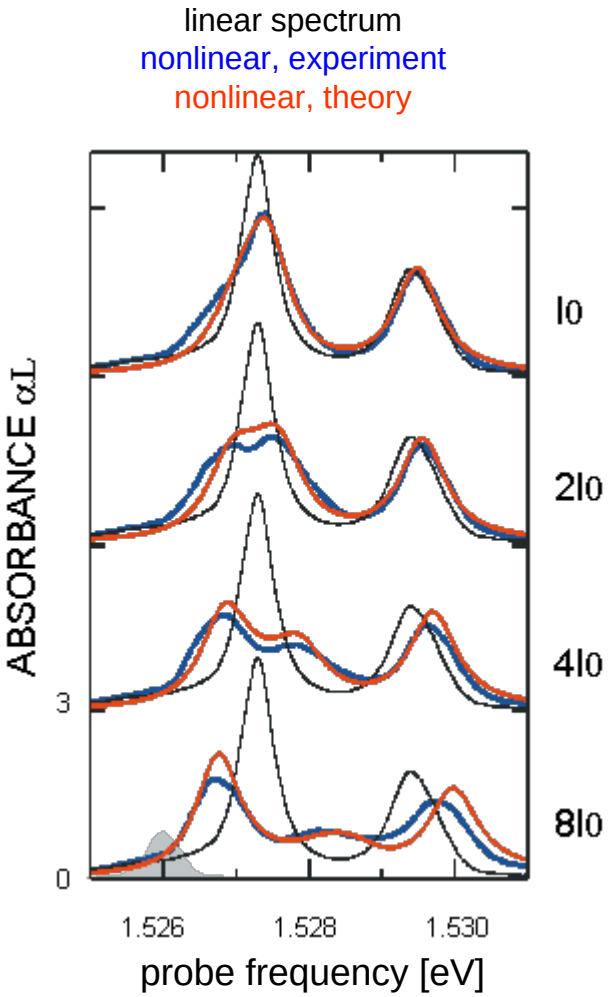
Phillips, Wang, Rumyantsev, Kwong, Takayama, Binder, Phys. Rev. Lett. 91, 183602 (2003)



EIT dip at

$$\hbar\omega_{pump} + \hbar\omega_{probe} \approx \varepsilon_{biexciton}$$

shifts with increasing pump intensity
(excitonic correlations beyond 3rd order)



Phillips, Wang, Rumyantsev, Kwong, Takayama, Binder, Phys. Rev. Lett. 91, 183602 (2003)