Degenerate four-wave mixing in semiconductor microcavities

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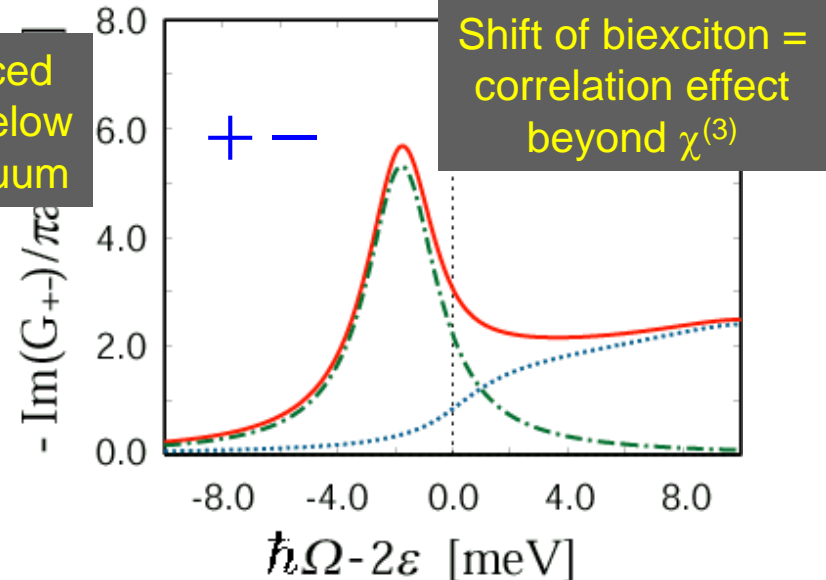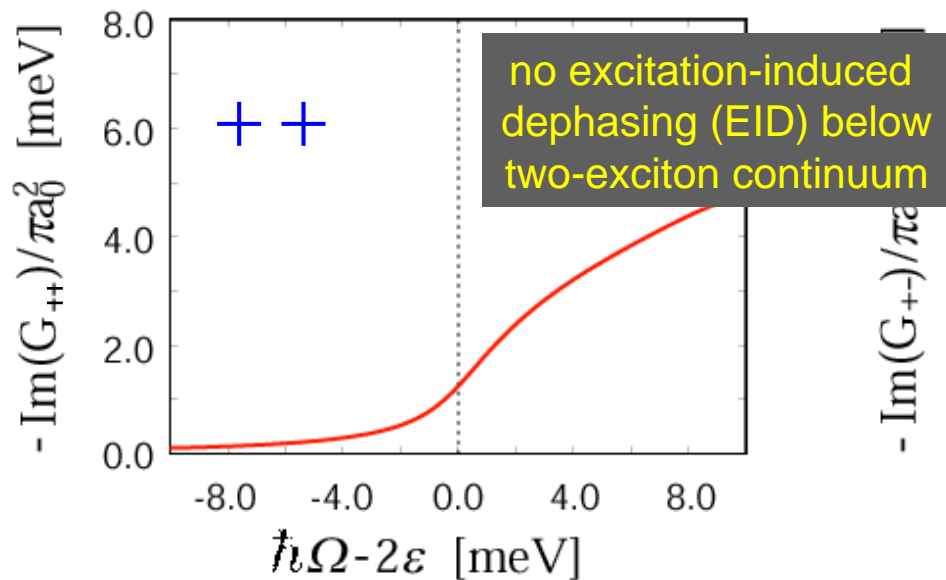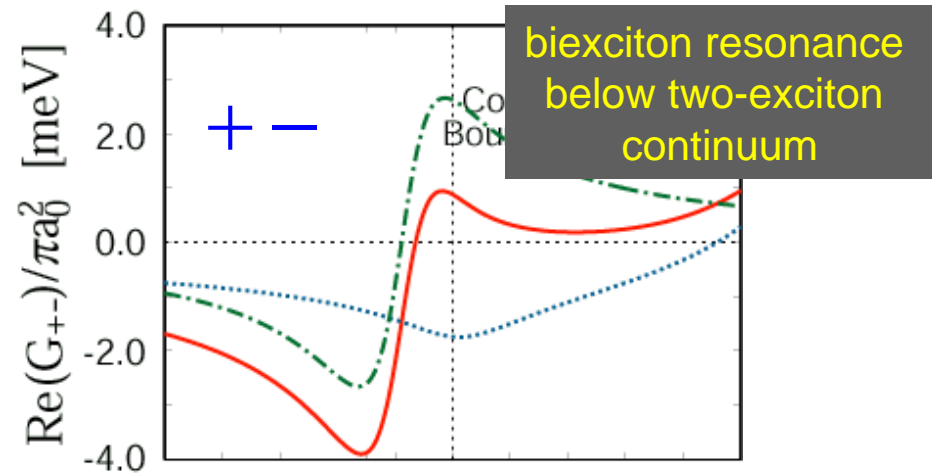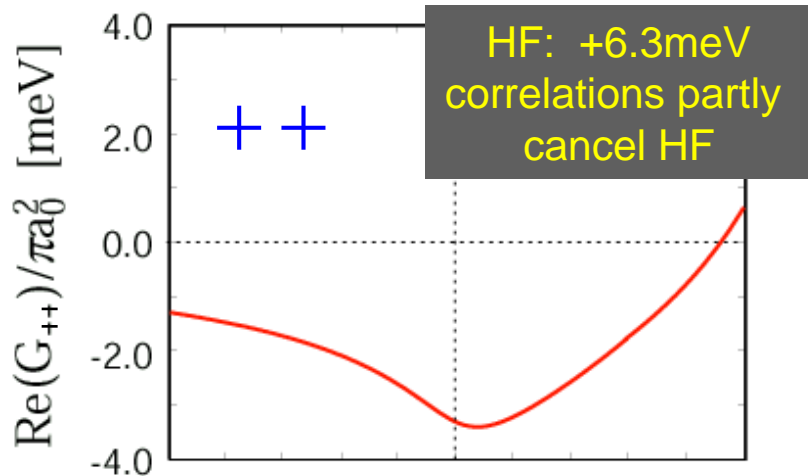# Degenerate FWM
(all fields at frequency ω)

$$p_f^{\pm}(\omega) = \chi^{++}(\omega)\, E_{p\pm}(\omega)\, E_{s\pm}^*(\omega) + \chi^{+-}(\omega)\, E_{p\mp}(\omega)\, E_{s\pm}^*(\omega)$$

$$\chi^{++}(\omega) \sim \left|\chi^{(1)}(\omega)\right|^2 \left[\chi^{(1)}(\omega)\right]\left\{G^{PSF}(\omega) + V^{HF} + 2G^{++}(2\omega)\right\}$$

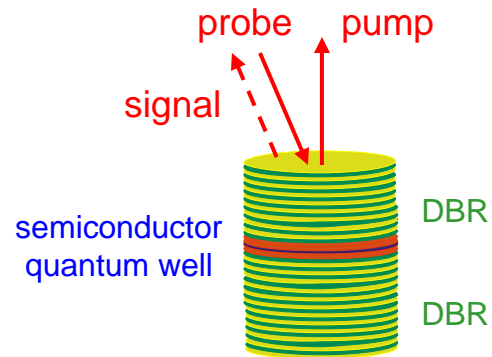$$\chi^{+-}(\omega) \sim \left|\chi^{(1)}(\omega)\right|^2 \left[\chi^{(1)}(\omega)\right] G^{+-}(2\omega)$$

with $\quad \chi^{(1)}(\omega) \sim \dfrac{1}{\omega - \varepsilon_x + i\gamma} \qquad G^{PSF}(\omega) \sim 1/\chi^{(1)}(\omega)$

• Takayama, Kwong, Rumyantsev, Kuwata-Gonokami, Binder, JOSA-B 21, 2164 (2004)
• Kwong, Takayama, Rumyantsev, Kuwata-Gonokami, Binder, Phys. Rev. B 64, 045316 (2001)

Takayama, Kwong, Rumyantsev, Kuwata-Gonokami, Binder, Eur. Phys. J. B 25, 445 (2002)

Frequency-Domain Degenerate Four-Wave Mixing in Semiconductor Microcavities

Polarization configution
(pump, probe, signal)

Signal strength (cw approximation) proportional to:

(x, x, x)

$$|G^{PSF}(\omega)+T^{++}(2\omega)+T^{+-}(2\omega)|^2$$

(x, y, y)

$$|G^{PSF}(\omega)+T^{++}(2\omega)-T^{+-}(2\omega)|^2$$

(x, +, +)

$$|G^{PSF}(\omega)+T^{++}(2\omega)|^2$$

(x, +, -)

$$|T^{+-}(2\omega)|^2$$

Signature of non-perturbative continuum correlations in 2 dimensions

blue: experiment
(Gonokami et al., 1997)

red: full theory

green: 2nd Born

Kwong, Takayama, Rumyantsev, Kuwata-Gonokami, Binder, Phys. Rev. Lett. 87, 27402 (2001)