Investigations on the parity of Fano resonances in photonic crystals

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Investigations on the parity of Fano resonances in photonic crystals

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I. Why Photonic crystal Fano structures?
• Photonic crystals (PhCs) have potential applications within integrated photonics.
• Highly nonlinear resonant behavior makes Fano structures suitable for photonic switching in integrated circuits [1] and recently a PhC Fano laser has been proposed [2].

II. What is a PhC Fano structure?
• Fano = narrow Lorentzian field + broad background field

III. Explanation of Fano parity in Fabry-Perot limit, \( d/a \geq 4.5 \)
• Single-mode description is sufficient when the cavity-PTE distance, \( d \), is at least 4-5 unit cells.
• Transmission equation becomes scalar, since all other modes are extinct:

\[
T = T_{PTE}^{+} (1 - RT)^{-1} T_{cav} \quad (1)
\]

\[
RT = R_{cav}^{+} P_{PTE}^{+} (2)
\]

IV. Experimental observation of Fano parity shifts
• SEM image of PhC Fano structure:

V. Conclusion
• The parity of a Fano transmission spectrum depends on the position of the PTE relative to the cavity.
• The phase shift obtained in completing one roundtrip in the Fabry-Perot cavity determines the parity in the Fabry-Perot limit.
• Experimental results have confirmed the dependence of parity on the position of the PTE.