Supporting Information: Strong Coupling to Generate Complex Birefringence: Metasurface in the Middle Etalons

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Supporting information consists of:

- This document 3 pages, 1 figure.
- MATLAB code in a single separate ASCII file ph0c01064_si_002.txt

Transfer-matrix model

The transmission of the metasurface in the middle etalons in the main text has been calculated using a simple transfer-matrix based modeling tool for arbitrarily layered stacks of resonant plasmonic metasurfaces interspersed with dielectric and metallic multilayers.[S1] The optical properties of each layer are specified by either its thickness and refractive index, or its complex reflection and transmission coefficients. Relating the parallel field components at the front side and back side of a slab through a matrix multiplication, the field of an arbitrary stack of layers is obtained as the matrix product of all the single layer transfer matrices. The metasurface transfer matrix is directly derived from its S-matrix parameters, i.e. reflection amplitude r_a and transmission amplitude $t_a = 1 + r_a$.

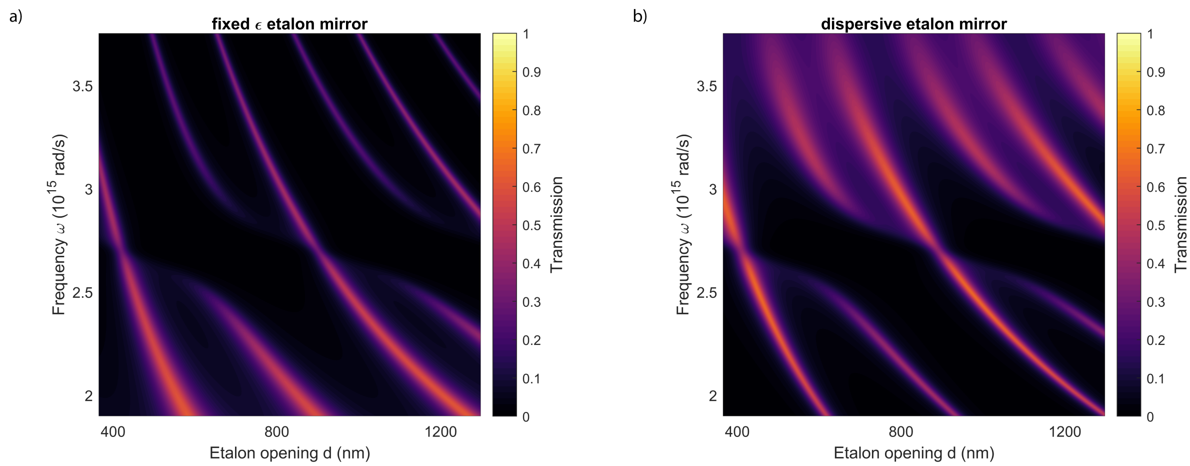

Figure S1: Calculated transmission through a planar Fabry-Pérot cavity-antenna hybrid with pitch 200 nm as a function of etalon thickness and frequency. Calculated with a) dispersionless Au mirrors ($\epsilon = \sqrt{0.25 + 4.5i}$) and b) taking into account the dispersion of the Au mirrors.

An example routine for MATLAB is found in *ph0c01064_si_002.txt*, which is documented with reference to.[S1] The top level function can be adapted by the reader to explore etalon spacing, antenna oscillator strength, as well as materials of mirrors, spacers, and super/ substrate (to be chosen non absorbing). Results are only valid for lattice pitches chosen dense enough that no lattice diffraction occurs, and mirror-antenna spacing large enough that negligible near-field (evanescent diffractive) coupling occurs (validity analysis reported in.[S1] The example top level function returns a comparing of strong coupling for an etalon with plasmon array for dispersionless (fixed ϵ) and dispersive outside Au mirrors for the case of Fig. 2f/2k in the main text. The output is reproduced in Fig. S1. Dispersive mirrors using literature optical constants of Etchegoin[S2] show increased loss, and hence reduced finesse towards higher frequencies, as is also observed in experiment.

References

(S1) Berkhout, A.; Koenderink, A. F. A simple transfer-matrix model for metasurface multilayer systems. *Nanophotonics* **2020**, *9*, 3985.

(S2) Etchegoin, P. G.; Le Ru, E. C.; Meyer, M. Erratum: "An analytic model for the optical properties of gold" [J. Chem. Phys. 125, 164705 (2006)]. *J. Chem. Phys.* **2007**, *127*, 189901.