Tailoring the spectra of Fabry-Pérot lasers using quasi-periodic grating structures

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Conventional distributed feedback lasers can be regarded as ID photonic crystal lasers where the translational symmetry and resultant photonic band structure determine the lasing modes of the cavity. More recently, lasing has been observed in the absence of external feedback in quasi-periodic photonic crystal structures, which offer new possibilities for spectral manipulation [1].

Here we present a transmission matrix calculation relating the threshold condition to the effective index seen by an optical mode in a Fabry-Pérot (F-P) laser. Our perturbative approach and the use of Fourier techniques allow us to solve the inverse problem relating the effective index along the cavity to the threshold gain modulation in wavenumber space. In this case the external cavity mirrors are the primary source of feedback while the construction of an appropriate quasi-periodic grating allows for the precise tailoring of the laser spectrum. As an application of the technique, single mode lasers at a predetermined wavelength near 1.5 micron are demonstrated.

[1] M. Notomi, H. Suzuki, T. Tamamura and K. Edagawa, *Physical Review Letters*, **92**, 123906 (2004).