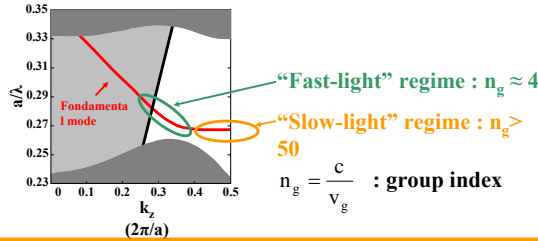


Dispersion curve



Slow-light photonic crystal waveguides :

Why slowing the light ?

- Enhancement of matter/light interactions (gain, thermo-optical effects, optical nonlinearities ...)
- Time processing of optical signals

Loss

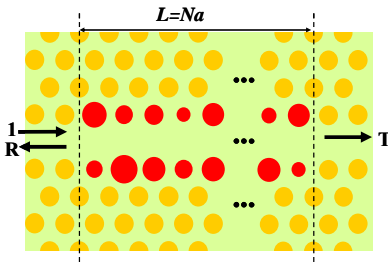
Fabrication imperfections (mainly roughness in cylinders surfaces) breaks the symmetry of photonic crystal.

Two types of loss :

- Backscattering
- Out of the propagation plane loss

Coupled Bloch-modes method

Model



Independent Gaussian random variation of the two inner row radii

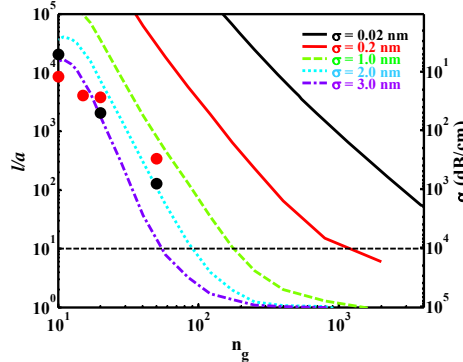
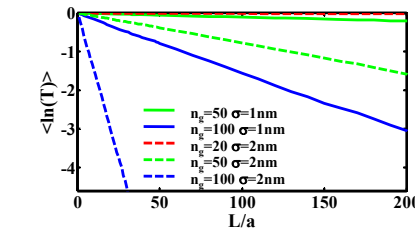
σ : standard deviation of radii distribution

Exact calculation of the backscattering and the out of plane losses at every elementary cell.

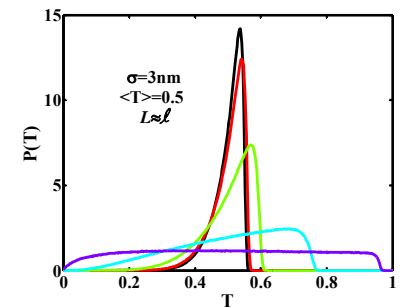
G. Lecamp, J.P. Hugonin and P. Lalanne, Opt. Express 15,11042-60 (2007).

- Measure Univ. of St Andrews
- Data from E. Kuramochi, Phys. Rev. B, 72, 161318, (2005)

Localization length



Probability density function

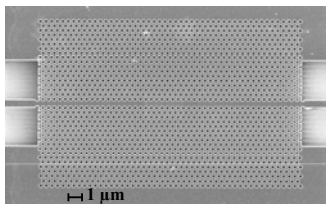


Histograms calculated for 5.10^4 independent disorder realizations

- $n_g=11$ $L/a=11600$ Out of plane loss ~ Backscattering
- $n_g=13$ $L/a=9800$ Backscattering increases
- $n_g=15$ $L/a=7800$
- $n_g=17$ $L/a=3200$
- $n_g=30$ $L/a=260$ Out of plane loss << Backscattering

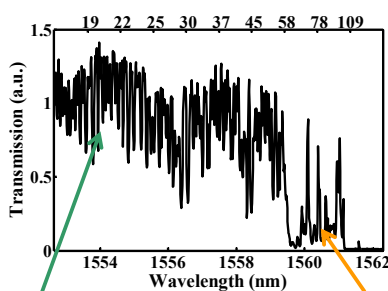
Even for relatively high transmissions ($\langle T \rangle \approx 0.5$) : the localization leads to a broadening of the transmission statistic

Experimental validation

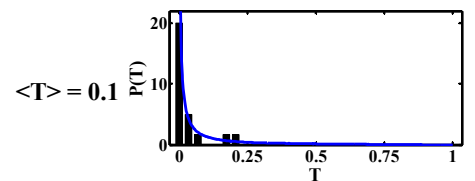
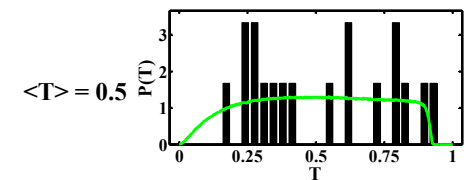
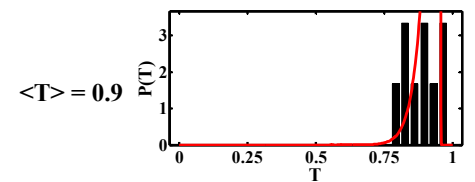
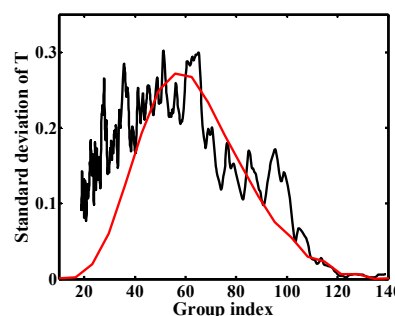
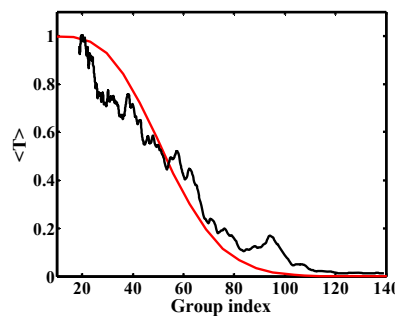


20 independent realizations of the same structure
Collaboration : D. Beggs and T. Krauss,
Univ. St Andrews

- Transmission set-up : measurement of $T(\lambda)$
- Interferometric set-up : measurement of $n_g(\lambda)$



- Fast-light regime
- "Slow-light" regime
- W1 has low loss
- High loss in W1



Conclusion

- First transmission model taking into account multiple scattering
- Probability density function description
- Experimental validation of the prediction

Fabrication errors in W1 waveguides are currently too important to use these device in slow light regime