Journal Club Q&A

Q. As in slide 4, we understood refractive index n can influence on the spontaneous emission rate. However, in the waveguide, only the group index n_g is enhanced by photonic crystal waveguide. How n_g can influence on the spontaneous emission rate to the waveguide?

A. Aside from intensity of electric field, in slide 4, spontaneous emission rate increase is due to an increase of density of modes(DOS). Because a group index is proportional to the inverse of group velocity $\left(\frac{d\omega}{dk}\right)^{-1}$, we can expect $dk \propto n_g d\omega$ near that frequency. In this way, the group index increases DOS and the spontaneous emission rate to the waveguide.

Q. Is there any localization method except for the side-illumination(SI) beam? As far as I can remember, there was another method in the previous papers of Kimble.

A. Following to this paper, another active method does not exist. However, in the supplement, they have mentioned Casimir-Polder potential near the waveguide and said "The distribution of atoms along the APCW is being investigated in more detail"

Q. In the figure $\overline{N}$ versus Γ_{tot}/Γ_0, is it correct that $2\Gamma_0$ when $\overline{N}$=0? And is it correct that spontaneous emission is linearly increasing in $\overline{N}$<<1 regime?

A. Yes. Because they have measured spontaneous emission rate of atoms, only $N \geq 1$ case can contribute to the spontaneous emission rate. So minimum spontaneous emission rate is $2\Gamma_0$. In the same way, under the condition $\overline{N}$<<1, the major contribution to average number of atoms is N=1 or N=2. Regarding P(2, $\overline{N}$) = P(1, $\overline{N}$)*$\overline{N}$/2 and P(0, $\overline{N}$) is neglected, the spontaneous emission rate is proportional to $\overline{N}$/2 when $\overline{N}$<<1.

Q. Is there any localization of atoms along x-axis due to the reflected SI beam from the periodic spikes of the waveguide?

A. Maybe not. Following to their words, "Along the x axis of the APCW, the dipole trap is insensitive to the dielectric corrugation within a unit cell and is nearly uniform within <2% around the central", there would be negligible localization due to the spikes of the waveguide. In my opinion, localization in Z_1 site is owing to the reflectance from the inner side of the waveguide.

Q. Why do the spikes exist in the alligator photonic crystal waveguide?

A.The periodic structure of the spikes gives the similar effect to alternating refractive index in the photonic crystal.