

# Photon Pair Generation in Biexcitonic Cavity QED and Device

Prof. Hiroshi AJIKI (Osaka Univ.), Prof. Hajime ISHIHARA (Osaka Prefecture Univ.)

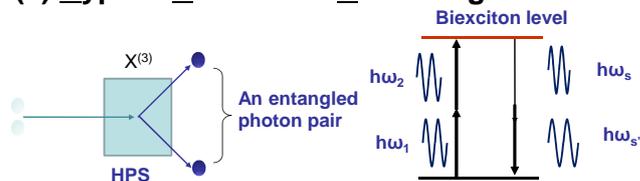
## 1. An entangled photon pair generation → Much higher efficiency is expected !!

### (1) Parametric Down Conversion: PDC



- Well known method.
- Output photon's wave length becomes halved.

### (2) Hyper - Parametric Scattering: HPS

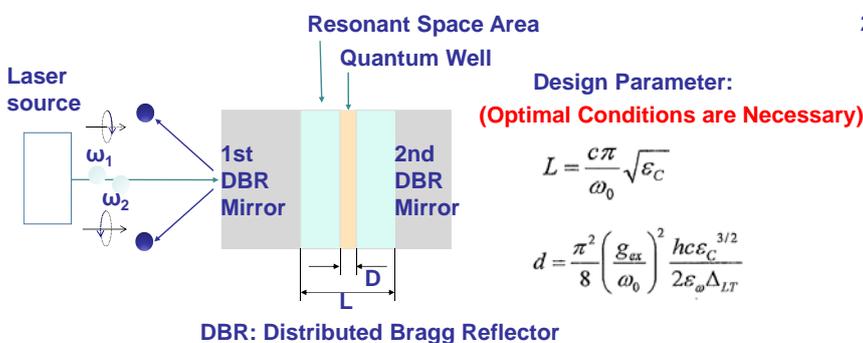


- Utilize Biexciton level. (ex. CuCl bulk/nano crystal)
- Output photon's wave length is almost same as the input one.

## 2. Novel Patented Technology

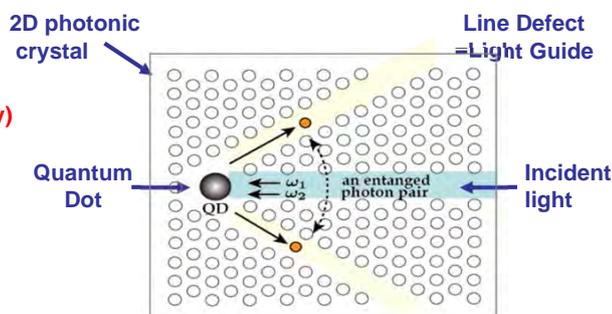
New architecture, the combination of **HPS** and the **Microcavity with Quantum Well / Dots** enhances the generation efficiency drastically

Device 1: A quantum well in a DBR cavity



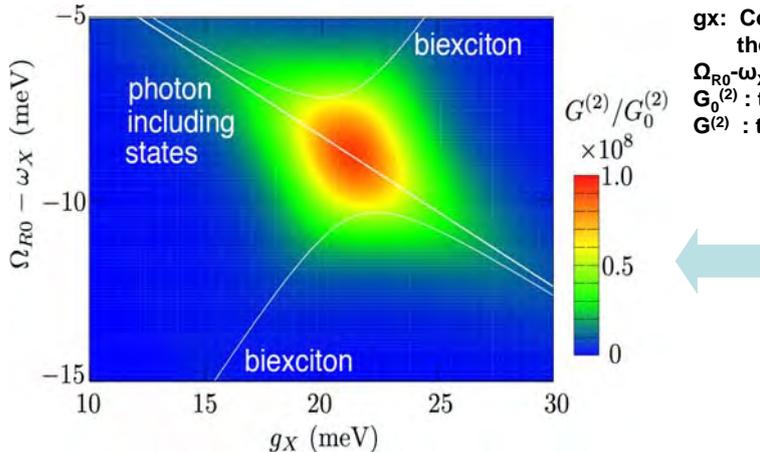
DBR: Distributed Bragg Reflector

Device 2: A quantum dot in a photonic slab cavity



## 3. Normalized Efficiency enhances up to the order of ~ 10<sup>8</sup>

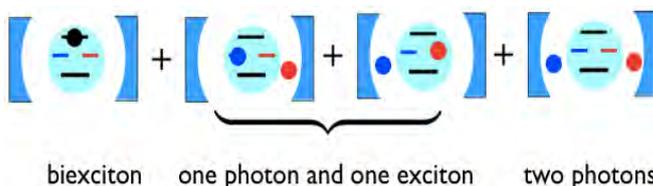
- The optimal entangled-photon generation exists at the level-crossing region of the biexciton and the photon including states.



gx: Coupling const. between the exciton and the cavity photon ( $-\omega_1$ )  
 $\Omega_{R0} - \omega_X$ :  $\omega_2 - \omega(\text{exciton})$   
 $G_0^{(2)}$ : the intensity without the cavity effect.  
 $G^{(2)}$ : the intensity with the cavity effect.

To enhance the efficiency, two excitation dressed states are necessary.

Two excitation dressed states:



## 4. Control method for the Optimal Conditions of the entangled photon generation

Effects of the Cavity quantum electrodynamics (Cavity QED) are significant.

- The frequency  $\omega_1$  of a right (left) circularly polarized laser field is tuned to a frequency of a cavity polariton.
- The frequency  $\omega_2$  of a left (right) circularly polarized field is tuned to the transition frequency from the cavity polariton to the two-excitation dressed states.

## 5. Application

Quantum Information / Communication Technology  
 Quantum Lithography

## Patent Licensing Available

Patent No. : JP 4863105, 3649408  
 US 7649679, 7683361

JST/ IP Management & Licensing Group :  
 phone: +81-3-5214-8486, e-mail: license@jst.go.jp