Towards tunable Rydberg exciton maser

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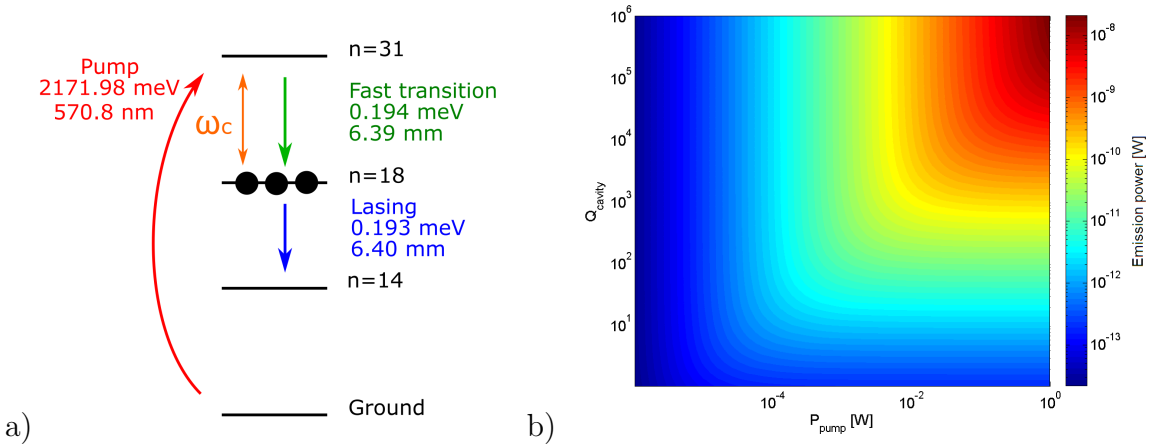
Since their discovery by Kazimierczuk *et al* [1], Rydberg excitons in Cu_2O attract a lot of interest due to their unique properties such as exceptionally long lifetimes. Up till now the researches involving in Rydberg excitons, both theoretical and experimental, have concentrated on their static properties (excitonic states, electro- and magneto-optical properties). We aim to investigate the dynamics of such a medium in the situation of population inversion, which leads to possible realization of a solid state maser.

Such a solid-state device is highly desirable, but the short lifetimes of emitters in solids are a major obstacle [2]. However, the long living excitonic states might overcome this issue. Masing has been arleady achieved with Rydberg atoms, where few-hundred-ns-long bursts of mm-wave radiation have been produced [3]. Our proposal is to exploit the characteristic properties of highly excited excitonic states in Cu_2O, where the wealth of accessible states provides many opportunities for creating a three level maser system (Fig. 1a), high density of excitons leads to significant output power (Fig. 1b), and the sensitivity to the applied electric field makes the setup easily tunable.



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