# 固体パラ水素のコヒーレント振動二光子遷移

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## Coherent vibrational two-photon transitions of solid parahydrogen

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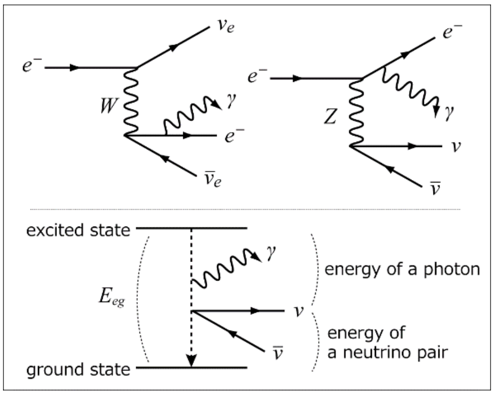
We, the SPAN (SPectroscopy of Atomic Neutrinos) collaboration, have proposed to study extremely rare processes involving neutrinos. The processes are called "Radiative Emission of Neutrino Pair (RENP)". In the RENP processes, an excited atom or molecule decays to its ground state by emitting one photon and a pair of neutrinos simultaneously. Examples of Feynman diagrams and a schematic energy diagram of the RENP are shown in the figure to the right. It is relatively easy to observe the photons, which contain rich information of the neutrino pairs, although almost impossible to observe the neutrino pairs. The unknown neutrino properties such as their absolute masses, mass type (Dirac or Majorana), and CP-violating phases can be investigated by observing spectra of the photons. It is a common practice to prepare a vast number of targets for observing rare phenomena. However, gathering tons of excited atoms/molecules is unrealistic. We have planned to amplify the RENP rate by taking advantage of collective interactions.




Collective interactions between atoms mediated by photons has shown a variety of interesting and useful phenomena. Among them, constructive interference effects can be quite useful for observing rare phenomena because its resultant rate become proportional to the square of the number of excited particles and can be very large.

As a first step of the project, we have experimentally investigated the coherence amplification of QED processes emitting plural photons, which are analogies to the RENP processes emitting plural particles. I would like to present our resent results on coherent vibrational two-photon transitions (two-photon emission and anti-Stokes scattering) from solid parahydrogen. Vibrational decoherence time of the solid parahydrogen is longer than that of usual solids due to its quantum nature. It is found that emission intensity in the solid increases even after excitation pulses pass through the solid completely. We also found that this "coherence feeding" effect depends on the geometry of excitation. The recent experimental results will be reported although its physical origin is still unclear.