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Efficient and Selective Photon Detection using Amplification Without Inversion.[1] KEVIN MERTES, MICHAEL DI ROSA, Los Alamos National Laboratory — We describe ongoing theoretical and experimental research at Los Alamos National Laboratory of a new technology for photon detection that exploits quantum processes to attain an unrivaled combination of high quantum efficiency and sharp spectral discrimination. The amplification without inversion (AWI) scheme we are exploring consists of a Λ system found in the excited states of ^{202}Hg. The $6^3P_0 \Rightarrow |1\rangle$ and $6^3P_2 \Rightarrow |2\rangle$ states form the lower 2 levels of the Λ system, and $7^3S_1 \Rightarrow |3\rangle$ forms the upper level. By incoherently pumping Hg vapor into $|3\rangle$ while simultaneously driving $|3\rangle \leftrightarrow |2\rangle$, approximately 50% of the population will reside in $|1\rangle$. Under these conditions, the system is radiating along $|3\rangle \rightarrow |1\rangle$ with an emission spectrum with a narrow dark line centered precisely on the $|3\rangle \rightarrow |1\rangle$ resonance. A faint light signal that is resonant with the $|3\rangle \rightarrow |2\rangle$ transition that enters the system would precipitate a coherent pulse of photons. This gain occurs from the coherent redistribution of population through level $|3\rangle$. The expected spectral width for gain is a narrow 20 MHz. Due to spontaneous-emission quenching the noise added from this scheme should be significantly less than ordinary laser amplifiers.

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