Solving Computational Problems with Coupled Lasers

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Computational problems may be solved by realizing physics systems that can simulate them. Here we present a new system of coupled lasers in a modified degenerate cavity that is used to solve difficult computational tasks. The degenerate cavity possesses a huge number of degrees of freedom (300,000 modes in our system) that can be coupled and controlled with direct access to both the x-space and k-space components of the lasing mode. Placing constraints on these components are mapped on different computational minimization problems. Due to mode competition, the lasers select the mode with minimal loss to find the solution. We demonstrate this ability for simulating XY spin systems and finding their ground state, for phase retrieval, for imaging through a scattering medium, and more.