# A Coherent Ising Machine Based on Degenerate Optical Parametric Oscillators

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A coherent Ising machine (CIM) is an optical many-body system based on degenerate optical parametric oscillators (DOPO) coupled with mutual optical injection [1, 2] or measurement-feedback [3, 4]. It has been shown that the measurement-feedback CIMs can find low-energy solutions to large-scale Ising model problems [3–5]. Our recent experiments revealed that the CIM can generate the Ising spins with various energy distributions depending on the operational conditions of the DOPOs [5,6]. This fact suggests that the CIM can be used as a very fast canonical spin sampler, which is useful for information processing tasks that requires fast sampling from probability distributions, including Monte-Carlo simulation and machine learning.

We also found that a pair of DOPO pulses coupled with opposite signs mimics spiking neuron behaviors, which we expect will be a new platform for brain-inspired computation [7]. As an example of such computation, we recently demonstrated the formation of chimera states using our "DOPO neurons" [8].

## References

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