Day 1 (Poster B)

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Title: Dissipative quantum dynamics in coherent Ising machine with measurement-feedback spin-spin couplings

Abstract:
Coherent Ising machines (CIM) is a physical system to solve combinatorial optimization problems described by the Ising model. In this system, degenerate optical parametric oscillator (DOPO) pulses are pumped up to represent the binary spins emerging above the oscillation threshold concomitantly with bifurcation phenomena on quantum-mechanically-squeezed quadrature phases of each pulse. Remarkably, recent experiments show better performance when we hold the pulses just below the threshold ahead of the spin emergence with an efficient implementation of spin-spin couplings via feedback injection of coherent lights based on measurement outcomes of a particular phase amplitude of each pulse. To investigate the unclarified dynamics around the threshold theoretically, we use a dissipative quantum model of the CIM dynamics, the Lindblad master equation, derived from a theoretical analysis of the measurement-feedback couplings and the squeezing with two-body loss on DOPOs. The time-evolution including fluctuations due to the couplings and the local quantum effects is numerically simulated by means of a phase space method for small Ising problems, which reveals peculiar characteristics of CIM just below the threshold; non-thermal long-tailed energy distribution appears by the non-classical fluctuations.

This is a collaborative work with Kensuke Inaba in NTT Basic Research Lab.