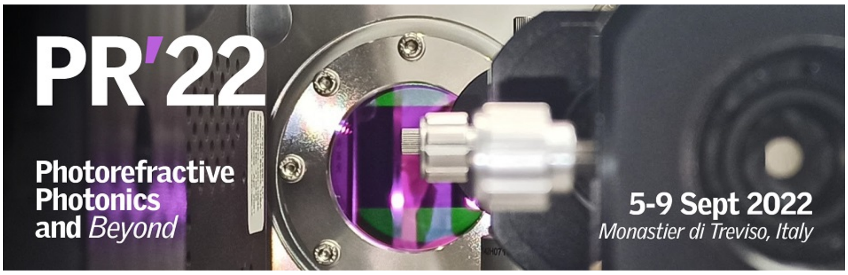

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Optical computation of the spin glass dynamics

Thursday, 8 September 2022 15:25 (25 minutes)

Optical computation is an emerging scheme in quantum transport, quantum simulation and machine learning. Computation exploiting light field can be performed in the time needed for a laser pulse wave-front to be shaped by a phase mask which can be as short as few femtoseconds: the calculation can performed at the "speed of light".
Spin glasses serve as prototype models, capable of providing both equilibrium and off-equilibrium nontrivial phenomenology while, at the same time, they are still hosting many open questions in modern statistical mechanics. Complex systems from diverse fields fall into the spin glass universality class: brain functions, random lasers, and quantum chromodynamics. Indeed, novel methods for the calculation of the equilibrium states and of the dynamics of a spin glass system are highly sought after.
By exploiting last-generation optical modulation devices, millions of light rays can be driven simultaneously between several states within microseconds, thus potentially providing a scalable optical platform that only needs to be built around the relevant computationally hard problem.
In a recent paper [M. Leonetti et al, PNAS 118(21), e2015207118 (2021)] we proposed an analog optical system to compute the dynamics of a given spin glass state. We observed that the overall intensity on a screen placed downstream of a strongly scattering medium shone with N coherent light rays can be formally written as a spin glass Hamiltonian, in which spin states maps on the light rays phase. We demonstrate the supremacy (speedup) of our approach with respect to digital computing.

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