Quantum simulator with hot atomic vapors

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Numerical resolution of complex problems remains a challenge for various applications, high performance computation centers reaching their limits in terms of speed in addition to being huge energy consumers. In recent years, important efforts are conducted to realize quantum computers and quantum simulators in order to address these limitations. Many devices presently under construction, exploit many entangled qubits, and are often based on cryogenic or ultra-cold atom techniques, in order to avoid thermal decoherence.
A alternative, though less universal development has thus emerged with the goal of realizing more specialized quantum simulators, able to solve specific problems. In this project we propose to develop a remote-controlled stand-alone device to operate as a wave simulator based on the non-linear interaction of a laser beam with a hot atomic vapor [1]. Initial problems to be addressed include hydrodynamic equations [2]. In parallel, the use of this wave simulator as an optical reservoir computer is under investigation to develop an efficient machine learning device.

References

[1] Nonequilibrium precondensation of classical waves in two dimensions propagating through atomic vapors (2018), N. Santic, A. Fusaro, S. Salem, J. Garnier, A. Picozzi and R. Kaiser, Phys. Rev. Lett. 120, 055301 Authors, Journal, Issue (Year) page

[2] Dissipation-Enhanced Collapse Singularity of a Nonlocal Fluid of Light in a Hot Atomic Vapor (2021), P. Azam, A. Fusaro, Q. Fontaine, J. Garnier, A.
Bramati, A. Picozzi, R. Kaiser, Q. Glorieux and T. Bienaime, Phys. Rev. A 104, 013515

Figure

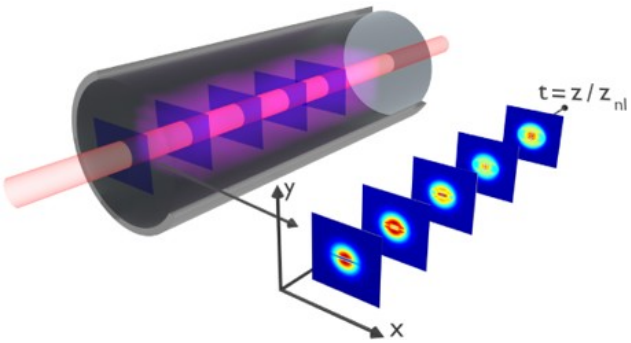

Figure 1: Scheme of laser beam propagating through atomic vapor (nonlinear medium) resulting in the simulation of a 2D fluid of light while propagation axis (z) corresponds to the time evolution of this fluid.