Minicolloque n° 10 **X Oral** **□ Poster**

Classical black hole back-reaction in nonlinear optics

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With recent and astounding experimental progress demonstrating that numerous experiments (e.g., Bose-Einstein condensates, nonlinear optics, polaritons, and water) can host analogue black holes, it is important to fully explore the extent to which this analogy can pushed. In this respect, an important backreaction process has been identified in the context of AdS/CFT [1] wherein a high-energy process near the horizon describes information scrambling. Importantly, the process depends solely on the Hawking temperature and captures the chaotic nature of trajectories near the horizon. We propose to test this scenario in a nonlinear optics simulation. Within this setup, the key interaction is a three-photon interaction: disturbing the velocity of the soliton (which produces an effective event horizon) by kicking it Wwith one of photon may result in a comoving photon to escape the horizon or fall past it, a classical analogue to information scrambling and chaotic dynamics.

[1] J. Maldacena, S. H. Shenker, and D. Stanford, J. High Energy Phys. **2016**, 106 (2016)