Postdoctoral Position in Theoretical Physics

Topic: Numerical investigation of novel quantum states in SU(N) spin lattice systems

Laboratory: Laboratoire de Physique et Modélisation des Milieux Condensés (CNRS), Grenoble (France)
Supervisor: Pierre Nataf
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Description:

When loaded in an optical lattice, ultra-cold fermionic atoms with an internal degree of freedom (e.g. the nuclear spin of alkaline rare earths) can be described by lattice spin models with SU(N) symmetry, where N is the degeneracy of the internal degree of freedom [1]. To describe the Mott insulating phase of N-colors fermions, one can start with the SU(N) Heisenberg Hamiltonian. The use of **standard Young tableaux** [2] allowed us to implement the SU(N) symmetry in an **Exact Diagonalization** algorithm [3] and in a **Density Matrix Renormalization Group algorithm** [4,5]**.** The purpose of the current proposal is to develop this numerical technology to study **SU(N) spin chains or ladders**, and secondly to generalize the method to tensor networks to address **2D systems.** We wish to study the occurence of SU(N) symmetry-protected topological (SPT) phases in 1D and SU(N) chiral spin liquids in 2D. The powerful numerical tools that we would like to develop will then help the experimentalists to precisely anticipate the conditions to observe some unconventional quantum phases.

The position shall start no later than **October 1, 2022** and lasts **12 months.**

Bibliography:

[1] A. V. Gorshkov, *et. al.,* Nat. Phys. **2**, 289 (2010); G. Pagano, *et. al*., Nat.Phys., **10**, 198 (2014), X. Zhang*, et. al*., Science **345**, 1467 (2014); C. Hofrichter*, et. al*., Phys. Rev. X. **6**, 021030 (2016); S. Taie, arXiv 2010.07730v1 (2020).
[2] A. Young, Proc. London. Math. Soc. (2), **28**, 255 (1927).
[3]P. Nataf and F. Mila, Phys. Rev. Lett. **113**, 127204 (2014).
[4]P. Nataf and F. Mila, Phys. Rev. B. **97**, 134420 (2018).
[5]S. Gozel, P. Nataf and F. Mila, Phys. Rev. Lett. **125**, 057202 (2020). P. Nataf, S. Gozel and F. Mila, Phys. Rev. B. **104**, L180411 (2021).

Necessary pre-requisites:

PhD in Theoretical physics/condensed matter/quantum physics, Numerical skills.

How to apply:

Send to the supervisor a cv including a list of publications, and (at least) one recommendation letter.