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Colloquium of the Physics Department of ENS

Mercredi 11 Janvier 2023, 13 :30
DPT-PHYS-ENS, ConfIV (E244) - 24 rue Lhomond 75005 PARIS
Domaines : physics

Titre : *Quantum many-body physics with ultracold atoms : Sailing the quantum seas*

Orateur : **Prix Des Trois Physiciens 2022 - Frédéric Chevy**

Résumé : *Understanding the properties of a large number of particles in interaction is one of the frontiers of modern physics : from the stability of sandpiles to the formation of large structures in the universe or the behaviour of complex neural networks, it is at the core of almost all current fields of research. In the quantum world this question explores the properties of quantum materials or those of nuclear matter and the combination of quantum mechanics and many-body physics leads to the most complex challenges probably ever faced by the physics community.*

Thanks to the versatility of the manipulation techniques of ultracold atoms with light and magnetic fields it is now possible to explore a broad variety of quantum many-body systems with an unprecedented control of the experimental parameters. In my talk, I will discuss the case of the simplest yet non trivial situation where a single particle (the so-called impurity) is immersed into a quantum many-body ensemble. The interactions with the background creates a cloud of excitations that dresses the impurity and gives rise to a quasi-particle. The properties of this so-called polaron are strongly affected by the nature of the background and I will show that ultracold atoms can be used to explore several instances of this problem : the Fermi polaron, where the background is an ideal gas of spin polarized fermions, the Bose polaron where the impurity is immersed in a Bose-Einstein condensate of weakly interacting bosons, and finally the superfluid polaron where the medium is an attractive gas of spin 1/2 fermions and that interpolates between the two previous situations.
