# SÉMINAIRE du PÔLE THÉORIE

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## In the shadow of beta radiations: testing fundamental symmetries with *ab initio* nuclear theory

Ever since the first detection of radioactivity, the experimental study of beta decay has been continuously shaping our understanding of the fundamental interactions. In the recent years, the increase in experimental precision has been setting stronger and stronger constraints on physics beyond the standard model. In particular, the experimental data gathered on superallowed Fermi transitions have been setting the most precise constraint on the unitarity of the CKM matrix. The most recent data are now in tension by 2-3 standard deviations with the standard model. In this case, the main source of uncertainty comes from the theoretical modelling of low-energy nuclear corrections connecting experimental observables to Vud.
In the first part of my talk, I will discuss our recent attempt at reducing these nuclear uncertainties using the *ab initio* No-Core Shell Model for light nuclei. In particular, I will focus on the calculation of nuclear structure dependent one-loop correction to the $^{10}$C to $^{10}$B transition. Our preliminary results indicate a significant shift from previous estimations in the literature, which confirms the need to revisit thoroughly the theoretical uncertainties of superallowed Fermi transitions in a modern *ab initio* framework.
In the second part of my talk, I will discuss recent developments in the design of a novel exact *ab initio* method based on Variational Monte Carlo and Neural Quantum States. The end goal is to be able to extend this exact *ab initio* method to reach all superallowed Fermi transition up to $^{74}$Rb. To this end, I will discuss a novel optimizer based on decision geometry which allowed us to accelerate the optimization of Neural Quantum States by one order of magnitude compared to other state-of-the-art optimizers.

*Tuesday 13$^{th}$ February 2024,*
*16h00*
*IJCLab, Build. 100, Room A243*