FOUR-BODY CORRELATIONS IN ATOMIC NUCLEI: QUARTETTING AND ALPHA PARTICLE

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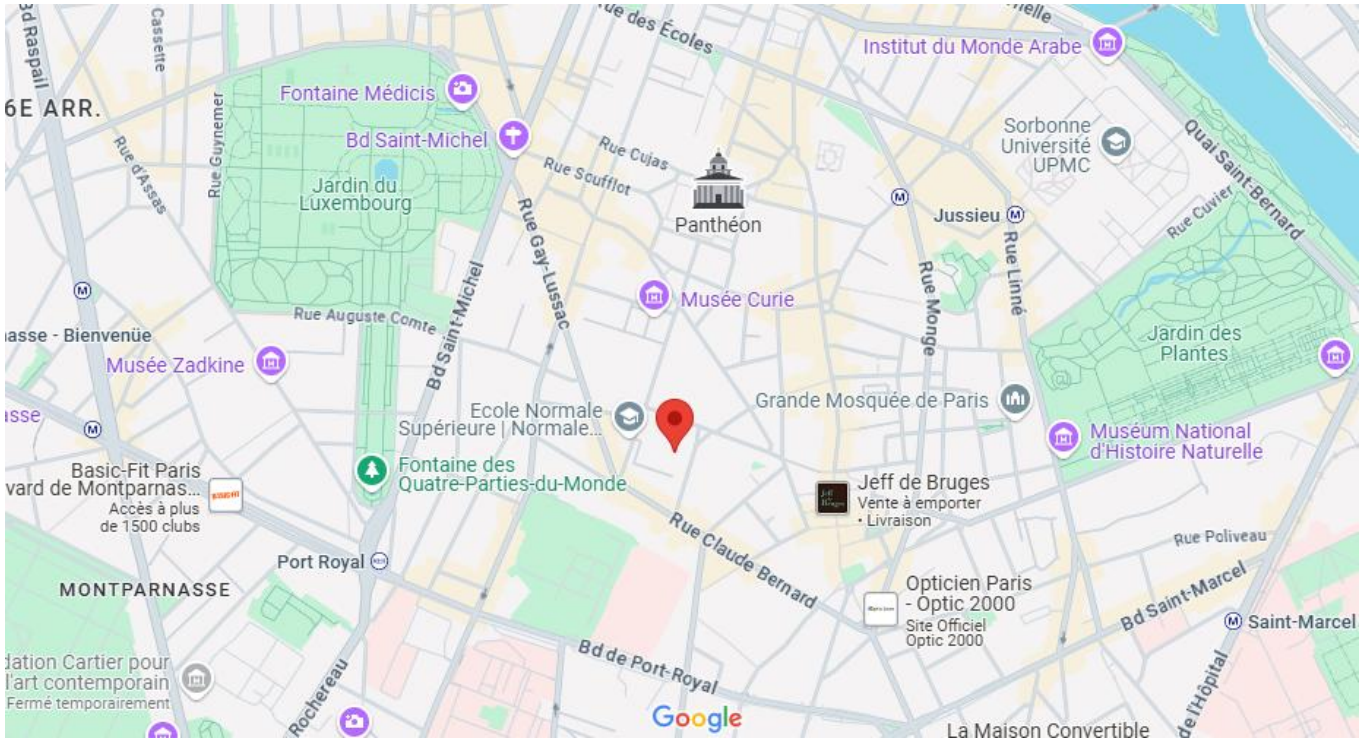
Journée des nouveaux entrants du Pôle théorie

Supervisors: Elias **KHAN** (IJCLab) and Jean-Paul **EBRAN** (CEA)

BEFORE THE PHD

Studies at École normale supérieure – PSL:

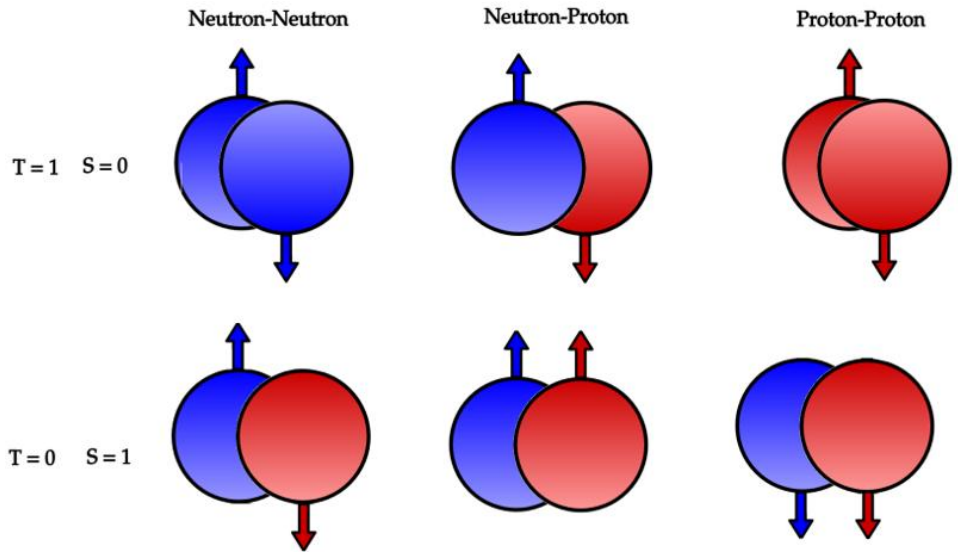
- 2020-2022: L3 and M1 of Fundamental Physics
- 2022-2023: Agrégation de Physique
- 2023-2024: M2 ICFP – Theoretical Physics



PHD PROJECT

Nuclear experimental data:

- There exist pair nucleon correlations
- We want to go beyong pairing: quartetting
  - We consider Cooper pairs in two different channels of isospin: (T=1, S=0) and (T=0, S=1)



- Quartetting consist in correlations between two Cooper pairs in order to for an alpha particle

PHD PROJECT

Formalism:

- Quartetting operator Q_T for the isovectorial or isoscalar channel
- We have a Quartetting Hamiltonian and a Quartetting Wave Function

$$|\Phi_Q\rangle = \left(\alpha Q^\dagger_{T=0} - \beta Q^\dagger_{T=1}\right)^{N_q} |-\rangle\,, \quad \alpha^2 + \beta^2 = 1$$

$$H_Q = \sum_{i,j} V_{ij}^{T=1} \sum_\tau P^\dagger_{i,\tau} P_{j,\tau} + \sum_{i,j} V_{ij}^{T=0} \sum_\tau D^\dagger_{i,\tau} D_{j,\tau}$$

$$\underbrace{P^\dagger_{i,\tau} = \left[a^\dagger_i a^\dagger_{\bar{i}}\right]^{J=0,T=1}_{M=0,\tau}\,, \quad D^\dagger_{i,\tau} = \left[a^\dagger_i a^\dagger_{\bar{i}}\right]^{J=1,T=0}_{M,\tau=0}}_{\text{Cooper Pairs}}$$

PHD PROJECT

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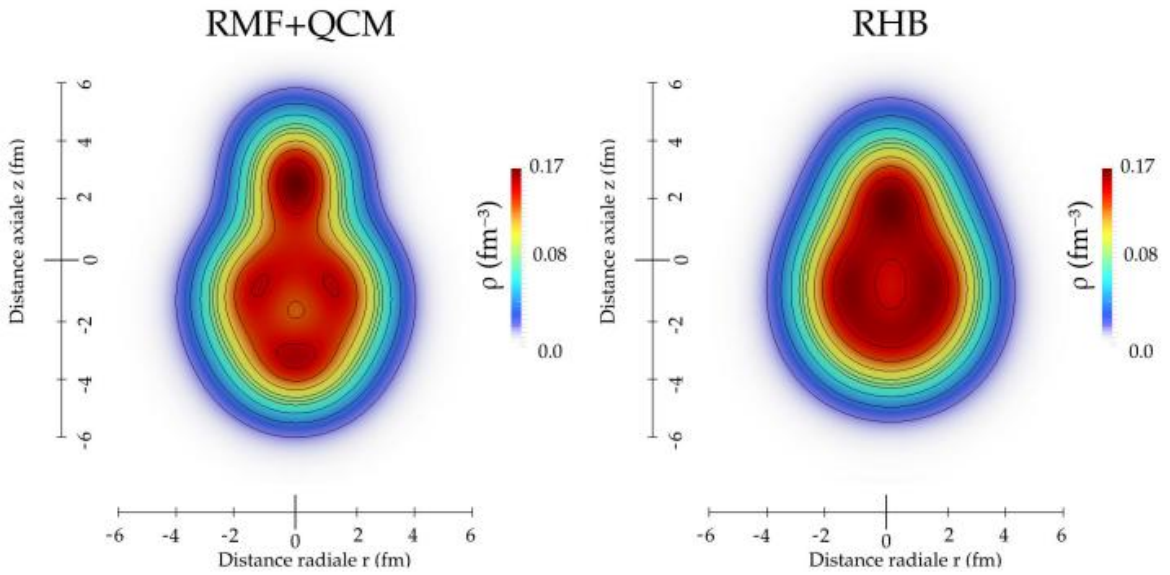
Cooper Pairs

Simulation of ^{20}Ne



Isovectorial Quartetting

Pairing

PHD PROJECT

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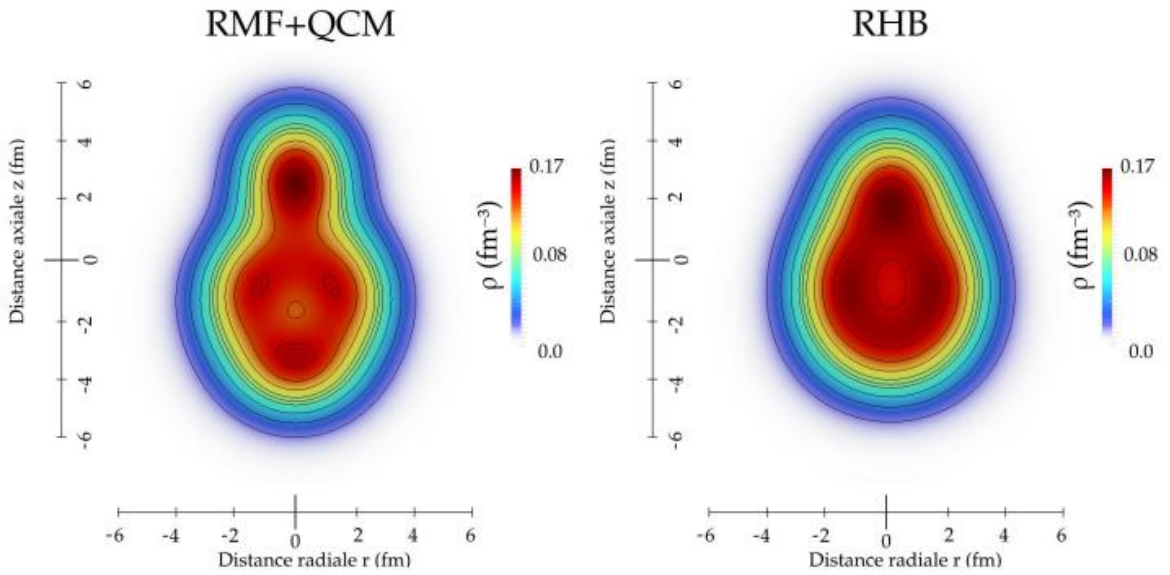

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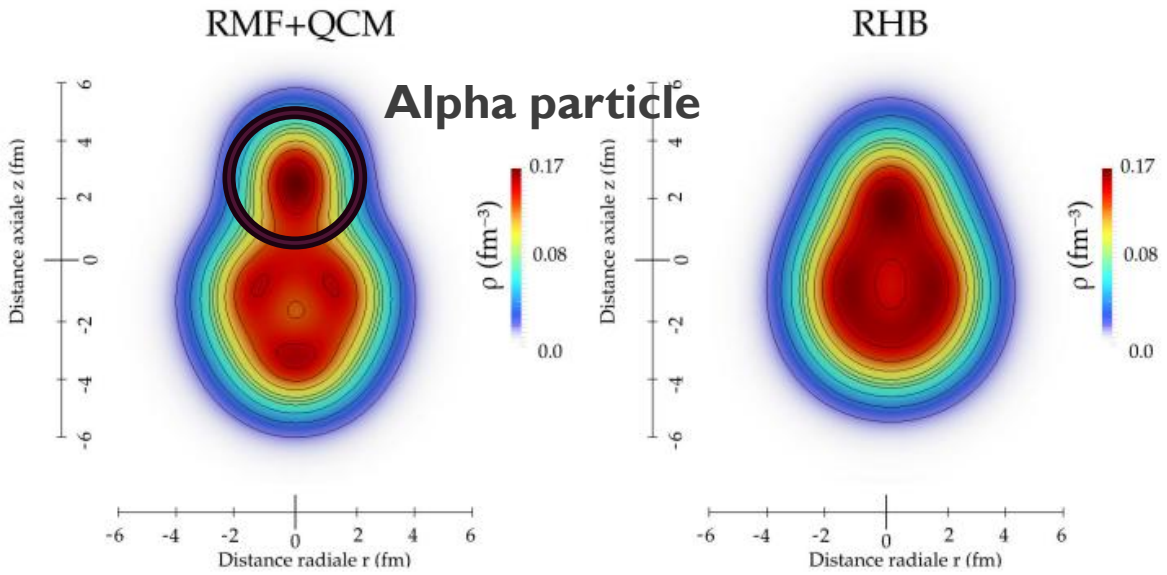

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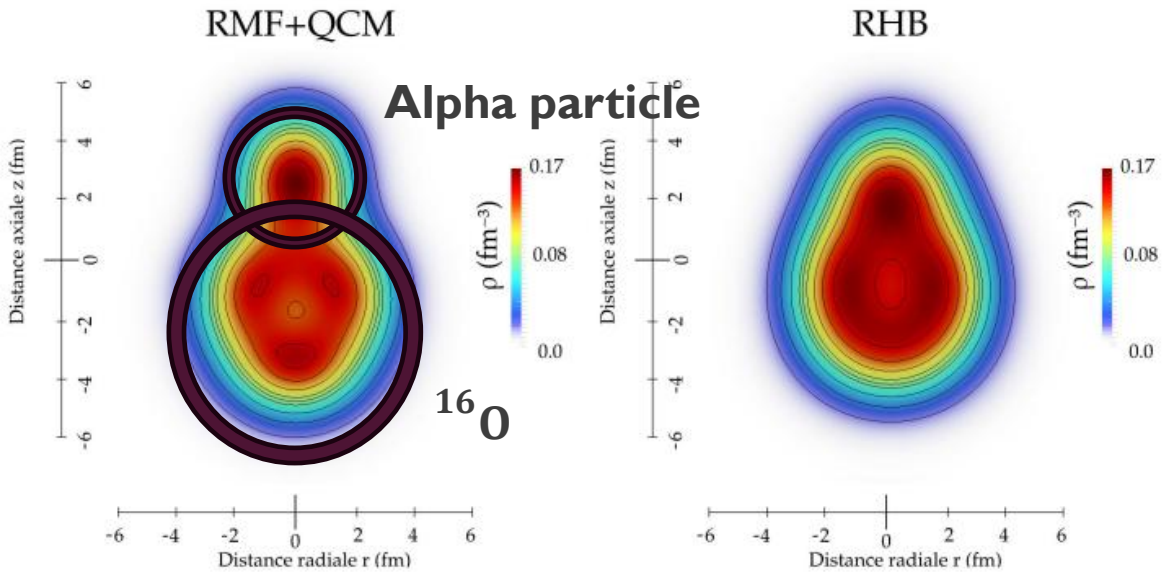

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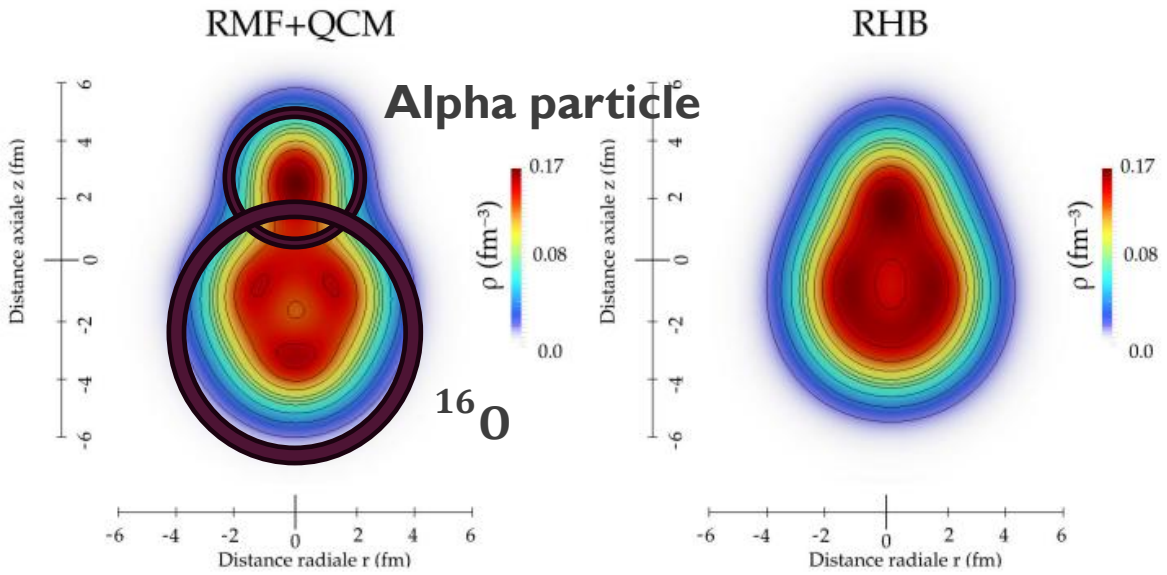

Isovectorial Quartetting

Pairing

Project: adding the isoscalar quartetting

THANKS FOR YOUR ATTENTION!

A huge thanks for Pierre ARTHUIS for introducing me and my work!