Contribution ID: **19** Type: **not specified**

NMR Quantum Information Processing with liquid chloroform and Europium doped organic-inorganic hybrids

Thursday 9 February 2023 17:35 (15 minutes)

In quantum information processing, it is ubiquitous to reliably be
able to prepare quantum states, manipulate them and measure the resulting state. Additionally, an
important device for both of these applications is the quantum memory. While for quantum computers, quantum memories are indispensable for storage, in long distance quantum communication, with a current maximum range of 100km, a possible solution for longer distance communication are quantum repeaters, which require quantum memories in their design..
Presently the best platforms for this are those related to cold atoms. In spite of the large number of
different platforms in study there is still
not enough data to conclusively decide on which are the best platforms for a given quantum application. Some Quantum memories with Rare Earth Ion Doped Crystals have already been developed
and are already heavily under study.
In this work, we set ourselves to investigate both liquids and solid materials for quantum information processing: liquid chloroform and a platform which has yet to be thoroughly studied, Europium-doped organic-inorganic hybrids (di-ureasil doped with Eu3+ Complex) in solid form. In particular, we will investigate the NMR Spectra of the solid sample, identify the most important interactions and construct its hamiltonian from them, then proceed with the preparation and manipulation of quantum states, and implementation of 1 or 2-qubit quantum gates in both the Liquid Chloroform and the Solid sample, as well as the evaluation of their relaxation
lifetimes, T1 and T2. We investigate these properties using NMR, as it is an easy and efficient way to evaluate these lifetimes. If an interesting medium is found, a possible next step would be to investigate light-matter interactions of the solid sample, by coupling the relevant transitions with large population and coherence lifetimes
to light, by using a laser at the appropriate transition frequency.

Author: MIRANDA, Hugo

Co-authors: Dr CRUZEIRO, Emmanuel (QuLab/ Instituto de Telecomunicações); Prof. FIGUEIRINHAS, João (CeFEMA)

Presenter: MIRANDA, Hugo