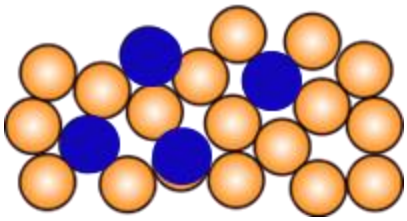
CEA Saclay –Service de Physique de l'Etat Condensé (SPEC) (page web)
Laboratoire *SPHYNX* (page web)

PROPOSITION DE STAGE/THESE 2020

TAKING UP THE CHALLENGE OF THE GLASS TRANSITION BY OPTICAL MANIPULATIONS OF MOLECULES.



Schematic view of optically active molecules (in blue) pinned by their interaction with a well chosen light, and immersed in a glass forming liquid insensitive to the light (orange).

According to the Nobel Prize awardee P.W. Anderson "The deepest and most interesting unsolved problem in solid state theory is probably the nature of glass and the glass transition". This sentence reflects the fact that we still do not know if glasses are a true thermodynamic phase of matter or, on the contrary, if they are just out of equilibrium liquids which have become too viscous to flow on human time scales. Finding the answer to this seemingly simple question is hampered by the fact that, when decreasing temperature, the relaxation time of glass forming liquids becomes so large that one cannot rely onto the experimental techniques used to evidence standard thermodynamic phase transitions (e.g. liquid/gas transition or liquid/crystal transition). By using a totally new approach we aim at unveiling the nature of the glass transition, which is of great importance both for fundamental physics and for applications, since glasses play an increasing role in modern technologies (e.g. in optical fibers for communications, in photovoltaic devices, or in airplanes fuselages).

More precisely, we have just built an experiment corresponding to the "ideal thought experiment" proposed recently by some theorists, so as to unveil the presence or the absence of a true thermodynamic glass transition. In this experiment a fraction of molecules, randomly chosen in space, is pinned and one monitors the response of the rest of the liquid: if this pinning of a small fraction of molecules changes the global dynamics of the liquid, this means unambiguously that an order was present before establishing the pinning field, even though the extremely complex nature of this order had made it impossible to evidence by standard experimental tools. The approach that we have built involves: i) designing the optically sensitive molecules; ii) building an optical setup allowing the realize pinning in the well-chosen liquid; iii) comparing the experimental results to the theoretical predictions. The internship and/or the thesis consists in working onto the improvment and the exploitation of this experiment.

This project is a collaboration gathering all the required expertise between physicists, chemists, and theoreticians working at CEA Saclay –near Paris- and in the University of Montpellier. The internship and/or the thesis will mainly take place in the NIMBE/LIONS and SPEC/SPHYNX laboratories in the CEA center of Saclay. We are looking for a candidate who, by relying onto the expertise available in the laboratories, really wants to invest herself/himself onto this project by providing us his/her skills in experimental physics (mainly optics, and dielectric spectroscopy).

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