Cesium in Argon matrix: toward an electron Electric Dipole Moment (EDM) measurement

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The existence of a permanent electric dipole moment (EDM) of the electron would awaken the existence of a new physics beyond the standard model of particle physics. The current best limit (~10^{-29} e.cm) is based on spectroscopic measurement of molecules in a beam. However, more than 50 years ago it was suggested to combine the long coherence times and high particle numbers of the solid-state experiments with the sensitivity of gas phase experiments by embedding atoms or molecules in solid matrices of inert gases: rare gases (He, Ne, Ar, Kr, Xe) or para-hydrogen. This is the path we have chosen to follow using Cs atoms, as well as the groups of E. Hessel and A. Vutha in Toronto[1] using BaF molecule We envision an improvement by several orders of magnitudes over the current best limit thus accessing a region able to close the gap between all proposed theoretical models of new particles and the standard model prediction (~10^{-38} e.cm).
Our project is based on spectroscopic measurements of the valence electron of the cesium atom trapped in a cryogenic argon matrix. We obtained an ANR funding with the consortium LAC/ISMO/LPL/CIMAP [2]. The experiment started in end 2021 with the delivery of the cryostat made by http://www.mycryofirm.com/. We will present our first (absorption, fluorescence) measurement performed in order to understand the trapping sites of Cs atoms in Ar. This will help us to estimate the effects of the crystal field on the optical manipulations we will have to perform to reveal the EDM. We will finally discuss the required steps needed to be able to perform a first measurement and detail possible systematic effects.

[1] yorku.ca/edmcubed
[2] https://anr.fr/Project-ANR-21-CE30-0028