

Letter of Motivation

Dear Members of the GERLI Scientific Council,

I am writing to apply for the **2026 GERLI Thesis Prize** for my PhD thesis entitled “Neuroprotective lipid nanoparticles for regeneration from post-COVID-19 neuronal damage”, defended on 11 December 2025 at Université Paris-Saclay under the supervision of Dr. Angelina Angelova.

This work significantly advances knowledge in the field of lipids by elucidating the self-assembly, nanostructural organization, and structure bioactivity relationships of lyotropic liquid crystalline lipid nanoparticles (cubosomes, hexosomes, and vesicles). Using monoolein, DMPC, ω -3 polyunsaturated fatty acids (PUFAs such as EPA and DHA), plasmalogens, and the ionizable lipid DLin-MC3-DMA, I designed multifunctional nanocarriers that co-encapsulate Ginkgo biloba extracts (ginkgolides B/C, quercetin, kaempferol). Synchrotron small-angle X-ray scattering (SAXS), including time-resolved experiments, revealed pH-triggered lattice contractions and phase transitions (e.g., hexagonal phase shrinkage and intermediate states) that enable controlled release and endosomal escape under conditions relevant to neuronal environments. These findings establish how lipid composition, interfacial curvature, and ionization modulate internal topology (lamellar vs. non-lamellar), stability, and payload delivery.

Furthermore, the incorporation of bioactive lipids (PUFAs and plasmalogens) transforms the nanocarriers themselves into therapeutic agents that support membrane integrity and mitochondrial function. *In vitro* and *in vivo* evaluations of the therapeutic efficacy of lipid nanoparticles in both SH-SY5Y cells and the MitoPark mice model demonstrated the restoration of glutathione peroxidase activity, modulation of mitochondrial proteins (ATP5A1), and transcriptomic reprogramming of oxidative phosphorylation pathways. This thesis therefore provides new mechanistic insights into lipid nanoassemblies as versatile platforms for brain-targeted delivery, bridging fundamental lipid self-assembly with advanced nanomedicine applications. I believe these contributions deepen our understanding of lipid mesophases and their functional roles in therapeutic contexts.

My doctoral fellowship was jointly funded by the Ghana Scholarship Secretariat and the French Embassy through Campus France, reflecting the growing scientific collaboration between the two countries. I am aware that, within this partnership, I represent something beyond my own research. The GERLI Thesis Prize would extend this representation further, not as a personal accolade, but as a signal to young women, particularly across sub-Saharan Africa who are watching to see whether science is a world that has space for them.

Thank you for considering my application.

Yours sincerely,



Thelma Akanchise, PhD