**PROJECT NARRATIVE**

We propose a combinatorial mouse system for identifying multiple memories with single-cell resolution across the whole brain to better understand how memories are formed and interact with one another. To that end, we will capitalize on genetically engineered mouse models and all-virus based strategies, behavioral assays, whole-brain imaging, RNA sequencing, *in vivo* Ca2+ imaging, and viral tracing strategies to indelibly label and manipulate multiple memory traces. This combinatory system will result in a whole-brain atlas for individual memories, including positive and negative memories, with single-cell resolution.