Towards achieving highly calibrated light-response artificial cells using plant-based photoreceptor systems

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Abstract: Artificial cell research is rapidly evolving to develop biochemical systems that mimic essential biological processes, including responsiveness to external stimuli. However, achieving life-like responses to light remains a significant challenge due to the complexity of natural light-sensing mechanisms. In this project, we address this limitation by integrating plant photoreceptor systems into artificial cells. Plants possess highly evolved light-responsive capabilities, yet their integration into bioengineered systems has been largely unexplored. Leveraging high-throughput protein engineering and AI-assisted structural refinement, we aim to modify plant's modular photoreceptors for seamless incorporation into programmable artificial cells. This approach enables the development of pseudo-living entities capable of remote communication and temporary interventions in extreme environments—such as space, deserts, and the Arctic—using tailored light stimuli. Our research expands nature's fundamental environmental cue, light, into novel engineered functionalities, unlocking disruptive applications across various domains and paving the way for transformative advancements in artificial cell technology.