Chirality, the absence of mirror symmetry, is a fundamental design principle in nature, governing biological function through stereoselective interactions. Mimicking this complexity in synthetic materials, particularly to generate circularly polarized light (CPL), is a major frontier in materials science. CPL is crucial for emerging technologies in 3D displays, optical data encryption, and quantum information processing. However, developing materials that efficiently produce tunable CPL, especially in the near-infrared (NIR) regime, remains a significant challenge due to inherent efficiency losses and complex fabrication requirements.

GOAL: The goal of this project is to establish a novel materials platform—dubbed **CPL@FORM**—for efficient and dynamically reconfigurable CPL emission. We will achieve this by designing solution-processable organic thin films that exploit Förster resonance energy transfer (FRET) from a chiral, tunable ESIPT (excited-state intramolecular proton transfer) donor to a tailored acceptor. This approach decouples the functions of light absorption, energy transfer, and chiral emission, aiming to overcome traditional efficiency limits and create a versatile system where the CPL output can be tuned post-fabrication.

RESEARCH PLAN: Our research plan integrates molecular design, tailoring of optical properties, advanced materials processing, and device engineering. First, we will synthesize a library of chiral ESIPT donors and achiral NIR acceptors. Second, we will formulate these into inks and utilize inkjet printing to fabricate thin-film heterostructures, optimizing morphology for efficient FRET. Third, we will characterize these films with advanced photophysical and chiroptical techniques (time-resolved PL, CPL spectroscopy) to quantify energy transfer and dissymmetry factors. Finally, we will integrate the optimized films into proof-of-concept organic light-emitting diode (OLED) devices to demonstrate circularly polarized electroluminescence (CPEL).

SIGNIFICANCE: This project will provide fundamental insights into chiral energy transfer processes and establish a new paradigm for generating CPL. The successful development of the **CPL@FORM** platform will directly address the critical manufacturing bottleneck of solution-processable multilayer devices. The impact extends to multiple fields, enabling new designs for energy-efficient displays, secure communication systems, and advanced biomedical sensors. Furthermore, the reconfigurable nature of the material opens possibilities for adaptive optoelectronics, creating a foundation for the next generation of smart photonic devices.