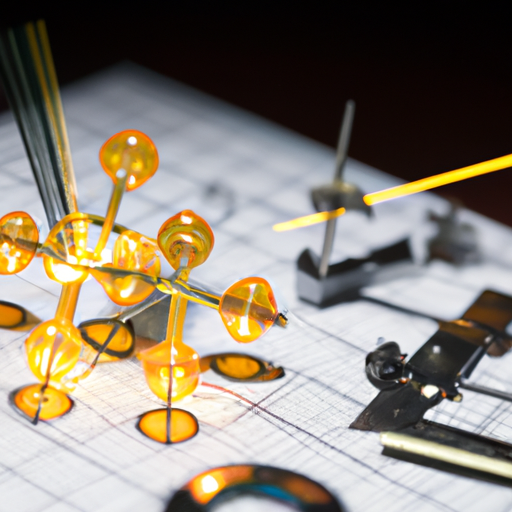
| Berkley: | LIWEN KO | theoretical and numerical studies of light absorption and energy transfer dynamics in natural photosynthesis

| Cambridge: | Oliver Powell | quantum photonic devices. From hexagonal boron nitride

Research Proposal:

# Exploring Non-Classical Effects in Quantum Photonic Devices for Energy-Efficient Quantum Technologies



## Introduction:

Quantum photonic devices have the potential to revolutionize quantum technologies. However, current material platforms for solid-state single photon generation, such as diamond nitrogen-vacancy centers, require cryogenic cooling for coherent emission, leading to high energy consumption. This research proposal aims to combine the research of Oliver Powell and Liwen Ko to establish limits of performance for potential applications of defects in hexagonal boron nitride in quantum photonic devices. By understanding the energy transfer dynamics and exploiting non-classical properties of light, this study seeks to develop more energy-efficient hardware for the upcoming quantum technological revolution.

## Objective:

The objective of this research is to investigate the optical coherence properties of defects in hexagonal boron nitride and their potential for energy-efficient quantum photonic devices. By studying the theoretical and numerical aspects of light absorption and energy transfer dynamics in natural photosynthesis, and coupling them with experimental quantum light spectroscopy, we aim to gain insights into the design principles that can be applied to artificial photosynthetic systems.

## Methods:

Oliver Powell's research on the optical coherence properties of defects in hexagonal boron nitride will serve as the foundation for this study. By utilizing the tools of quantum optics and open quantum systems, we will model the energy transfer mechanism in photosynthetic systems under both natural and laboratory conditions. Liwen Ko's expertise in theoretical and numerical studies of light absorption and energy transfer dynamics in natural photosynthesis will be instrumental in this investigation.

Furthermore, by leveraging non-classical properties of light and exploring techniques such as quantum emitters and confocal microscopy, we will seek to gain information about the energy transfer dynamics in hexagonal boron nitride. This will allow us to assess the potential of this material platform for quantum photonic devices and its ability to provide energy-efficient alternatives to current cryogenic-cooled systems.

## Expected Outcomes and Impact:

This interdisciplinary research will contribute to the development of energy-efficient quantum photonic devices for use in quantum technologies. By establishing the limits of performance for defects in hexagonal boron nitride and understanding the energy transfer dynamics in artificial photosynthetic systems, we can provide valuable insights and design principles for the engineering of quantum hardware that does not rely on cryogenic cooling. This could lead to significant energy savings in the scaling-up of quantum technologies for industrial applications.

Moreover, this research will have implications beyond energy efficiency. It will contribute to the overall understanding of quantum emitters, quantum communication, and nonlinear spectroscopy, opening up new possibilities for advancements in the field of quantum optics and its applications in various technological domains.

## Conclusion:

By combining Oliver Powell's exploration of the optical coherence properties of defects in hexagonal boron nitride with Liwen Ko's theoretical and numerical studies of light absorption and energy transfer dynamics in natural photosynthesis, this research proposal aims to establish the limits of performance for defects in hexagonal boron nitride and exploit non-classical properties of light for energy-efficient quantum photonic devices. Through this interdisciplinary approach, we aim to contribute to the upcoming quantum technological revolution, offering new possibilities for more sustainable and scalable quantum technologies.