Enhancing Efficiency in Quantum Dot Solar Cells Through Quantum Computational Simulations for Sustainable Energy and Environmental Health

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The foundation of my research lies in my commitment to finding innovative, impactful solutions to real-world problems with Quantum science. I conducted independent research to identify and demonstrate the potential of quantum dot-based solar cells in overcoming the limitations of traditional silicon-based solar cells. With unique properties like tunable bandgap and high absorption coefficients, quantum dots can revolutionize sustainable energy. I optimized their efficiency using quantum algorithms, particularly the Variational Quantum Eigensolver. Throughout the project, I designed experiments, analyzed results, and presented findings to peers, teachers, and mentors to ensure alignment with my research goals. This project advances QDSCs, which offer higher efficiency while remaining environmentally sustainable. Traditional solar cells face the Shockley-Queisser limit of 33%, whereas QDs can theoretically achieve up to 66%. Using quantum computational simulations, I identified optimal configurations for QD materials, including cadmium selenide, lead sulfide, indium phosphide, copper indium selenide, and perovskite quantum dots. This eliminates costly and potentially hazardous experimentation while reducing resource wastage, making it particularly suitable for societies transitioning to renewable energy. This project allows us to explore cleaner energy sources, significantly reducing reliance on fossil fuels. Long-term benefits include substantial CO2 emission reductions, crucial for combating climate change and improving public health. I used quantum computing simulations to provide a scalable, cost-effective pathway to more efficient solar energy. Through community engagement and cutting-edge research, I strive to contribute to a sustainable future.

Awards Won: