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STUDY OF A PROPOSED NEW SOLAR TO ELECTRICITY CONVERTER BASED ON ELECTRON-PHOTON INTERACTION, A THEORETICAL STUDY

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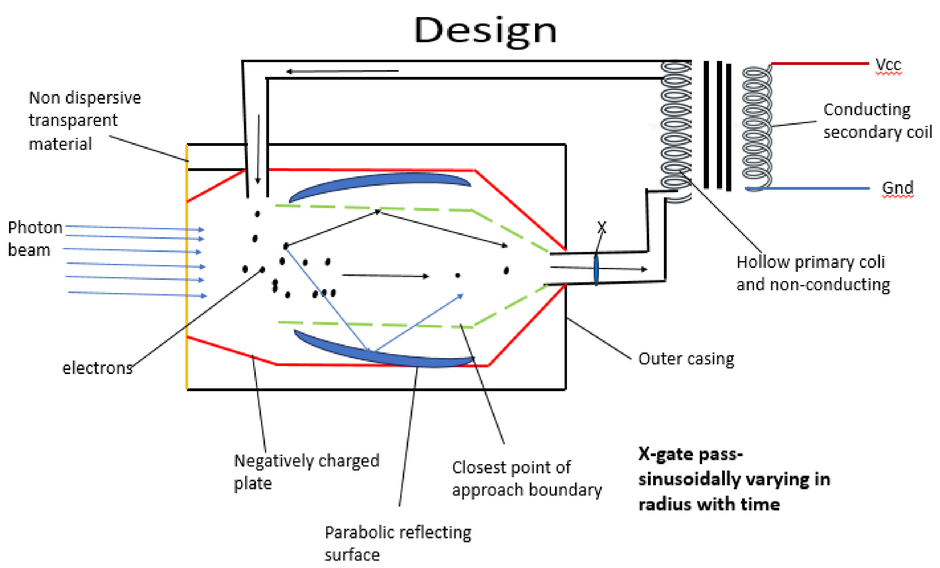
MOTIVATION

Current solar cells even those used in space have low efficiencies due to electron-hole recombination phenomenon and S-Q limit[1-2], besides being heavy and bulky. Hence there's need to introduce new and efficient solar energy conversion systems. This theoretical study presents a potential efficient system that can be applied in space-crafts.

EXPRIMENTAL METHODS



- Based on Compton's scattering, wave-particle duality and Euclidean geometry, derive the equation of Q(t) and I(t) considering electron flux through X [3-4].
- Simulate the behavior of the two equations in Matlab.
- Study the efficiency of energy conversion.

RESULTS

Derived equations describing Q(t) and I(t) for the proposed system for a circular cross-section X

$$Q(t) = \sqrt{\frac{hfe^2}{m_e aR}}\left(\sum_{i=2}^{N}\beta_i k_i^{1/2}\right)\sqrt{n^2 sin\left(\frac{\pi t}{T}\right)}\left(1 + d_c + \sum_{i=1}^{m-1} d_i\right)$$

$$d_i = 2\sin\left(\cos^{-1}\left(\frac{2m_j\sqrt{3}}{n\sin\left(\frac{\pi t}{T}\right)}\right)\right)$$

$$m_j = 1,2,3,\ldots,\frac{R}{r\sqrt{3}}\ ;\ k_i = \left(1 - \frac{1}{1 + \frac{hf}{mc^2}(1-\cos(\theta))}\right)$$

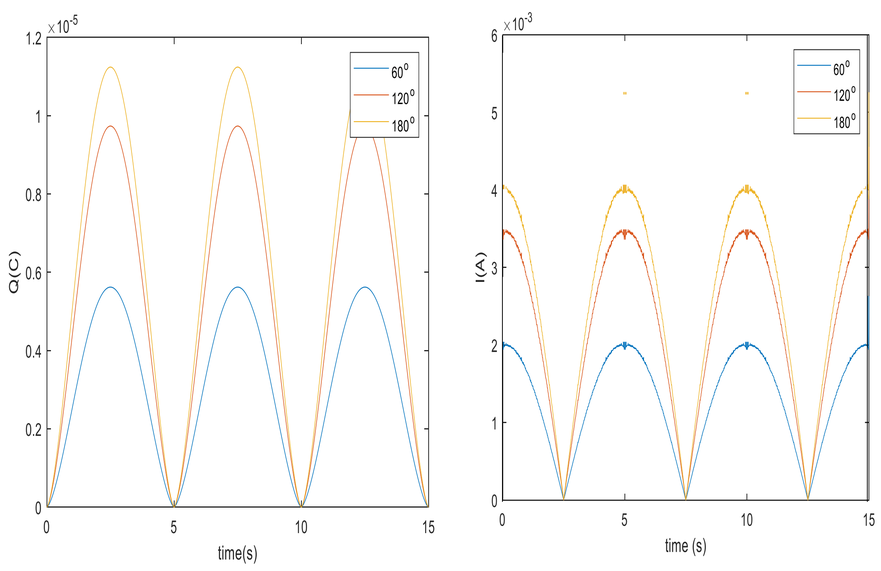
$$n = \frac{R}{r}; where\ R - radius\ of\ X$$

$$r - particle's radius$$

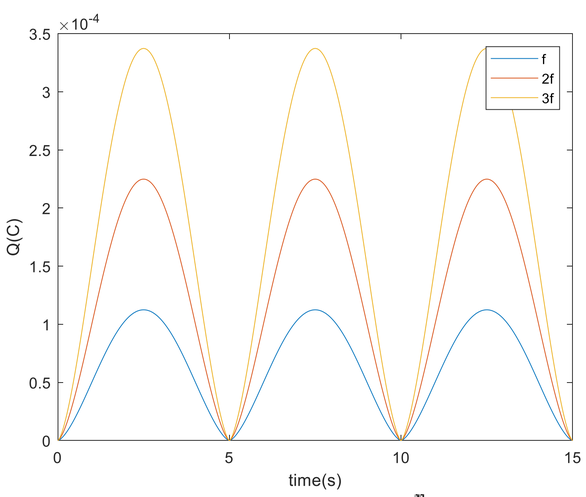
$$I(t) = \frac{d}{dt}\left[\sqrt{\frac{hfe^2}{m_e aR}}\left(\sum_{i=1}^{n}\beta_i k_i^{1/2}\right)\sqrt{\sin\left(\frac{\pi t}{T}\right)}\left(d_0 + d_c + \sum_{i=1}^{m-1} d_i\right)\right]$$

RESULTS

The effect of varying scattering angle on charge and current across X



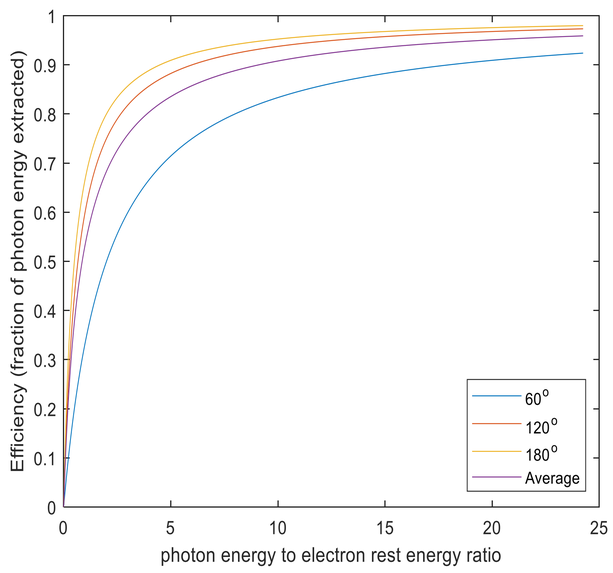
The effect of varying frequency on charge flux across X



$$Average\ Efficiency = \sum_{i=1}^{n}\beta_i k_i$$

$\beta_i - is\ the\ fraction\ of\ electrons\ scattered\ at\ a\ given\ angle$

Effect of varying frequency and scattering angle on efficiency



BIBLIOGRAPHY

1. https://doi.org/10.1016/C2016-0-01527-9
2. https://doi.org/10.3390%2Fma15165542
3. https://doi.org/10.1126%2Fsciadv.ade0932
4. https://doi.org/10.1016/j.solener.2023.112185

CONCLUSION

- **The system would generate direct but varying current and voltage**
- **The efficiency of conversion of such a system is dependent on the photon's scattering angles. The larger the scattering angle the higher the efficiency.**
- **Efficiency is also directly dependent on the incident photon energy to electron's rest energy.**
- **This system is mostly suitable for space-craft applications since in space, there're high frequency radiations which can be effectively converted into electrical energy at high efficiencies. The system has high energy density and has light in weight due to its simple structure.**

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