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Design and construction of *ultra-relativistic collision* PV panel and its application into building sector to mitigate total energy demand

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ABSTRACT

To meet total energy demand for a building, a sustainable technology has been developed to double up the photon production from a single one by ultra-relativistic collision into the solar panel, which is actually a part of building's exterior skin curtain wall. Subsequently, mathematical analysis has been performed considering the reaction between two bare ions which is activated by quark-lepton complementarily particle's interaction into the solar panel. To confirm this pair photon production, a further mathematical modeling has been implemented by assuming the creation of pair electron into a bound ionic state (e^+e^-) which is employed by two approaches (i) the equivalent photon approximation, and (ii) the first order perturbation and multipole expansion of wave functions. With the analysis of these approaches, a detailed calculations have been conducted considering two bound free e^+e^- pairs as well as of bound free e^+e^- and free $\mu^+\mu^-$ pairs created by collisions of bare ions which suggest that the double photon production processes from a single photon is feasible into the *ultra-relativistic collision solar panel* that interestingly allow to double up the energy production simultaneously into the solar panel. The energy production efficiently, is thereafter, been estimated which revealed that if only a mere of 12.5% of building exterior curtain wall is used as *ultra-relativistic collision capable solar panel* it will meet the total energy demand for a building which is also 100% environmentally friendly.

1. Introduction

The approach in this research is to design the innovative PV panel by using building's exterior curtain wall that can double up the photon production and convert into electricity. To meet the total energy demand of a building, Standard Model of Particle Physics has been used as an experimental tools where the electron is an elementary particle of the Lepton family, and photon is the mediator of the Electromagnetic force. Since electrons carry a unit negative charge, and thus two electrons can interact with each other via the electromagnetic force (this involves exchange of the force mediator particle, namely the photon). Therefore to create electron-positron pairs into the proposed PV panel by inducing relativistic ion–ion as well as ion–atom collisions, a strong electromagnetic field surrounding the PV panel has been introduced to confirm to produce pair photons eventually [2,3]. For this process it has been assumed that certainly electrons and positrons are to be produced from a single collision by the impact of high frequency electromagnetic coupling force into the PV panel [4,5]. In fact, production of free e^+e^- pairs, has been tried in the past considering the single detection of coincidence observation of emitted electrons, unfortunately, the results was not presumptively successful [1,4]. To overcome this problem, it has been therefore investigated by multiple detection of emitted electrons e^+e^- which is created from the bound ionic states into the PV panel [20,21,41]. Although bound free pair e^+e^- production is optimistic considering free-free electron pairs, but the experimental observation is much more feasible by detection of loaded down ions. In order to confirm the photon pair production in ultra–relativistic heavy ion collisions into the proposed PV panel I have employed here the impact parameter approach such as straight line ion moving trajectory into the proposed PV panel. Therefore, the experiment was conducted in ultra–relativistic collisions between bare nuclei in to PV panel to allow to count of pair photon production that also suggested a new field of particle physics. Once the pair photon production is confirmed, an estimate of the energy production rate by the solar panel has been performed. Also a comparison between fossil fuel energy and this PV panel energy consumption by the building sector has been analyzed. Just because buildings have a significant impact on climate change since it use almost 40% of energy consumption from burning fossil fuel [29]. In this concept, a building with zero emission building (ZEB) shall greatly be an innovative one to balance of its energy demand if the building skin are designed with a mere of 12.5% high performance PV

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(photovoltaic) panel that will reduce the 8.01×10^{11} t CO_2 in a year [29,30]. It well established that currently 402 ppm CO_2 presents in atmosphere causing global warming, naturally building sector's conventional energy demand caused nearly 40% climate change. To confirm global cooling at comfortable level it need to be cut down at 300 ppm CO_2 presence at the atmosphere [19,30]. Once this high performance PV panel is designed to implement at each building, it will reduce 40% CO_2 per year which mean it will take only $\{\int_{300}^{402} (1-0.4)dx\}$=61.2 years to cool the atmosphere, resulting no more climate change after 62 years. Simply it can be said that by applying this photo physical collision reaction technology to converting single photon into two photons to transform it energy by using exterior skin as the ultra-relativistic collision solar panel would a new era of building and energy science technology to meet the complete energy demand of building sectors and to mitigate the global warming dramatically.

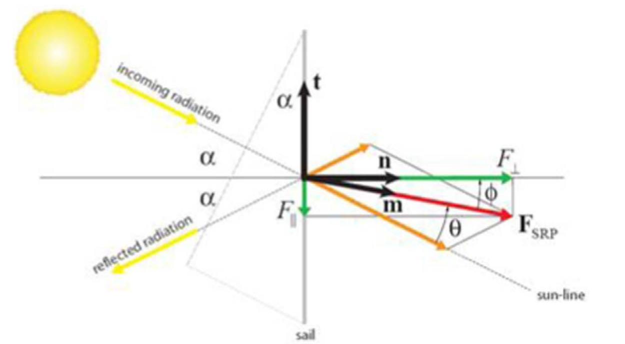

Fig. 1. Solar Flux Orientation where nearly 80% is absorbed and induced by PV panel and only 20% in reflected by the surface of the PV panel.

2. Methods and materials

2.1. PV panel modeling

Photovoltaic modules functionally is a semiconductor diode which junction is exposed to the sun light allow to absorb solar radiation [11,12,35,36]. Therefore, pair photon production from a single one in to the ultra-relativistic collision capable solar panel has been analyzed by detail mathematical calculation considering the maximum power output once the photovoltaic solar irradiance is on the photovoltaic module [22,23].

Naturally most photon particle (some of them reflect) induced into the PV cell, collide with bare ions into the solar panel, therefore, in order to convert a single photon into pair photon precisely, photo approximately and first order perturbation theory has explained [37–39]. Once the pair photon is produced sufficiently enough to isolate the electrons into the semiconductor, it has been then allowed to generate charges and deliver the electric current by expressing the following term [12,13]:

$$I=I_{ph}-I_0\left[\exp\left(\frac{V+R_sI}{V_T}\right)-1\right]-\frac{V+R_sI}{R_p} \tag{1}$$

where I is the current and V is the voltage into the of the PV panel. $I_{ph}(=N_pI_{ph,\ cell})$ is the photo-generated current in the PV module consisting N_p cells connected in parallel. I0 $(=N_{pIO,\ cell})$ is expressed as reverse current into N_p cells connected in parallel, where each cell has the reverse saturation current $I_{O,\ cell}$. Consequently, $V_T(=aN_s{\cdot}kT/q)$ is acted as matrix of the thermal stress of NS cells which is connected in series where (~1.5=1.0) considering the diode ideality factor, k(=1.38e-23 J/K) is constant, q (=1.602e-19C) Boltzmann is the electron charge and T is kelvin temperature. Rs is expressed as series resistance for PV generator where Rp is considered as a parallel resistance. The PV device is operating in practice a hybrid behavior of the current source or voltage considering on the operating point. Realistically in PV panel, series resistance Rs plays major role on the performance of photovoltaic modules when the device operates in the region of the voltage source, and thus the influence of Rp parallel resistance will be stronger in the source region current operation [13,20]. It was studied by some researcher that the value of Rp is so high to neglect this resistance to simplify the model [14,15], subsequently, value of Rs is very low which also can be ignored [9,10]. The temperature of the PV generator can be influenced by solar radiation and ambient wind speed which can be expressed as follow [18].

$$T=3.12+0.25\frac{S}{S_n}+0.899\,T_a-1.3\,v_a+273 \tag{2}$$

where S and S_n (=1000 W/m^2) solar radiation are in working condition and the nominal test, respectively, and T_a is the ambient temperature and v_a is the local wind speed. The I-V characteristics of photovoltaic panel depend on the internal features of the device (Rs, Rp); subsequently solar irradiance and ambient temperature influence the outer features. The incident light which is generating the photo current is correlated linearly on the solar irradiation and temperature is expressed as follow [12,13]:

$$I_{ph}=(I_{ph,n}+\alpha_I\,\Delta T)\frac{S}{S_n} \tag{3}$$

where I_{ph} is the light generated current at STC and ΔT=T-Tn, T is noted as the PV panel temperature considering solar irradiation, and Tn is expressed as a nominal temperature. In order to avoid the difficulties of the photo-current to determine the parallel resistance (very high) and the series resistance (very low), we have assumed that Isc≈Iph is to clarified a sophisticated PV modeling to confirm open circuit voltage to be influenced by temperature [14] and be expressed as: (Fig. 1)

$$V_{oc}=V_{oc,n}(1+\alpha_v\Delta T)+V_T\ln\left(\frac{S}{S_n}\right) \tag{4}$$

where $V_{oc,n}$ is expressed as the open circuit voltage which is measured at the nominal condition and α_v is expressed as the voltage-temperature coefficient. The ultra-RRRRR PV datasheets provides the electrical and thermal characteristics of PV panels and we therefore, incorporate these feature for better performance of the PV panel considering I-V curve of PV array such as Eq. (1). The features of our proposed PV panel we confirmed that it should have: the nominal open- circuit voltage(Voc,n), the nominal short-circuit current(Isc,n), the Maximum Power Point (MPP) voltage(Vmp), the MPP current(Impp), the short-circuit current/temperature coefficient(αI), the open-circuit voltage/temperature coefficient(αV), and the experimental peak power(Pmax), in order to measure at the nominal condition or standard test conditions(STC) of temperature T=298 K and solar irradiation of S=1000 W/m2. At the STC, the basic equation can be rewritten as

$$I=I_{ph,n}-I_{0,n}\left[\exp\left(\frac{V+R_sI}{V_{T,n}}\right)-1\right]-\frac{V+R_sI}{R_p} \tag{5}$$

where the value n are measured at the standard test condition and assumed to confirm that the series resistance and the parallel resistance are independent and thus, we therefore simplify the modeling as following Eq. (5).

$$I=I_{ph,n}-I_{0,n}\left[\exp\left(\frac{V+R_sI}{V_{T,n}}\right)-1\right] \tag{6}$$

The I-V curve of solar cells has three important points: short circuit(0, I_{sc}), open circuit(Voc,0) and maximum power point(V_{mp}, I_{mpp}) which can be expressed as: