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Concentrated solar power using a perfect black body

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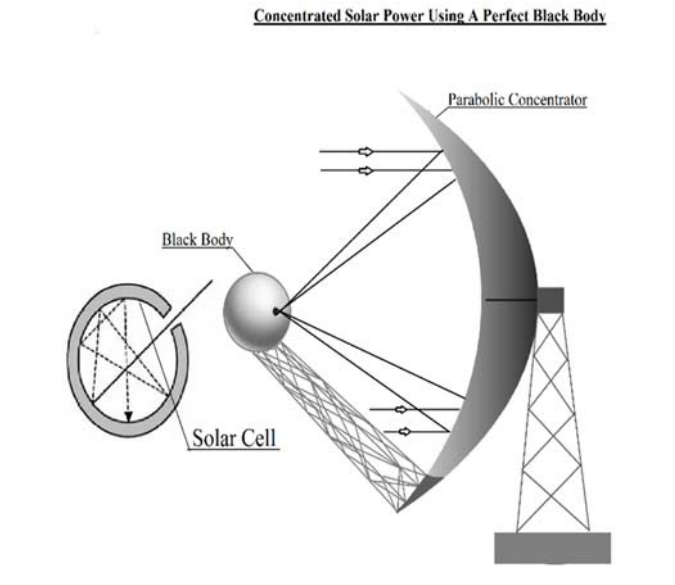
Abstract
Proposed design aims to make an efficient solar power system without use of expensive coatings. Now a days solar cells are relatively expensive and does not promise high power output density. The extra cost arises from the coatings used to trap photons falling on solar cells. The main problem with solar cells is that the photons of lower wavelength or higher energies get reflected by solar panels, these photons contains most of the available useful energy of solar spectrum. Every wavelength penetrates to certain depth of solar penal and there is always a fraction of probability of photon to get absorbed. Main aim of research in to design a solar power system that efficiently trap the photons of all wavelength and also to increase the probability of interaction of photon to nearly unity. We all know about a perfect blackbody. We need to do is to create a black body and merge it with a solar cell so that all the radiation falling on it is absorbed and never emitted back. Design consist of creating a hollow cavity black body with inner surface coated with solar cells to act as a radiation absorbing layer.

Keywords: Solar Power, High Efficient Solar Energy, Black Body, Concentrated Solar Energy, Solar Photovoltaics.

1. Introduction
The concept of trapping all the photons falling on the hole in the hollow spherical cavity representing a black body. Focusing high numbers of photons into the hole using a parabolic concentrators, this would not be expensive as input radiation is supported by concentrated solar energy concept. There is not a need of any expensive ARC coating on solar cells inside the black body, as all photons are already trapped inside the spherical cavity and will go multiple or virtually infinite reflections followed by multiple absorptions. By trapping all photons in cavity black body, we are actually increasing the probability of interaction of photon with band gap of solar cell to unity. By using a larger area of concave mirror the numbers of photons can be increased to desirable limits. Efficiency of solar cells inside the black body should not be increased as to make system economical. Use of conventional solar cells with 15 to 18% efficiency can be adopted for creating photon absorption surface. Efficiency of solar cell cannot be increased above 44% due to physics limits. Cost increases exponentially above 20% efficiency solar cells. There is no need to make solar cell more efficient, instead use of solar cells of 15% efficiency which is economical is desired. Just increase the number of photons falling on solar cells and increasing the probability of interacting with the band gap will yield to highly economical and efficient solar power system. Cooling the black body using circulating coolant is adopted to prevent solar cells from temperature failure.

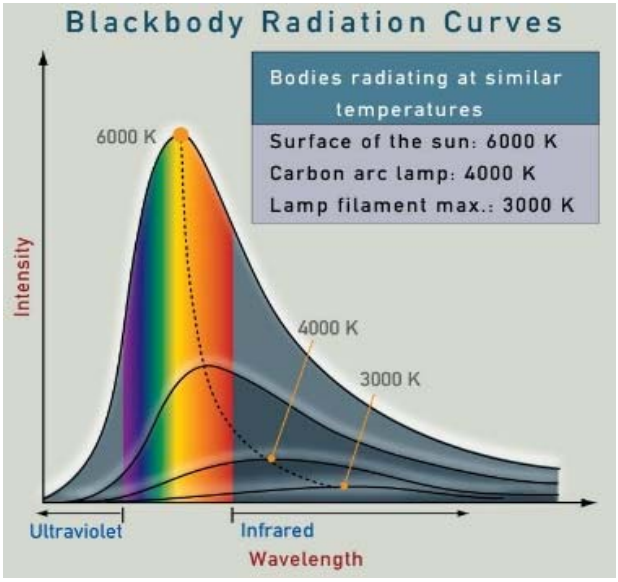
2 Amplification in Efficiency
Photons going multiple reflection (unlike the traditional solar cells which only utilizes single interaction with photons) will surely amplify overall output by individual solar cell. Used solar cell are only 15% efficient but efficiency is indirectly increased due to multiple absorption of lost photons. If a 44% efficient solar cell absorbs photons with probability of .44 and used 15% efficient solar cell absorbs with a probability of .15, but by practical point of view, the 44% efficient solar cell is absorbing photons with high efficiency but only in one absorption cycle. It is unable to use the radiation that is reflected or lost after one reflection. But adopted 15% efficient solar cell is able to use the reflected radiation to nearly infinite times unlike single time interaction, all the radiation should be absorbed in any one of interaction of photons. We are not comparing single time efficiency, instead we are comparing overall efficiency of the system which practically will be more than expected for 15% solar cell. Coming to high wavelength radiation or low energy photons which basically

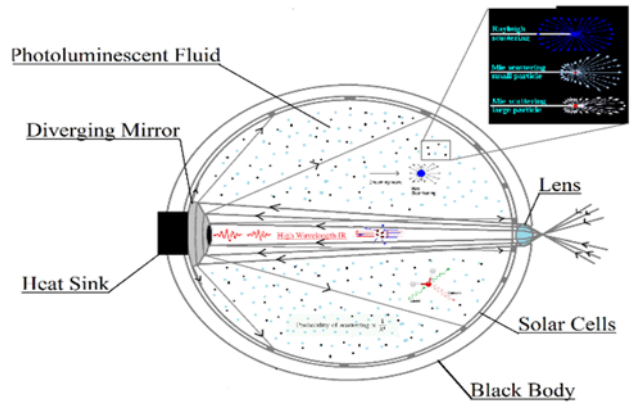
are easy to absorbs but they penetrate the solar panel to very deeper depth, they simply do not interact if possess a wavelength below a threshold value. Problem with these photons is that they don't interact with the band gap, the lower energy photons will simply penetrate the silicon crystal as like it penetrate a glass and get passed unaffected. We need to coat this sphere with metal paint or a highly reflective coating, so that it can reflect these radiation again to get absorbed. Drawback in this process is that a lot of thermal energy is produced in the form of heat loss or infrared radiation, we need to use coolant fluid that circulates and discard this thermal loss to protect the system from temperature failure.



3 Design of Black Body

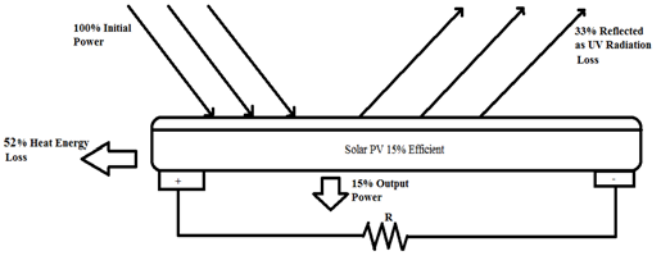
Supported by a hollow spherical body, the black body consist of three major components. First the casing that should be thermally insulating and coated with highly reflective paint to prevent photons of higher wavelength to escape from the body wall. Second but the core component of the black body is the solar cells that are provided at inner surface of the shell to make a radiation absorbing layer supporting the multiple absorption concept. Third part of the system is the coolant that is circulating type to cool the system and discard thermal losses from the system. This will prevent system from temperature failure.





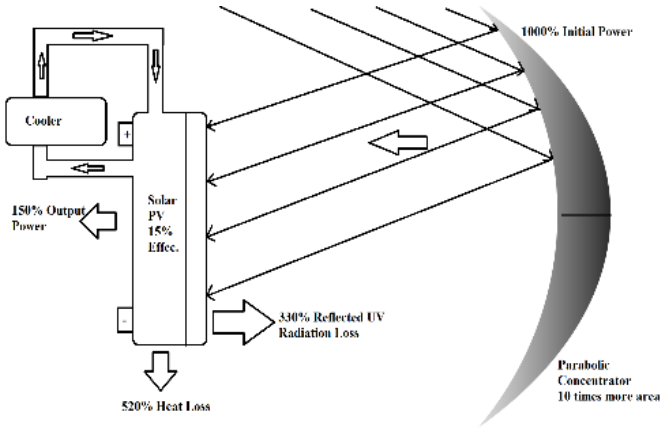
4 Output Power & Corresponding Losses

Losses corresponding to conventional single time reflection and absorption from a solar cell. The model for solar cell is considered to be 15% efficient. The losses considered are UV losses and IR losses.



Conventional Single time absorption solar cell

Amplified losses when combined to first stage amplification by providing high number of photons using a parabolic concentrator.



Hypothetical Representation of 10 times amplifying the incoming irradiation on a solar cell
Normal solar cell would melt under this condition

5 Modelling Based on Demand

Solar power produced using concentrated reflectors meets power demand in many countries, it only requires one time installation cost besides maintenance. But each reflector comes with a smart circuit that help it follow the sun to focus the light on one spot where the opening for the black body is present. The amount of input radiation is directly proportional to the area of the concentrator used. The power demand need to be supported partially or fully by this system by providing alternative options for providing power storage and on demand use of power generated in the day time. The amplification offered by the multiple absorption of lost radiation need to be considered in determining the

overall efficiency of the system. The economical aspect of providing concentrators reduces the area of solar cell needed for power generation. Design of black body is directly related to the size of the concentrator mirror and the amount of incoming radiation. The system is maintained with a constant area of solar cell to the area of concentrator ratio. This ration is considered for a suitable optimum irradiation on the solar cells for them to work under breaking potential of failure. The surface area of black body need to be sufficient to provide the coolant to effectively transfer heat to the cooling system, under working temperature limits.

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