Exercise 5.1.2 Energy, Field Strength and Photons

Illustration

You have a LED as a light source that emits a monochromatic light beam with wave length (in air) of λ **= 500 nm**. The light is generated in a very small volume ("point source") and spreads out in a cone that illuminates a circle with radius **1 cm** at a distance of **10 cm** on some white paper. The **LED** has an over-all or plug efficiency of **50 %** and is driven at **2V** with **20 A**.

Here are the questions:

- How much power in **W/m^2** flows into the paper?
- How does that number compare with the light power coming from the sun at "AM 1" conditions (High noon, equation, no clouds)? You're supposed to know this basic number in some "simple number approximation".
- How many photons per second must hit the piece of paper, if we discuss the energy flux now in the particle picture?
- What kind od field strength would we have on the paper? Consider first that the light beam is fully coherent, next that the photons are completely uncorrelated.

If we now follow the light beam back to its source, we can obtain a few more insights:

- What does the number of photons produced per second tell you about recombination rates, carrier densities, and current densities in the semiconductor?

Link to the solution