

Science behind Global Warming

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'What're quantum mechanics?'
'I don't know. People who repair quantum, I suppose.'
- Terry Pratchett

Introduction

It is a weird time we are living in, the time when the science of physics became science fiction. Common sense and skepticism were replaced by fairy tales. It is not a secret that today's theoretical physics is dominated by mathematics. Piece of paper and pencil are good enough to win Nobel Prize in physics, which is not experimental science anymore. Data? Where we're going, we don't need data.

For a long time relativity was the most expensive branch of physics. I am talking about nuclear fusion, which is always five years ahead. The only scientific ground for nuclear fusion is relativistic formula $E=mc^2$.

Situation change dramatically lately. Now the absolute champion is quantum mechanics, which provides foundation for "climate science".

There are no doubts climate changes exist, but are those changes depend on human activity or on carbon dioxide concentration in the atmosphere? We shall see.

Models

How do we know that the temperature of our home planet will rise significantly in one hundred years? The answer to that question is fairly simple – computer models. Let's take a look at the science behind such models.

Planck's Law

Black body radiation is fundamental principle in the study of quantum mechanics. It is the most important thing in the climate science as well.

All bodies emit energy at different wavelength. Spectrum shows how the energy is distributed among wavelength or other variable. The hotter body emits in shorter range of wavelengths. When temperature drops, the maximum of the spectrum is shifted to longer wavelength.

Sun emits short wavelength radiation, which goes through atmosphere unaffected by greenhouse gases. The surface of the Earth emits radiation mainly within infrared band and outgoing radiation is absorbed by various gases. Part of absorbed energy returns back to Earth rising its temperature and creating “greenhouse effect”.

Planck’s law gives a mathematical formula for black body radiation.

One who was curious enough to find a mathematical formula for Planck’s law will be surprised. There are two variants of Planck’s law – energy density as a function of wavelength:

$$B(\lambda, T) = \frac{2hc^2}{\lambda^5} \frac{1}{e^{\frac{hc}{\lambda kT}} - 1}$$

and energy density as a function of frequency:

$$B(\nu, T) = \frac{2h\nu^3}{c^2} \frac{1}{e^{\frac{h\nu}{kT}} - 1}$$

These two variants of Planck’s formula could be found in any textbook or on Wikipedia, main media of mainstream science.

Frequency is related to wavelength by following formula:

$$c = \lambda\nu$$

It is reasonable to expect that both variants of the Planck’s law provide us with exactly same results after substitution wavelength by frequency and vice versa.

Everyone familiar with Microsoft Excel could build a graph of black body radiation, for example at a temperature of 5770 degrees Kelvin, which is the temperature of the Sun, for both variants of the formula. For our surprise we will find quite different results.

On graph below frequency variant of the formula was scaled up in order to compare results:

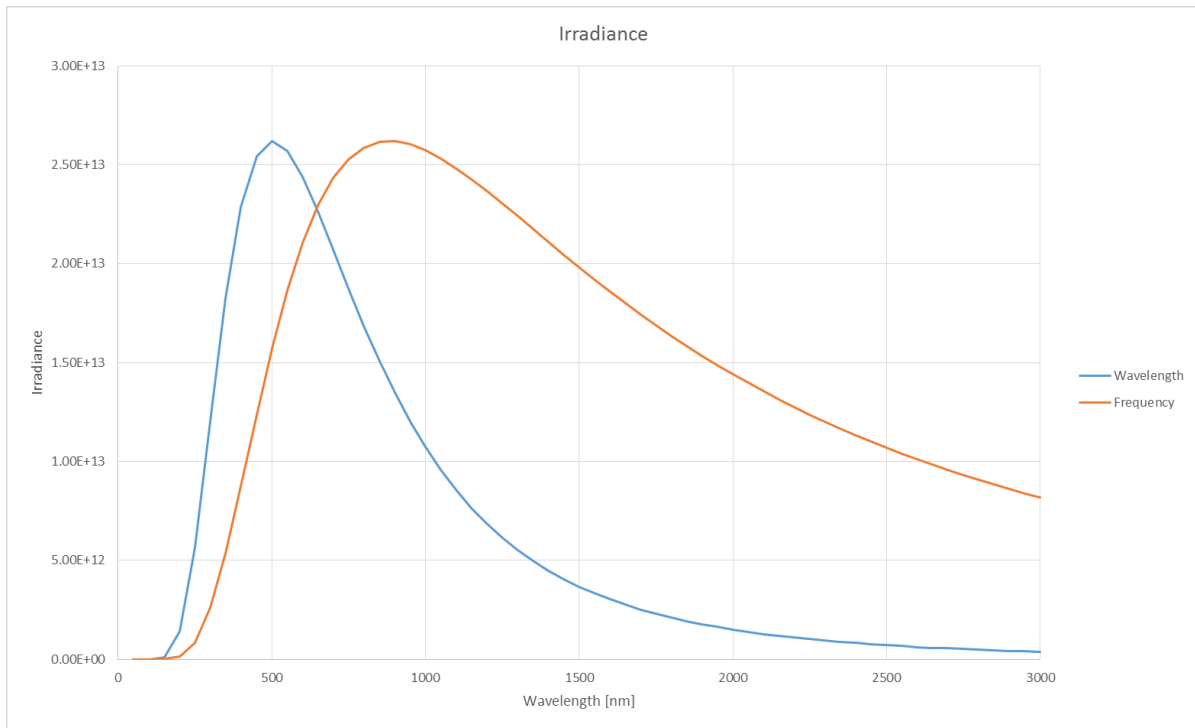


Fig 1. Solar spectrum vs wavelength and frequency

While the maximum of wavelength variant located around well-known 500 nanometers, the maximum for the frequency variant located somewhere around 900 nanometers!

Radiation spectrum is also used to determine the temperature of stars or Sun by finding the position of the maximum of energy. If we measure the temperature of our Sun using frequency variant of the Planck's formula, the Sun's temperature will be equals to 10000K instead of science adopted value of 5770K!

Two variants of the formula just could not be both correct!

Big question arise – which variant of Planck's formula was used in computer models?

The temperature of the Sun is 5770K as determined from wavelength variant of the Planck's law. The temperature of the Sun according to frequency variant of Planck's law should be determined as 10000K!

It appear that quantum mechanics could not explain the difference of 4200K in Sun's temperature calculation, but claims that in the near future it will be three degrees warmer? Are you kidding?

Stefan-Boltzmann Law

Second essential law of any climate model is Stefan-Boltzmann law. This law is also related to quantum mechanics.

The law defines total power density emitted by black body – power density is proportional to the fourth power of temperature.

$$j = \sigma T^4$$

The power density defined at the surface of black body.

The total power emitted by the Sun could be calculated as power density times surface area of the Sun. On its way to the Earth, the energy spreads over spherical surface with the radius equals to the radius of the Earth's orbit.

For the planet of Earth the solar power density near orbit or solar constant equals 1360 Watts per square meter.

Stefan-Boltzmann law states that certain amount of energy, proportional to the fourth power of temperature was emitted from the surface of black body every second. Was it? Take a closer look at the Earth's inner core!

There are no reasons why Stefan-Boltzmann law could not be used for calculating the energy flux from inner core. The inner core temperature is estimated to be 5700K, which is about the temperature of the Sun. Why it should not emit radiation? Is it less black body than the Sun is?

The energy flux from inner core do not travel in the form of radiation, of course. It absorbed by surrounding material and travels to the surface of the Earth in the form of conductive heat transfer. The only way for energy emitted by the inner core is up to the surface. We all know that heat transfer is only possible from hot to cold.

The power density from inner core, according to Stefan-Boltzmann law is:

$$P = \sigma T^4 S \approx 1.1e+21$$

In order to calculate power density at the surface of the Earth, we should divide this value by Earth's surface area:

$$p_s = \frac{P}{4\pi R^2} \approx 2.19e+6$$

That is 1,360 Watts per square meter from the Sun and 2,190,000 Watts per square meter from the inner core of the Earth!

The energy flux from inner core should be 1600 times greater than one from the Sun. It should be the same temperature on Earth day or night, winter or summer, equator or pole!

Such tremendous energy flux is well in accordance with quantum mechanics but contradicts to our senses. The temperature of the Earth's surface according to Stefan-Boltzmann law should be around 2500K!

Stefan-Boltzmann law is fundamental law of quantum mechanics and should works for any black body. But the nature does not care about quantum mechanics.

Greenhouse Effect?

Sun emits energy. The further from Sun, the less this energy is, inversely proportional to the square of the orbit radius. The planet absorb this energy and emit energy back to space according to Stefan-Boltzmann law.

We could calculate effective temperatures for every planet in Solar system. However this temperature is usually lower compare to observed temperatures. The difference attributed to greenhouse effect. Exact explanation and formulas could be found here (http://aerosols.ucsd.edu/classes/COSMOS2013_Lecture4_Norris.pdf). And here (<https://www.acs.org/content/acs/en/climatescience/energybalance/predictedplanetarytemperatures.html>) are the numbers for some planets of the Solar system.

We could use simple greenhouse model in order to calculate greenhouse effect for Venus. Observed temperature of Venus is 500 degrees above calculated value. Let's follow the calculations.

Simple model of greenhouse effect:

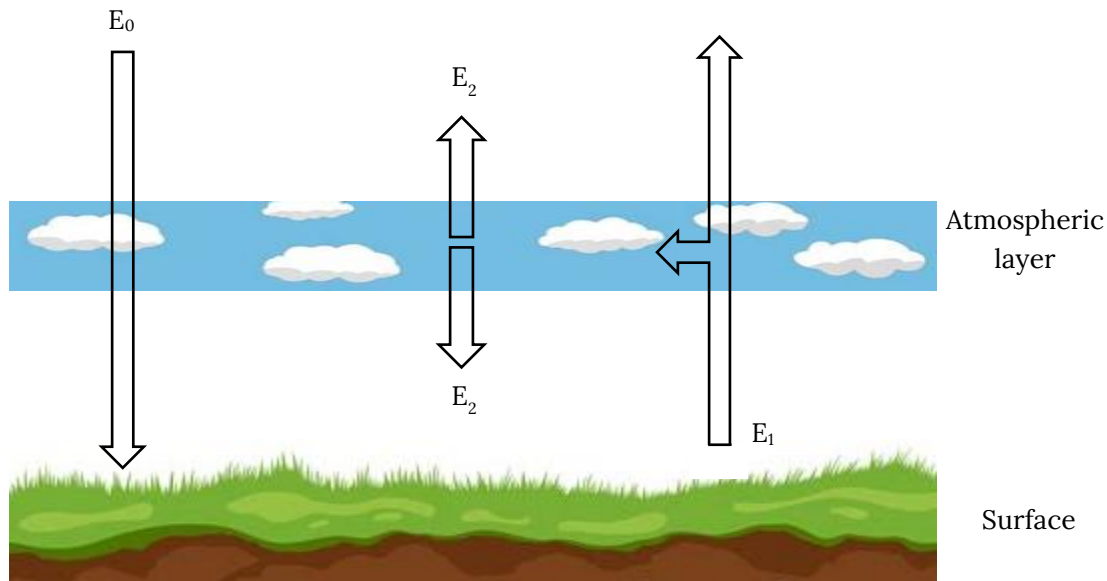


Fig.2 Simple greenhouse model.

On the figure above E_0 is incoming energy from the Sun. The energy spectrum is out of atmospheric absorption band and this energy coming through atmosphere unaffected. E_1 is the energy emitted by planet. Part of this energy βE_1 absorbed by atmosphere and the rest $(1 - \beta)E_1$ returned back to space. Energy E_2 emitted by atmosphere equally in both directions.

Despite of the simplicity this model works for Earth. By “works” I mean the fact that calculations followed from this model are used as a proof of Earth's greenhouse effect.

Venus has observed temperature 735K compare to 232K of calculated temperature. Huge difference attributed to strong greenhouse effect, since the atmosphere of Venus is pure carbon dioxide.

Now it's time for simple math. Don't worry, not a rocket science. Since everything in equilibrium, "energy in" always equals to "energy out". Here are the balances:

- Space balance: $E_0 = E_2 + (1 - \beta)E_1$
- Atmosphere balance: $\beta E_1 = 2E_2$
- Surface balance: $E_0 + E_2 = E_1$

The solution for above system of equations is:

$$E_1 = \frac{2E_0}{2 - \beta}$$

$$E_2 = \frac{\beta E_0}{2 - \beta}$$

Incident energy E_0 for Venus (keeping albedo in mind) equals:

$$E_0 = K_S(1 - \alpha)$$

Solar constant of Venus is 2623 W/m^2 with albedo of 0.75 and E_0 equals to 656.

The energy emitted by the surface without atmospheric absorption ($\beta = 0$) equals to

$$E_1 = E_0$$

And effective temperature will be:

$$T = \sqrt[4]{\frac{E_1}{4\sigma}} \approx 232K$$

Which is well corresponds to calculated temperature of Venus from multiple sources.

Our next step is to maximize atmospheric absorption ($\beta = 1$). This is absolute maximum for absorption. Nothing could absorb more than 100%. Then:

$$E_1 = 2E_0$$

And

$$T = \sqrt[4]{\frac{E_1}{4\sigma}} \approx 276K$$

Calculated temperature is the absolute maximum temperature which could be attributed to greenhouse effect.

Meanwhile observed temperature of Venus is 735K. The difference of 460 degrees could not be explained using greenhouse effect.

Conclusion

Climate models are built on the quicksand of quantum mechanics and could not provide any prediction for the future temperature of the Earth.