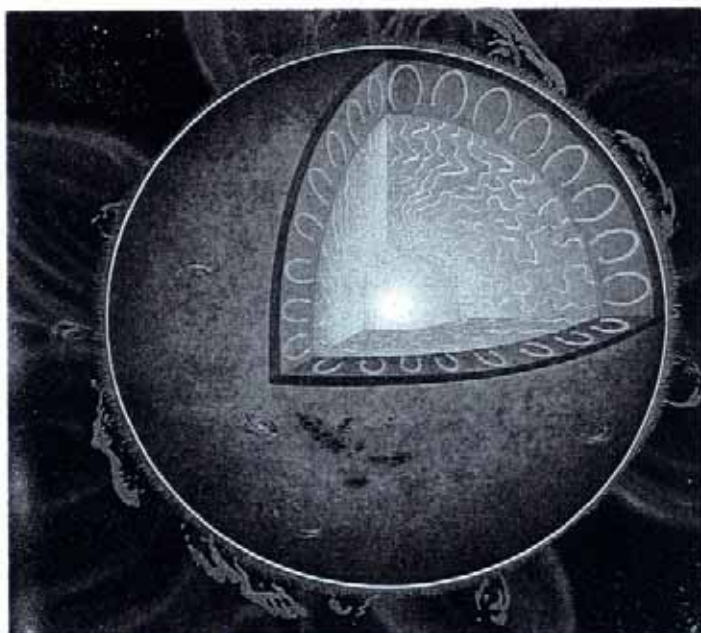


## SOLAR ENERGY IN PERSPECTIVE



**Fig 2.1 Interior of the Sun**

*Natures mighty solar engine. The 1'392'000 Km diameter juggernaut operates in exquisite balance; titanic pressure within counterbalanced by an equally titanic gravity. The nuclear fire burns steadily.*

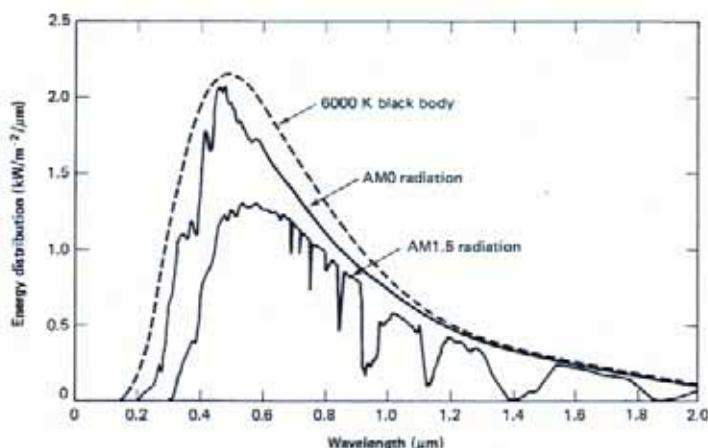
The Sun is our local star. Of medium size in galactic terms, it is in essence a sphere of glowing hot gases, predominantly hydrogen, with traces of many other elements. The Sun burns hydrogen in a sustained atomic fusion reaction due to the immense pressure, in excess of one million Earth atmospheres, that exists at the core, generating a temperature of at least 15 million degrees Kelvin.

The pressure at the core fuses 700 million tonnes of hydrogen into helium each second. In the process, 5 million tonnes of matter are converted into magnetic radiation, each and every second. This stupendous transformation commences as a searing blast of gamma rays which extends out from the core to the convective zone. Here, the deadly gamma rays are filtered into safer, lower frequencies before bursting through the photo sphere as radiant heat and light.

This vast outpouring of electromagnetic energy covers a wide bandwidth, extending from 0.15 to 2.5 micrometers. To comprehend

the meaning of this, imagine a piano keyboard. The visible light frequencies that you see in a rainbow (the total extent of our vision), would extend an octave upwards from the left of *middle C*. Above this lies the ultra-violet and beyond. Below middle C, extending along the right hand side of our imaginary keyboard lie the infrared and far infrared frequencies. Now strike all the keys at once; What a din! Imagine the mighty voice of the Sun!

The Earth travels around the Sun in a slightly elliptical orbit at a nominal distance of 150 million kilometres, which is one hundred times the Sun's diameter (to give you a sense of scale). The radiant energy density falling perpendicular to the Sun's direction, outside the Earth's atmosphere but at the nominal Earth-Sun distance remains practically constant at 1.35 kilowatts per square metre area. This is known as the *Solar Constant*. It has been determined by taking measurements with high altitude balloons and spacecraft at the outer reaches of the Earth's atmosphere. For this reason, the solar constant (1.35 Kw) is also known as *Air Mass Zero (AM0)*. It is useful to understand a little about sunlight and its intensity at the Earth's surface as photovoltaic panels convert light (not heat) directly into electricity. Sunlight is attenuated during its passage through the atmosphere due to



**Fig 2.2 Solar energy spectrum**

*The dotted line represents the Sun's output. Air Mass Zero is just outside the atmosphere, and Air mass 1.5 is the industry standard for rating photo-voltaic panels.*