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YEAR OF ECLIPSES
This year will see five eclipses, including a total solar eclipse on July 11.

Lighting up our night skies...

ASTRONOMY There are other sources of energy and illumination too for the earth other than just the sun and moon. There's Venus, there's Sirius, and then there are a zillion stars, explains **C Sivaram**

The inky blackness of a moonless night sky is all too familiar to most of us, especially during power cuts. On a moonless night, sometime after sunset, the combined illumination from all the stars has 100 mn times less intensity than sunlight.

Sunlight vs moonlight

Sudden darkness, post sunset, gave astronomers the first clue that the universe cannot be infinite in extent and static (unchanging)—a viewpoint much favoured especially in earlier times by many philosophers. This is embodied in the so called Olber's paradox, which implies that the night sky should also be dazzling bright in such an infinite static universe. A later discovery that the universe is indeed in a state of expansion and has a finite lifetime solved the paradox.

The power of sunshine falling on the entire earth's surface on a clear day, is close to half an exawatt (one exawatt is equal to a billion watts) while the full moon illuminating the night sky has an intensity about a millionth that of the sunlight. This implies that the total power in moonlight falling is about half a terawatt. (A terawatt is a trillion watt).

Although, considering that the total installed power capacity (of all power plants) used by mankind is about 10 terawatt, the power of moonlight is not insignificant. Of course, it is too diffused (about a milliwatt

SHINE ON, VENUS The total radiation power falling on earth from Venus is about 60 megawatts.

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Although, considering that the total installed power capacity (of all power plants) used by mankind is about 10 terawatt, the power of moonlight is not insignificant. Of course, it is too diffused (about a milliwatt of moonshine falling on a square metre) to be of much practical use.

And as for the intensity of sunlight, it is a kilowatt on a square metre area. So, even to get adequate solar power, say a 1,000 megawatts or a gigawatt, one has to cover an area of millions of square metres with solar panels.

Planet radiation

There are other sources of energy and illumination too for earth other than just the sun and moon. Next to our natural satellite, is the brightest object in the night sky—the planet of Venus.

The total radiation power falling on earth from Venus is about 60 megawatts while its brightest star Sirius contributes 10 megawatts. In the absence of the moon, the combined light falling from all the stars in the night sky on earth is about five gigawatts or 5,000 megawatts.

This appears large in absolute terms but is spread across the earth's surface. Therefore, the combined flux of starlight on earth, works out to about ten microwatts per square metre (compared to a kilowatt for the sun).

In addition, the sun also emits neutrinos (almost massless chargeless particles produced in the nuclear reactions at its core). The solar neutrino power falling on earth (day or night) is around 30,000 terawatts but almost all these particles go right through the earth without getting absorbed.

In contrast, we have the so called 21 cms radio radiation emitted from cold hydrogen atoms all over our galaxy and the intensity of these radio waves on earth is barely one watt! But, even such a tiny amount has enabled radio astronomers map the structure of our galaxy.

Earth's own power

The earth too emits radiation (apart from what it gets from the sun) owing to the decay of several radioactive isotopes present in its rocky interior.

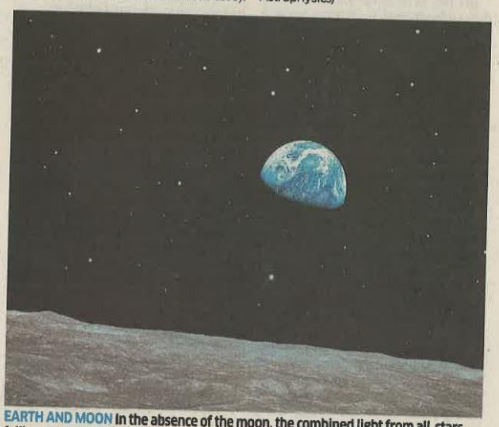
Its total heat radiation works out to be 44 terawatts. On the other hand, a large planet like Jupiter emits about three times more radiation than what it gets from the sun.

Apart from the terawatt of moonlight, the power of the lunar tides dissipates about three terawatts and this is already utilised in many places.

The total intensity of microwaves incident on earth (from the cosmic microwave background) is about 5,000 megawatts. The power in cosmic rays (highly energetic particles coming from all over the sky) falling on earth is about three gigawatts.

It all boils down to this—even in the absence of sunlight, the earth receives immense radiation, which can be calculated in terawatts and gigawatts.

(The author is with the Indian Institute of Astrophysics)



EARTH AND MOON In the absence of the moon, the combined light from all stars, falling on the earth at night is about five gigawatts. GETTY IMAGES