JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A REVIEW OF SUN'S ATMOSPHERE

Sameer Ahmed[1], Inamul Haq Wani[2]
Department of Physics, Govt. Maulana Azad Memorial College Jammu, Jammu and Kashmir, India

ABSTRACT: The sun's atmosphere is mainly divided into four parts, namely photosphere, chromosphere, transition zone and the corona. The Photosphere is closest layer to the sun's surface which is visible to us. All other layers or not visible as such, but can be seen during a solar eclipse. The chromosphere appears as dim red ring and it lies just above the photosphere. The transition zone lies in between the chromosphere and Corona . The defining characteristics of this region is the variation in its temperature. The Corona is the outermost layer of the sun's atmosphere, and it appears as a glowing white line surrounding the sun during a total solar eclipse.

Keywords : Photosphere, Chromosphere, Tenuous, Corona, Balmer line, Solar winds, Spicules, Prominences.

INTRODUCTION:

The Sun's atmosphere is composed of several layers, each with its unique characteristics and properties. The layer closest to the Sun's surface, which is visible to us, is called the photosphere. The photosphere is a relatively thin layer but represents the region where most of the Sun's visible light is emitted. Above the photosphere lies the chromosphere, a region characterized by its reddish glow. The chromosphere is a dynamic layer that exhibits various features, including spicules, filaments, and prominences, which are extensions of the Sun's magnetic field.

Beyond the chromosphere, we encounter the transition region, a narrow and critical layer that separates the chromosphere from the corona. The transition region is known for its abrupt temperature increase, defying the expected behavior of decreasing temperature with increasing distance from the Sun's core.

The corona is a tenuous and extended layer that extends millions of kilometers into space. It is characterized by its extremely high temperatures, reaching several million degrees Kelvin. The corona emits a soft glow during total solar eclipse and is responsible for solar winds, a continuous stream of charged particles that flows outward from the Sun.

Exploration of the region:

1. Solar Dynamics Observatory (SDO): Launched by NASA in 2010, the SDO provides continuous high-resolution observations of the Sun in various wavelengths. It has helped capture detailed images of solar flares, prominences, and coronal mass ejections (CMEs). SDO's instruments have also provided data on the Sun's magnetic field, temperature, and solar wind.
2. Interface Region Imaging Spectrograph (IRIS): Launched in 2013, IRIS is a NASA small explorer mission focused on studying the interface region between the Sun's chromosphere and corona. It observes the ultraviolet (UV) spectra of the solar atmosphere, providing crucial information about the heating and dynamics of this region.

3. Parker Solar Probe: As mentioned earlier, the Parker Solar Probe, launched in 2018, is a NASA mission specifically designed to study the Sun's corona up close. It flies through the Sun's outer atmosphere, or corona, to gather data on the solar wind, magnetic fields, and energetic particles, aiming to unravel the mysteries of solar heating and acceleration processes.

VARIOUS LAYERS OF SUN'S ATMOSPHERE:

The sun's atmosphere is constituted of several layers each having distinct and unique characteristics. From the innermost to the outermost, the layers of sun's atmosphere are:

1. Photosphere
2. Chromosphere
3. Transition Zone
4. Corona

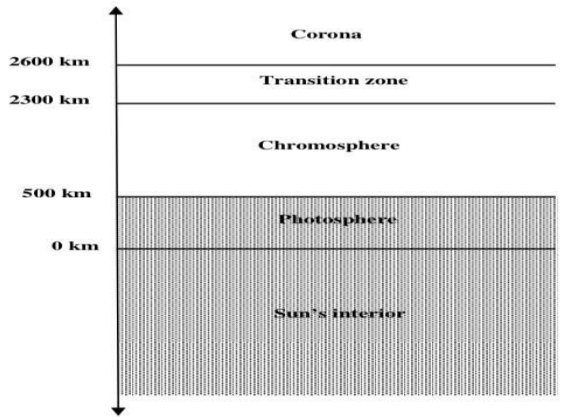


Figure 1 : Schematic diagram showing layers of sun's atmosphere

Photosphere:

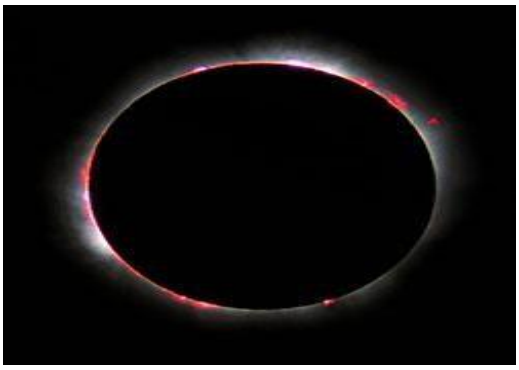
The photosphere is the innermost and the only visible layer of sun's atmosphere. All the light received from the sun, in fact, comes from the photosphere. At the centre of the sun, the energy is generated in the form of high energy photons called gamma rays. By the time the photons reach the photosphere they are reduced to photons of visible region of electromagnetic spectrum. Therefore, visible radiation is emitted from the photosphere. The density of photosphere is 3400 times less than the density of the air we breathe. The thickness of the photosphere is about 500 km and the temperature at its base is around 6500 Kelvin. The temperature decreases upward and reaches a minimum value of around 4400 Kelvin at the top.

The photosphere is primarily composed of hydrogen gas with traces of other elements, such as helium and heavier elements. The photosphere is not a quiet region, it shows a granular structure.

Figure 2 : The Sun's Photosphere

When looked carefully, we can see that the photosphere consists of bright and irregular shaped granules: each granule surrounded by dark edges. It has been found that these granules are very hot and are caused due to convection. The typical size of these granules is around 1500 km.

Chromosphere:



Above the photosphere lies the chromosphere, a region characterized by its reddish glow. This layer of the sun's atmosphere is normally not visible from the Earth because of its faintness. This layer extends up-to around 2000 km from the surface of sun. The name chromosphere is derived from the fact that a few seconds before and after a total solar eclipse, a bright, reddish flash appears above the photosphere. The appearance of this colored flash is due to the emission of the first Balmer line of hydrogen which occurs in the red region.

In the chromosphere, the density decreases by a factor of 10^4 from that of photosphere, while the temperature rises up to 25,000 Kelvin, within a short distance of 2000 km. The

sudden increase in temperature is because of the presence of hot gas produced in the form of jets called Spicules. These spicules are observed throughout the chromosphere and extend upwards in the chromosphere up to a height of around 10,000 km and last for as long as 14 minutes. Figure 3 : Chromosphere just before a total eclipse

Transition Zone:

Beyond the chromosphere, we encounter the transition region, a narrow and critical layer that separates the chromosphere from the corona. The transition region is extended up to 3000 km and the temperature in this region rises sharply to 10^6 Kelvin. The transition region is known for its sudden temperature increase, defying the expected behavior of decreasing temperature with increasing distance from the Sun's core. This temperature rise leads to the formation of the corona, the outermost layer of the Sun's atmosphere.

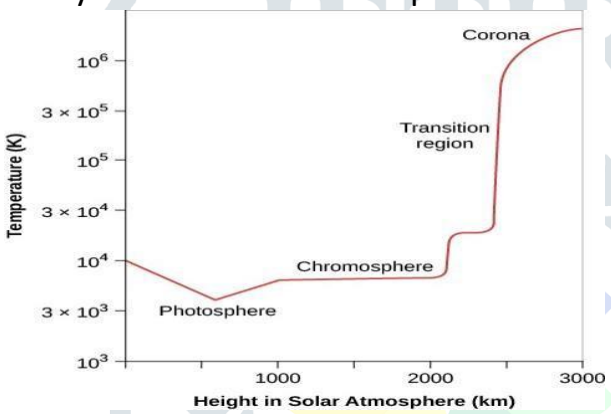


Figure 4 : Variation of temperature and density in the Sun’s atmosphere

Corona:

The corona is the outermost layer of the sun’s atmosphere, and is named after the greek word for Crown. Like the chromosphere, the corona can only be observed during a total solar eclipse. It is characterized by its extremely high temperatures, reaching several million degrees kelvin. The corona emits a soft glow during total solar eclipses and is responsible for solar winds.

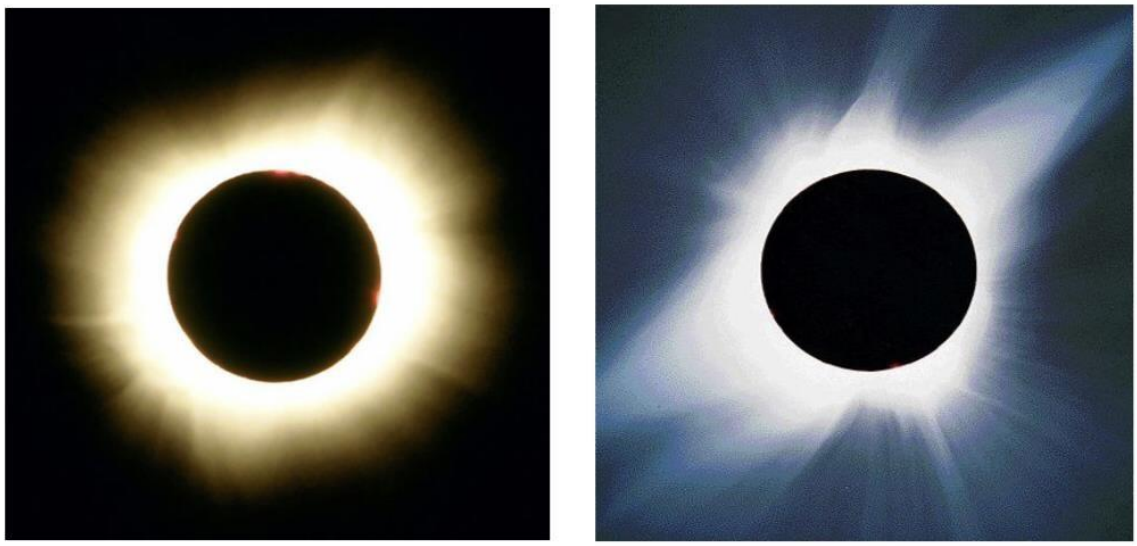


Figure 5 : Two photographs of the sun's Corona

Due to the high temperature, electrons in the corona region have high energies and when these electrons interact with the surrounding atoms, they ionize the atoms, resulting in the emission of x-rays. The coronal x-ray emission is much larger than that of the photosphere. The emission of x-rays is also an indication of the existence of very high temperature the Corona.

CONCLUSION:

We have studied and reviewed different layers of the sun's atmosphere with graphical representation of Sun's temperature.The Sun's atmosphere is a captivating and dynamic region that encompasses various layers, each with its unique properties and behavior. Different space missions to study the sun's atmosphere have also been discussed.

REFERENCES:

1. Astronomy and Astrophysics by M. Zeilik and S.A. Gregory.
2. "The Solar System and the Stars" http://www.egyankosh.ac.in
3. An introduction to astronomy, F.Shu and Mill Valley : University Science Books. Fundamental of Astronomy (Fourth Edition)
4. Luc Viatour. "The Chromosphere". NASA. Retrieved 1991
5. Baidyanath Basu, 'An introduction to Astro physics', Second printing, Prentice-Hall of India Private limited, New Delhi,2001.
6. K.S. Krishnasamy, 'Astro Physics a modern perspective,' Reprint, New Age International (p) Ltd, New Delhi,2002.