**LECTURE – 2 GENERAL INFORMATION ABOUT THE SUN. THE SOLAR SPECTRUM, ITS CHEMICAL COMPOSITION**

The Sun is the closest representative of the billions of stars in the sky to the Earth. Due to the fact that the Sun is billions of times closer to the Earth than the stars, it is possible to study the daily physical changes in its structure, composition, temperature and events. According to the processes taking place in the Sun, it is possible to think about the physical nature of stars and their evolution. That is why the Sun is studied with great interest by astronomers.

The Sun is the closest star to the Earth, with an angular diameter of 32 minutes 00 seconds. The Sun is a normal star with spectral class G2V, absolute magnitude Mʘ=+4.8m, and is a burning gas ball or cosmic plasma ball. The size (diameter) of the Sun is determined by its apparent diameter and the distance to it. The apparent diameter of celestial bodies depends on the distance of the observed celestial body (including the Sun) from the Earth. Our planet orbiting the sun is also at different distances from it. When the Earth is at its farthest distance from the Sun (at perihelion), the apparent diameter of the Sun is 32′35'', and when it is at the closest distance (aphelion), its apparent diameter is 31′will be equal to 31''. When the Earth is at an average distance from the Sun (149600000 km), the apparent radius of the Sun is 16′02'', its linear radius determined based on these data: Rʘ=696000 km, and its volume: Vʘ=1.41⋅It is 1027 m3. Mass of the Sun: M=2⋅1033 kg is the average density determined by these quantities:ρ= 1.41 g/cm3; Acceleration of free fall on the surface of the Sun:ρ= 247 m/s2.

***Table - 1.***

|  |  |  |
| --- | --- | --- |
| **Tracking information** | | |
| Average distance from the ground | | 1,496×108 km, 8 min 19 s at the speed of light |
| [Appearance brightness](http://en.wikipedia.org/wiki/Apparent_magnitude) | | -26.74 |
| [Absolute magnitude](http://en.wikipedia.org/wiki/Absolute_magnitude) | | 4.83 |
| [Spectral](http://en.wikipedia.org/wiki/Spectral_classification)class | | G2V |
| [Metallicity](http://en.wikipedia.org/wiki/Metallicity) | | *Z*= 0.0122 |
| Angle measure | | 31.6′ – 32.7′ |
| **Physical characteristics** | | |
| Average diameter | 1.392684×106 km | |
| Equatorial radius | 6.96342 × 105 km, 109 × Earth | |
| Equatorial circumference length (perimeter) | 4,379 × 106 km, 109 × Earth | |
| Surface area | 6.0877×1012 km2, 11,990 × Earth | |
| [Size](http://en.wikipedia.org/wiki/Volume) | 1,412×1018 km3, 1,300,000 × Earth | |
| Mass | 1.9891×1030 kg, 333,000×Earth | |
| Average density | 1.408×103 kg/m3 | |
| Density Central (model)  Lower photosphere The lower chromosphere crown (middle) | 1.622×105 kg/m3  2×10−4 kg/m35×10−6 kg/m31×10−12 kg/m3 | |
| Equatorial surface gravity | 274.0 m/s2, 27.94[*g*](http://en.wikipedia.org/wiki/G-force), 28 × Earth | |
| Second space velocity (at surface) | 617.7 km/s, 55 × Earth | |
| [Temperature](http://en.wikipedia.org/wiki/Temperature)a Center (model.) Photosphere (effective) [Crown](http://en.wikipedia.org/wiki/Corona) | ~1.57×107 K5,778[K](http://en.wikipedia.org/wiki/Kelvin) ~3×106 K | |
| Brightness | 3.846×1026[W](http://en.wikipedia.org/wiki/Watt), | |
| Moderate intensity | 2.009×107 W·m−2·sr−1 | |
| Age  Pressure Central  Photosphere  Magnetic Field Sunspots  Polar | 4.57 billion years  2.334×1016 Pa  10 Pa  0.1 – 0.4 T  0.001 T | |
| [**Rotational characteristics**](http://en.wikipedia.org/wiki/Rotation) | | |
| Sidereal cycle (at the equator) | 25.05 day | |
| (at 16° latitude) | 25.38 days, 25 days 9 hours 7 minutes 12 seconds | |
| (at the pole) | 34.4 days | |
| Rotational speed (at the equator) | 7.189×103 km/h | |

***Table - 2.***

|  |  |  |
| --- | --- | --- |
| **The main chemical constituents of Fraunhofer lines analysis** | | |
|  | *According to the number of atoms* | *According to the amount of mass* |
| *H* | 92.1 % | 70.68 % |
| *Hey* | 7.8 % | 27.43 % |
| *Other* | 0.1 % | 1.89 % |

Chemically, 3/4 of the Sun's mass is hydrogen and most of the rest is helium. The rest (1.69%, however, this mass is equal to 5.628 times the mass of the Earth) consists of heavy elements, namely oxygen, carbon, neon, iron, etc.

***Table - 3.***

|  |  |
| --- | --- |
| [**Composition of the photosphere**](http://en.wikipedia.org/wiki/Photosphere)**(by mass)** | |
| [Hydrogen](http://en.wikipedia.org/wiki/Hydrogen) | 73.46% |
| [Helium](http://en.wikipedia.org/wiki/Helium) | 24.85% |
| [Oxygen](http://en.wikipedia.org/wiki/Oxygen) | 0.77% |
| Carbon | 0.29% |
| Iron | 0.16% |
| [Neon](http://en.wikipedia.org/wiki/Neon) | 0.12% |
| Nitrogen | 0.09% |
| Silicon | 0.07% |
| [Magn](http://en.wikipedia.org/wiki/Magnesium)smell | 0.05% |
| Sulfur | 0.04% |

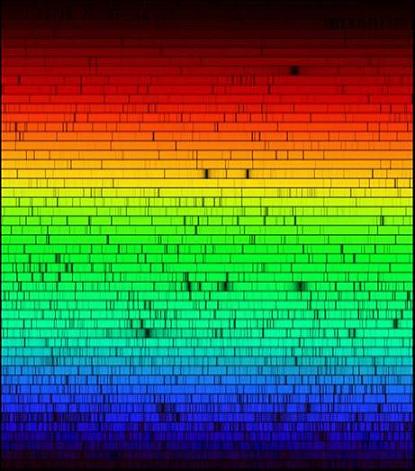
**Spectrum of the sun, its chemical composition and temperature**

**Solar spectrum.** According to the nature of any body emitting light and the environment through which the radiation is passing, the spectrum of the source is in the form of absorption, absorption and radiation (emission) spectra. The spectrum of a condensed body produced by a prism or a diffraction grating gives a coherent spectrum. If a certain gas candle is caught in the path of the rays coming from the burning body, then the absorption (fraunhofer) lines of the atoms that make up the candle gas will appear in the background of the ignition spectrum. The lines mentioned in honor of the physicist Fraunhofer, who explained the nature of these lines for the first time in 1814, are named after him.

The spectrum created by the candle itself is free from the adjacent spectrum, and consists of radiation (light) spectral lines that appear in the places where absorption spectrum lines are formed in the first case.

The spectrum of the Sun consists of an absorption spectrum, and its visible region covers the interval from 3900 Å to 6900 Å. In this interval, lines of hydrogen in the Balmer series, lines of ionized and neutral calcium, iron, manganese, magnesium, titanium and other metal atoms are common. Lines called H and K of ionized calcium in the solar spectrum (wavelengths λ=3900 Å and λ=3990 Å), H of hydrogenα(l=6563 Å) and Hβ(l=4860 Å), D1 (l=5896 Å) and D2 (l=5890 Å) lines of sodium are the most intense. Lines of gas molecules in the Earth's atmosphere, especially water vapor, nitrogen and oxygen molecules are also formed in the solar spectrum. Since the gas molecules giving these lines are not related to the photosphere, when studying the physical nature of the photosphere based on the spectral lines of the Sun, the mentioned lines of the Earth's atmosphere are relied upon.

The intensity is the highest in the 4300-5000 Å, i.e., blue-green color zone of the Sun's adjacent spectrum. In fact, the solar spectrum also has far ultraviolet and infrared regions. However, these fields of radiation are beyond the visual range of the eye and due to the strong absorption of these fields by the Earth's atmosphere, their study was initially difficult. In recent years, the spectrum of the Sun, obtained using Earth satellites, has shown that its nature is almost identical to that of the visible part of the wavelength range up to the ultraviolet region. In the shorter wavelength range, the intensity of the coupling spectrum decreases sharply, and the absorption lines turn into emission lines.



*Picture. Solar spectrum*

Radiation of the infrared region of the solar spectrum, up to a wavelength of about 15 μm, is partially absorbed by the Earth's atmosphere, and as a result, this region of the spectrum is rich in absorption bands of water vapor, oxygen and carbon dioxide molecules. The radiation of the field from 15 µm to 1 cm is strongly absorbed by the Earth's atmosphere.