**ACTIVE AREAS OBSERVED ON THE SUN: SPOTS. STRUCTURE, SIZE AND EVOLUTION OF SPOTS.**

Sunspots appear in the form of small dots between the granules. This appearance of a stain is called a bribe. Pores - mainly formed between granules located in the torch area. The sunspot consists of two parts, the central part of which is called the nucleus or shadow. The part surrounding the nucleus is called a penumbra (Fig. 8.1). Spots have a very strong magnetic field, the field strength reaches 4000-4500 ersted in some spots. The temperature of sunspots is 1000-1500º lower than the temperature around it, that is, it is close to 4500º K. Therefore, Sunspots appear as black objects in the photosphere. The existence of a magnetic field in sunspots became known in 1908 from Hay's spectral observations. If the diameter of the spots is more than 40,000 kilometers, it will be visible to the naked eye. Therefore, spots were observed by people even in ancient times. Sunspots have been observed in Chinese manuscripts dating back several hundred years. However, in ancient times, the observed spots were mistakenly interpreted as the projection of some planet (Mercury or Venus) passing in front of the Sun's halo. G. Galileo was the first in 1609, observing the spots in the telescope he made.

***Figure 9.1***

In the Sun's atmosphere, sunspots are objects that occur in groups and are rarely seen singly. Spot groups consist of one or two large spots, which consist of several irregularly arranged small spots and pores (Fig. 8.1). Interestingly, one of the two large spots in the group has a north magnetic pole, and the other has a south magnetic pole. Of these two large spots in the group, the one to the west is called the leader, and the one to the east is called the tail spot. Group stains are divided into classes according to their structure. If the group has spots with the same polarity or only one spot, it is called unipolar, and when it consists of two spots or groups of spots with opposite polarity, it is called bipolar. Spots in a group do not have a clear pattern in terms of polarization.

The lifetime of sunspots varies. If you don't pay attention to the bribes, the stains will live for several months. Spots that live for several months are very rare. Pores live from a few hours to a few days or turn into spots within a period.



The number of sunspots changes over time. The change in the number of spots, passing on the basis of certain periodicity, was determined by P. Gorribov from Copenhagen in 1775 and later by the German astronomy enthusiast G. Schwabe as a result of long-term observations. Swiss astronomer R. Wolff used the following formula to calculate the number of daily spots:

*W=k(10g+f)*

where k is the coefficient representing the power of the telescope, k = 1 for the telescope used by R. Wolff; f – represents the total number of sunspots, and g – the number of sunspot groups. Based on this formula at the Zurich observatory, based on changes in the number of sunspots observed over several years and the number of spots observed since Galileo's time, Wolff concluded that the number of sunspots varies with a period of 11.1 years. This period is called the period of solar activity.

Spots, mostly around the Sun's equator±It occurs at the border of the 40º latitude zone, and is almost not observed at latitudes greater than that. Spots during the period of minimum solar activity,±Formed at 45º heliographic latitudes, and then during its increase, the zone of their occurrence approaches the equator. This phenomenon was discovered by Carrington and studied by G. Spörer, and therefore it is called Spörer's law, or, as it sometimes appears, "Maunder's butterfly".

The size of the spots is different, their diameter goes from several thousand kilometers to several hundred thousand kilometers. The diameter of the big spot observed in 1858 was 230 thousand kilometers, 28 times larger than the diameter of the Earth.

In the penumbra of sunspots, a continuous outflow of gas mass is observed. The average speed of the current is 2 kilometers per second. This penumbra phenomenon was discovered by astronomer J. Evershed of the Kodaikanal Observatory (India) on the basis of the Doppler effect, and this phenomenon was called the Evershed effect in honor of the scientist. Studying the structure of the penumbra shows that it consists of dark and light fibers lying in the direction of the radius of the spot. The flow of gas through the penumbra was observed along black fibers, and light fibers did not participate in this movement, it was known on the basis of spectral analysis.